FINANCIAL COPING MECHANISMS AND HOUSEHOLD DECISION-MAKING FOLLOWING AN INJURY-RELATED HEALTH SHOCK: IMPLICATIONS FOR THE IMPLEMENTATION OF UNIVERSAL HEALTH COVERAGE IN VIETNAM

by
Niloufer Anna Taber

A dissertation submitted to Johns Hopkins University in conformity with the
requirements for the degree of Doctor of Philosophy

Baltimore, Maryland
December 2021

Abstract

In a context of imperfect risk protection, households may protect against the impact of a health shock by employing various financial and non-financial coping mechanisms, such as foregoing or reducing needed medical care, labor substitution, consumption reduction, borrowing money, dissaving, and selling assets. However, leveraging certain coping mechanisms may reduce future productivity, potentially trapping households in chronic or persistent poverty. Resources and risk are not necessarily shared equitably within a household; the ability and willingness of the household to leverage coping mechanisms, or the choice of coping mechanism may depend on the social protection policy context, household socioeconomic status, and type of intrahousehold risk sharing. Vietnam has been making policy changes aimed towards achieving Universal Health Coverage for the past several decades, culminating in a 2015 change mandating universal insurance coverage. This can potentially influence both providers in making decisions around service delivery and households around financing care. This research aims to contribute to the literature exploring the relationships among direct and indirect health care costs, potentially maladaptive coping mechanisms, and household living standards, within the particular health financing and social protection environment in Vietnam.

The first paper, “The Types and Timing of Financial Coping Mechanism Use: The Interplay among Individual Factors, Household Characteristics, and Health Financing,” examines associations between different types of financial coping and patient, household, and injury-related factors. The second paper, “Discharge Against Medical Advice in a Passive Purchasing Environment: Estimating the Effects on Direct Costs, Health Care Utilization, Patient Health, and Household Indirect Costs,” explores forgoing prescribed medical care as a strategy to avoid direct medical costs; the consequences for patient and household direct and indirect costs, length of stay, and the patient’s health over time; and the influence of provider behavior on the use of this coping strategy. The third paper, “Repeated Hardship Financing following Moderate- to Severe Injury: Consequences for Household Living Standards,” examines whether and to what extent the use of potentially maladaptive forms of financing, called hardship financing, leads to further hardship financing and has an effect on household living standards in the year following hospital discharge.

Advisor: Abdulgafoor M. Bachani

Thesis Advisory Committee: Abdulgafoor M. Bachani, Elizabeth Colantuoni, Krishna D. Rao

Readers: Joshua M. Sharfstein, Elizabeth Colantuoni, Antonio Trujillo, Renan Castillo, Joel Gittelsohn, Renee Johnson

Acknowledgements

I would like to express my deep appreciation and gratitude for the encouragement, mentorship, and support I have received from so many during my doctoral program. First, I would like to thank my advisor, Dr. Abdulgafoor Bachani, who has worked to provide me with opportunities, to connect me to resources, and to push me to think critically and with focus. His patience, kindness, and guidance has been essential over the past five years. Next, I would like to thank Dr. Elizabeth Colantuoni and Dr. Krishna D. Rao, members of my Thesis Advisory Committee, for their intellectual and methodological contributions on this work; their insights and feedback have been invaluable. The faculty and staff in the International Health Department, the Health Systems Program, and the International Injury Research Unit have been wonderful colleagues and mentors who have promoted my professional development. Finally, I would like to thank Dr. Pham Viet Cuong, Tran Thi Ngan, and all the faculty and staff at the Hanoi University of Public Health and the Center for Injury Policy and Prevention Research, who were so generous with their time and expertise in partnering on this project.

I would also like to thank my classmates and cohort mates for all their companionship, laughter, and advice, including Nukhba Zia, Arielle Mancuso, Jose Gutierrez, Ankita Meghani, M. Zabir Hasan, Madhuram Nagarajan, Rantimi Adetunji, and Ashley Sheffel. During the Covid-19 pandemic, my close friends have been an enormous source of support and strength: Ayinwi Muma, Melissa Adeyemo, Ellen Reid, and Diana Thow from college; Elizabeth Acker, Molly Sullivan, and Samantha Tress from high school; Alexandra Feathers and Justin Lin from graduate school; and Urmi Bhattacharya, Abhishek Jha, Vibha Mehta, Ryan Shanahan and Margaret diZerega from current and previous jobs. My loving and very extended family has been, as always, unconditionally supportive. I have felt wrapped in your warmth throughout this challenging process.

This work would not have been possible without the support from my husband and best friend, Iman Kalyan Sen, who has done everything from making sure that we have dinner on the table to helping me debug my Stata code, all while working more than full time and starting his own PhD program. You are an unimaginably generous, thoughtful, supportive, forgiving, and loving friend and partner.

Lastly, (and definitely least), I am also grateful to our dog, Dee, who has been my study buddy for the last three years. Walking, running, and playing with her has helped me to stay balanced. Good dog.

In loving memory of Shahnaz Kirsten Taber and Harry Warren Taber.

Contents

Abstract ii
Acknowledgements iv
List of Tables xi
List of Figures xiii

Introduction: Background, Motivation, and Context 1
Research goals and specific objectives 2
Background 6
a. Poverty and vulnerability 6
b. Health Shocks and Household Financial Decision-Making 8
c. Intrahousehold Allocation: Inequality in Resource and Risk Sharing 10
The Case of Vietnam: Transitioning to Universal Health Coverage 12
Conceptual Frameworks 18
Innovation: Injuries as Idiosyncratic Health Shocks with a Clear Time Origin 21
Overall methodology 26
a. Parent Project: The Health, Economic and Long-term Social Impact of Injuries (HEALS) Study 26
b. Ethical Review and Clearance 27
References 28

Paper 1: The Types and Timing of Financial Coping Mechanism Use: The Interplay among Individual Factors, Household Characteristics, and Health Financing 41
Introduction 42
Methods 46
a. Variable definitions 46
i. Outcomes: Coping Mechanisms and Hardship Financing 46
ii. Demographics 47
iii. Health Insurance Status 48
iv. Direct Medical and Non-Medical Costs 49
v. Indirect Costs 50
vi. Household Living Standards 51
vii. Alternative Coping Mechanisms: Consumption Reduction and Support from Government and Civil Society 54

viii. Injury Characteristics and Self-Reported Functional Limitations 55
ix. Time 56
b. Data Analysis 57
i. Descriptive analysis 58
ii. Temporal Patterns in Rolling Cohort Admission 59
iii. Multiple Imputation by Chained Equations for Independent Variables 60
iv. Longitudinal Mixed Modeling 64
v. Estimation procedure 66
vi. Marginalization 67
Results 69
a. The HEALS Cohort 69
i. Demographics, Household Living Standards, and Health Insurance Status 69
ii. Injury Characteristics, Outcomes, and Pre-injury Self-Rated Health 75
b. Parameterization for Regression Analysis 77
i. Temporal Patterns in Rolling Cohort Admission 77
ii. Missing Data Patterns: Multiple Imputation by Chained Equations 80
iii. Household Food Expenditure Missing Data 82
c. Descriptive and Graphical Analysis 83
i. Supports from Government or Civil Society 83
ii. Health Care Utilization, Insurance Status, Functional Impairment, and Costs 83
iii. Borrowing, Selling Assets, Spending Savings, and Hardship Financing 89
d. Associations with borrowing money over time 95
e. Associations with dissaving over time 99
f. Associations with selling assets over time 102
g. Associations with hardship financing 106
Discussion 109
a. The HEALS Cohort and the History of Health Insurance Reform in Vietnam 109
b. Temporal Trends and Seasonality 111
c. Frequency and Factors Associated with Different Financing Coping Mechanisms 114
i. Time 114
ii. Insurance Status, Health Care Utilization, and Direct Medical Costs 117
iii. Rurality 118
iv. Indirect Costs and Household Daily Per Capita Income 120

d. Strengths and Limitations 121
References 125

Paper 2: Discharge Against Medical Advice in a Passive Purchasing Environment: Estimating the Effects on Direct Costs, Health Care Utilization, Patient Health, and Household Indirect Costs 135
Introduction 136
Methods........ 139
a. Variable definitions........ 139
i. Forgoing needed medical care: Independent variable definition........ 139
ii. Impact of forgoing needed medical care: Outcome definitions........ 140
b. Data analysis........ 141
i. Associations with leaving against medical advice........ 141
ii. Consequences of forgoing medical care on direct medical costs and lengths of stay in-hospital 142
iii. Consequences of forgoing medical care on health status and indirect costs over time........ 145
Results 148
a. Associations with leaving against medical advice 148
i. Demographics, injury cause, injury severity, and hospital discharge type: Descriptive analyses 148
ii. Hospital admissions process, hospital discharge type, and insurance status: Descriptive analyses........ 150
iii. Insurance, costs, and hospital discharge type: Descriptive analyses........ 151
iv. Associations with discharge against medical advice: multivariable logistic regression........ 156
b. Cost savings from leaving hospital against medical advice........ 157
i. Propensity Score Matching........ 157
ii. Savings in hospital charges from leaving hospital against medical advice: Doubly-robust regression within propensity score matched sample........ 161
iii. Differences in length of stay due to leaving hospital against medical advice: Doubly-robust regression within propensity score matched sample........ 163
c. Differences in post-discharge health care utilization by patient discharge and insurance status 166
d. Post-discharge levels of impairment by insurance status and discharge type from hospital........ 169
e. Indirect costs incurred by patient and household members by discharge type from hospital 172
Discussion 182
a. Prevalence of discharge against medical advice 182

b. Patient and household characteristics associated with leaving against medical advice 187
i. Insurance status 187
ii. Pre-hospital medical care and source of referral 189
iii. Demographics 190
c. Health and disability consequences of LAMA 191
d. Financial consequences of leaving against medical advice 192
i. Direct medical costs and length of stay in-hospital 192
ii. Indirect costs 194
e. Strengths and limitations 196
i. Forgoing medical care: Beyond discharge against medical advice 196
ii. Propensity score matching methodology 197
iii. Difference-in-difference methodology 199
iv. Indirect costs 199
References 200

Paper 3: Repeated Hardship Financing following Moderate- to Severe Injury: Consequences for Household Living Standards 209
Introduction 210
Methods 213
a. Variable definitions 213
i. Household Living Standards and Impacts of Injury 213
b. Data analysis 214
i. Repeated Hardship Financing: Transition or Lagged-Response Model 214
ii. Transition Model Construction and Missing Data Considerations 216
iii. Impacts of Injury and Hardship Financing 221
Results 222
a. Multiple Imputation by Chained Equations for Transition Model 222
b. Patterns of Financial Coping Mechanism Use Over Time: Use and Repeated Use 226
i. Use of Financial Coping during Hospitalization versus in the Year after Discharge 226
ii. Household Choice of Financial Coping 228
iii. Choice of lagged outcome as independent variable 230
c. Hardship Financing Across Time: Comparison of Transition Models using Complete Cases, MICE, and IPWs 233
d. Association between Hardship Financing and Impacts of Injury 236

Discussion 240
a. Financial Coping During Hospitalization and After Discharge 240
b. Preferences for Different Financial Coping Mechanisms 240
c. Association of Hardship Financing with Future Hardship Financing 242
i. Consistency in Use of Hardship Financing 242
ii. Potential Explanations for Consistency in Use 244
d. Association between Hardship Financing and Changes to Living Standards 246
e. Strengths and Limitations 247
References 250

Conclusion: Health Financing Incentives, Governance, and Integration with Social Protection Systems 256

Health System Financial Sustainability in Vietnam: Incentives, Governance, and Universe Health Coverage 257
Health Shocks, Financial Coping, and Social Protection 261
References 265

Bibliography 268

List of Tables

Introduction: Background, Motivation, and Context

Table 1: Timeline of Health Financing, Governance, and Related National Events in Vietnam 16

Paper 1: The Types and Timing of Financial Coping Mechanism Use: The Interplay among Individual Factors, Household Characteristics, and Health Financing

Table 2: Patient demographics by insurance status 71
Table 3: Pre- injury household economic variables by insurance status 72
Table 4: Regression of WHODAS scores prior to injury 76
Table 5: Pre-injury level of physical limitation, injury characteristics, health care utilization, and outcome in hospital, by insurance status 77
Table 6: Missing data patterns among 1,022 patients in HEALS cohort 80
Table 7: Missing and imputed observations using Multiple Imputation by Chained Equations 82
Table 8: Missing food expenditure by study visit 82
Table 9: Financial coping mechanisms: Percent of sample ever used by insurance status 90
Table 10: Financial coping mechanisms: Percent of sample used over time 92
Table 11: Adjusted and marginalized odds ratios for borrowing money: Post-hospital discharge time points 96
Table 12: Adjusted odds ratios for borrowing money: Prior to hospital discharge, single time point 97
Table 13: Adjusted and marginalized odds ratios for dissaving and for having any savings 100
Table 14: Adjusted and marginalized odds ratios for selling assets: Whole sample vs rural residents only 103
Table 15: Adjusted and marginalized odds ratios for hardship financing 107

Paper 2: Discharge Against Medical Advice in a Passive Purchasing Environment: Estimating the Effects on Direct Costs, Health Care Utilization, Patient Health, and Household Indirect Costs

Table 16: Patient demographics, pre-injury household socioeconomic status, and injury factors by hospital discharge type 149
Table 17: Proportion of patients that left against medical advice by referral origin and admitting department 151
Table 18: Health care costs during hospitalization by insurance status 152
Table 19: Patient demographics and socioeconomic status, injury severity, and pre-injury levels of impairment by insurance status 154
Table 20: Direct health care costs and length of stay by insurance status and hospital discharge type . 155
Table 21: Multiple logistic regression of leaving hospital against medical advice 157
Table 22: Propensity score matching balance checks: Standardized mean difference (SMD) between those who did and did not leave against medical advice, before and after propensity score matching. 160
Table 23: Differences in total bill by discharge type from hospital: Propensity score matching combined with regression adjustment (bootstrapped standard errors) 162

Table 24: Differences in length of stay by discharge type from hospital: propensity score matching combined with regression adjustment 164
Table 25: Regression results from longitudinal mixed model of difference between pre-injury and post-injury WHODAS scores 170
Table 26: Results from longitudinal linear mixed model: Total, patient, and other household member indirect costs over time by hospital discharge type among propensity score matched sample 175
Table 27: Indirect costs during hospitalization: Overall, by patients, by household members, both total costs, and average costs per day of hospitalization 180

Paper 3: Repeated Hardship Financing following Moderate- to Severe Injury: Consequences for Household Living Standards

Table 28: Missing data patterns 222
Table 29: Transition probabilities for use of any financial coping mechanism: in-hospital versus ever post-discharge 227
Table 30: Transition probabilities for use of any financial coping mechanism: post-hospital discharge time points 227
Table 31: Transition probabilities for borrowing: in-hospital versus ever post-discharge 227
Table 32: Transition probabilities for borrowing: post-hospital discharge time points 227
Table 33: Proportion of households which used hardship financing by whether they had and spent savings and time 228
Table 34: Multiple logistic regression of hardship financing on lagged hardship financing: A comparison of methods 234
Table 35: Adjusted and marginalized odds ratios for at least one tangible impact of injury on living standards (unable to pay rent/mortgage, utilities, health care, school/childcare, and/or forced to relocate) 239

List of Figures

Introduction: Background, Motivation, and Context

Figure 1: The relationship of injury-related health shocks to poverty transitions, moderated by formal social protections, health insurance and financial and non-financial coping mechanisms...................... 18
Figure 2: Poverty flows in relation to social protection and social security programs 20

Paper 1: The Types and Timing of Financial Coping Mechanism Use: The Interplay among Individual Factors, Household Characteristics, and Health Financing

Figure 3: HEALS cohort: Proportion without any form of insurance by pre-injury income decile............ 70
Figure 4: Household socioeconomic status prior to injury by patient residence: Percent of Households 73
Figure 5: Whether household has savings: by patient residence and time since hospital discharge: Percent of Households 74
Figure 6: Patient sex and age by residence: Percent of Patients 74
Figure 7: Temporal trend in hospital discharge by patient being uninsured versus having any form of insurance 78
Figure 8: Temporal trend in hospital discharge by patient having a formal vs. informal occupation 79
Figure 9: Temporal trend in hospital discharge by patient main occupation as a farmer 79
Figure 10: Temporal trend in hospital discharge by household daily per capita income prior to injury ... 80
Figure 11: Multiple Imputation by Chained Equations for baseline data: Trace plot showing convergence pattern from 20 'burn-in' imputations prior to each of 50 stored imputations 81
Figure 12: WHODAS scores by type of health care utilization over time 85
Figure 13: Type of medical care used by insurance status and time 86
Figure 14: Type of medical care used by rurality and time.. 86
Figure 15: Out-of-pocket direct medical costs as a proportion of monthly household income by insurance status and type of care over time 87
Figure 16: Direct medical out-of-pocket costs by insurance status over time: Mean and 95% confidence intervals 87
Figure 17: WHODAS scores by whether patient returned to work/main occupation over time.............. 88
Figure 18: Total Household Indirect Costs as a Percentage of Pre-Injury Income by Whether Patient Has Returned to Work or Main Occupation over Time 88
Figure 19: WHODAS Scores by Household Daily Per Capita Income over Time 89
Figure 20: Financial coping mechanisms over time 90
Figure 21: Hardship asset sale and hardship borrowing as proportions of all asset sale and borrowing .. 91
Figure 22: Financial coping mechanisms over time by insurance status... 93
Figure 23: Financial coping mechanisms over time by urban or rural residence 93
Figure 24: Financial coping mechanisms over time by patient visit to a doctor or hospital, or use of rehabilitation services 94
Figure 25: Financial coping mechanisms over time by whether patient had returned to work yet.......... 94
Figure 26: Proportion of households which had savings by whether had used savings in the previous time period 99
Figure 27: Asset sale: Marginalized and adjusted odds ratios comparing rural and whole sample 105

Figure 28: Population of Vietnam: Total and number enrolled in social health insurance by year 113

Paper 2: Discharge Against Medical Advice in a Passive Purchasing Environment: Estimating the Effects on Direct Costs, Health Care Utilization, Patient Health, and Household Indirect Costs

Figure 29: Differences in propensity scores between matched observations by hospital discharge type 158
Figure 30: Propensity score distributions before and after matching 159
Figure 31: Predictive margins and 95% confidence interval of total bill by insurance status and hospital discharge type from multivariable regression following propensity score matching 162
Figure 32: Predictive margins and 95% confidence interval of length of stay by insurance status and hospital discharge type from multivariable regression following propensity score matching 164
Figure 33: Sensitivity analysis: Impact of propensity score estimation procedure on multivariable regression of total bill 165
Figure 34: Sensitivity analysis: Impact of propensity score estimation procedure on multivariable regression of length of stay 166
Figure 35: Use of any medical care since last follow up within matched sample, by hospital discharge type and insurance status, over time 167
Figure 36: Visited a doctor since last follow up within matched sample, by hospital discharge type and insurance status, over time 168
Figure 37: Use of rehabilitative care since last follow up within matched sample, by hospital discharge type and insurance status, over time 168
Figure 38: WHODAS scores prior to injury and at 1, 2, 4, and 12 months following hospital discharge within propensity score matched sample 169
Figure 39: Difference in WHODAS scores from prior to injury by patient hospital discharge type and insurance status among matched sample: Predictive margins with 95% confidence intervals 172
Figure 40: Total household income losses attributed to the patient's injury by hospital discharge type, insurance status, and time 173
Figure 41: Predictive margins following linear mixed modeling: Total household lost income (patients and household members) attributed to injury by insurance status, hospital discharge type, and time . 178
Figure 42: Predictive margins following linear mixed modeling: Lost income by patients attributed to injury by insurance status, hospital discharge type, and time 178
Figure 43: Predictive margins following linear mixed modeling: Lost income by household members attributed to injury by insurance status, hospital discharge type, and time 179
Figure 44: Cumulative proportion of patients who returned to work over the year following hospital discharge, by discharge type, insurance status, and time 181

Paper 3: Repeated Hardship Financing following Moderate- to Severe Injury: Consequences for Household Living Standards

Figure 45: Missing data patterns 223
Figure 46: Trace Graphs from MICE procedure: Borrowed money, Sold Assets, and Hardship Financing Following Hospital Discharge 224
Figure 47: Trace Graphs from MICE procedure: Have any Savings Following Hospital Discharge and Household Per-Capita Income Category Pre- and Post-Injury 225

Figure 48: Trace plot from MICE procedure: Visited a Doctor or Hospital, Used Rehabilitation Services Following Hospital Discharge 226
Figure 49: Patterns of financial coping mechanisms over time 228
Figure 50: Transition probabilities for hardship financing: Probability of use in current time period by use in previous time period 229
Figure 51: Patterns of hardship and non-hardship financing over time, by time post-discharge 231
Figure 52: Proportion of households using hardship financing by lag 1 hardship financing 232
Figure 53: Proportion of households using hardship financing by lag 2 hardship financing 232
Figure 54: Proportions of households experiencing tangible impacts of change in living standards since last survey over time 236
Figure 55: Household daily per capita income over time, from prior to injury to the year following hospital discharge (I$) 238

Introduction: Background, Motivation, and Context

Research goals and specific objectives

In a context of imperfect risk protection, households may attempt to alleviate the economic impacts of a health shock by employing various financial and non-financial coping mechanisms, such as reducing consumption, substituting labor, spending down savings, borrowing money with and without interest, selling productive and non-productive assets, and reducing use of medical care. However, using these coping mechanisms may have consequences for longer-term welfare, particularly if they involve the sale of productive assets or borrowing with interest, termed hardship financing, or if they involve foregoing needed medical care. (Berman, Ahuja, & Bhandari, 2010; Mitra, Palmer, Mont, & Groce, 2016) These coping strategies may be maladaptive in the longer term, leading to an inability to produce income in future periods, and potentially precipitating further hardship financing or reductions in human capital investment and increasing the risk for long-term changes in household living standards. (Flores, Krishnakumar, O'Donnell, & Van Doorslaer, 2008; Krishna, 2010)

Poverty measurement and the targeting of social protection programs based on such measurement usually involves measuring total household consumption, expenditure, or income, and then dividing it by the number of individuals within the household, perhaps using an adult equivalency to account for the smaller consumption needs of children. However, this division assumes that each household member receives an equitable share of total household consumption. Yet, studies of intrahousehold allocation have shown that resources are frequently not divided equitably, and that there are many impoverished people living in non-impoverished households. (Brown, Calvi, & Penglase, 2018; Brown, Ravallion, & van de Walle, 2017) While studies of intrahousehold allocation have often referred to *resource sharing*, there has been less work done on the dynamics of intrahousehold *risk sharing*. While the household may serve as the first source of risk protection, it does not necessarily serve all household members equally, with some members bearing a disproportionate share of welfare costs. (Dercon & Krishnan, 2000; Goldstein, 1999; Haddad, Hoddinott, & Alderman, 1997) For example, households may make different choices around sharing risk based on the importance of that individual's economic productivity to the household prior to the health shock; or households may make choices based not on economic productivity or need but on demographic characteristics of the patient, such as age or gender. The ability and willingness of the household to leverage potentially maladaptive coping mechanisms, or the choice of coping mechanism, may depend not only on social protection policy context and household socioeconomic status, but by the type of intrahousehold risk sharing and the position of the patient within the household.

Vietnam passed a Health Insurance Law in 2014, effective in 2015, mandating individual health insurance coverage, with full subsidies for those below the poverty line, or those who have recently ascended above the poverty line, and partial subsidies for the near poor who have not recently escaped poverty. (National Assembly of the Socialist Republic of Vietnam, 2014) Prior to the 2014 Health Insurance Law, households in the informal sector, the dependents of formal sector workers, and those living close to the poverty line were not required to have health insurance, and also did not receive subsidies for social health insurance contributions. (Somanathan, Tandon, Dao, Hurt, & Fuenzalida-Puelma, 2014) Prior to the 2014 Health Insurance Law, Vietnam also used a combination of global budgets and fee-for-service mechanisms to purchase inpatient health care services, dropping the use of global budgets in 2015. (Lieberman & Wagstaff, 2009; Teo, Bales, Bredenkamp, & Cain, 2019; Vian, Brinkerhoff, Feeley, Salomon, & Vien, 2012) Further, in 2002 and 2006, Vietnam devolved decision making around health service delivery to individual hospitals and developed a policy of hospital financial autonomy. (Sepehri, 2014; Teo et al., 2019; Vietnam Ministry of Health, Institute, Bank, & Organization, 2011) How providers, operating within this health insurance, hospital governance, and health services purchasing environment, may influence patient and household choices around coping with direct and indirect medical costs has not been explored.

Vietnam has demonstrated an interest in poverty transitions in relation to health, as those who have recently ascended above the poverty are eligible to retain the full subsidy for health insurance. The Ministry of Labor, Invalids and Social Affairs (MOLISA), the ministry tasked with poverty measurement and alleviation, is concerned that about a third of households which have moved above the poverty line will fall back below it. (Ministry of Labor, Invalids and Social Affairs (MOLISA), 2015) It may be of interest to understand not only how a health shock and its associated direct and indirect costs may affect household living standards, but also how household choices around coping with that health shock, may affect patients' physical health and household financial health.

The proposed research is a quantitative analysis of choices around coping with a health shock, risk sharing within households, and the health and economic consequences to patients and households of using certain coping strategies: what factors of the patient, household, and health financing environment shape the choice of coping strategy (Papers 1 and 2) and the consequences of those strategies for patient health and household living standards (Papers 2 and 3), using an injury as a sudden, individual health shock which sets a time origin for household decision-making and coping responses. This study uses a dataset collected prior to the full implementation of Vietnam's health insurance policy change to explore the dynamics of coping with the financial impacts of a health shock. This research aims to contribute to the literature exploring the relationships among direct and indirect health care costs, potentially maladaptive coping mechanisms, and household living standards, within the particular health financing and social protection environment in Vietnam.

This research has the following three specific aims, each of which will attempt to answer several questions:

- Aim 1: To understand the different patterns of coping mechanisms that households mobilize in the year following a health shock; and to understand factors that may be associated with hardship financing (interest-bearing debt and sale of productive assets) in particular.
    - Question 1: What are the different coping mechanisms that households mobilize in the year following a health shock, including reducing consumption, spending down savings, borrowing money with or without interest, selling productive or non-productive assets, and reducing medical care?
    - Question 2: How are hardship financing methods in particular associated with patient, household, and injury characteristics, especially access to and depth of insurance?
        - These factors may include:
            - Baseline characteristics such as patient demographics, injury characteristics, length of stay in hospital, pre-injury level of disability, month or season of hospital discharge, insurance status, pre-injury household poverty status, and the patient's productive role within the household.
            - Time-varying covariates, including level of disability, household size and dependency ratio, post-injury household poverty status, and the ratio of out-of-pocket costs to household income.
- Aim 2: To understand whether and why households may use forgoing medical care as a strategy to cope with direct medical costs, and what the financial and health-related consequences of avoiding medical care are during hospitalization and in the year following hospital discharge
    - Question 1: What is the prevalence of forgoing medical care among patients hospitalized for a moderate to severe injury?

- Question 2: What factors are associated with patients forgoing medical care, particularly insurance status?
- Question 3: What are the impacts of forgoing medical care on household direct and indirect costs, and on the health and welfare of the patient?

- Aim 3: To evaluate whether the use of hardship financing in one period increases the odds of use in the next period, after controlling for other factors; and whether repeated use of hardship financing influences the household's living standards over the course of a year.
  - Question 1: How does the pattern of repeated use of hardship financing over the first year following the index hospitalization vary according to different baseline and time-varying factors, including patient and injury characteristics; household-level socioeconomic status; and health insurance status?
  - Question 2: Does engaging in hardship financing increase the probability of doing so again?
  - Question 3: How does repeated use of hardship financing affect household living standards over twelve months following a health shock?

Background

a. Poverty and vulnerability

Movements out of poverty are worldwide accompanied by movements into poverty, transitions which have important consequences for human welfare but which are not captured by aggregated poverty prevalence or poverty gap data. (Krishna, 2010) These flows of poverty can occur over different periods of time; be the result of a single, precipitating event or an accumulation of multiple events; be associated with different household-level characteristics, such as size, gender of the head of household, rural or urban residence, etc.; and the change in poverty status, either positive or negative, can be permanent or temporary, significant or minor. The factors and processes by which individuals and households fail to escape poverty versus how they enter poverty are quite different; one involves an inability to invest in physical and human capital, while the other involves an inability to cope with risk. (Krishna, 2010)

Vulnerability is a concept often deployed to expand the numbers and categories of individuals for whom pro-poverty policies should be devised and directed. Vulnerability can be conceptualized as expected poverty over future time periods, defining risk using models and longitudinal data. (Pritchett, 2000) There are also variations on this definition which expand beyond headcount vulnerability, which is a corollary of headcount poverty, to depth of vulnerability, which is a corollary of poverty gap measures. (Dutta, Foster, & Mishra, 2011; Foster, Greer, & Thorbecke, 1984)

Vulnerability can also be conceptualized as the welfare costs of anticipating and attempting to cope with potential income or consumption shocks. Households may attempt to protect themselves against unexpected variability in income (income smoothing) by engaging in various risk management strategies, such as diversifying sources of income; maintaining liquidity rather than investing funds; and making only low risk, low return investments. Households may also attempt to protect themselves against unexpected variability in consumption (consumption smoothing), by engaging in various risk coping strategies such as informal insurance, precautionary savings, patronage relationships, or avoiding irreversible investments, such as in education or land improvements, which cannot be sold in an emergency. (Dercon, 2005; Fafchamps, 1999) Each of these strategies for attempting to limit exposure to risk (risk management) or to cope with the consequences of risk (risk coping) carries costs for the household. These costs include foregone investments and their associated potential income; time and resource costs of collecting information about the lives of others and applying social pressure in order to maintain and enforce reciprocal mutual support networks for informal insurance; and deferring consumption and investment to build up precautionary savings for self-insurance, sometimes through instruments such as cash or perishable food stores which effectively have a negative interest rate. (Dercon, 2005; Fafchamps, 1999) This indicates that some households are willing to accept a lower long-term mean level of consumption if doing so can also provide a lower long-term variance in their level of consumption – a concept familiar to anyone who has ever purchased an insurance policy.

Social protection programs such as health insurance serve, in part, to alleviate individuals and households of this second definition of vulnerability; the state takes on the costs associated with anticipating and coping with realized risks, potentially sparing individuals and households the associated welfare costs mentioned above. Health financing, integrated with other forms of social protection, therefore not only protects households from impoverishing or catastrophic direct medical costs, but also has the potential to alleviate the need for individuals and households to engage in various anticipatory risk coping strategies which may reduce the ability of the household to increase its income.

b. Health Shocks and Household Financial Decision-Making

A *health shock* is a sudden or unpredictable negative change in health status which can cause temporary or permanent disability. A health shock often requires an outlay of money for *direct medical costs* for health care goods and services and *direct non-medical costs* that are incurred in the process of seeking medical care, such as for transportation, food or lodging. Additionally, a health shock can result in *indirect costs*, or the productivity loss of the patient and/or other household members who may reduce their labor supply or change productive roles in the household in order to provide care to the patient. (Doorslaer et al., 2005; Leive & Xu, 2008; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008a, 2008b) Indirect costs may be incurred due to permanent or temporary disability, either due to the limited effectiveness of utilized medical care, or inaccessible or foregone medical care.

The impact of direct costs on households are often measured through their effect on the poverty status of the household, usually defined as household income or household expenditure on items other than health care falling below the poverty line. With or without causing actual impoverishment, direct costs can also affect the lifestyle of the household if they amount to a significant portion of household per capita expenditure. Such catastrophic costs are variously defined as 10% or 20% of non-food expenditure or up to 40% of total household per capita expenditure, with expenditures for children sometimes down-weighted using an adult equivalency. (O'Donnell et al., 2008a)

Household protection against a health shock is often measured by consumption smoothing, in response to Murdoch (Morduch, 1994) who identified inability to maintain a stable or consistent level of consumption over time as an indicator of poverty, measured as deviations from the permanent or average income line. (Genoni, 2012; Gertler & Gruber, 2002; Wagstaff, 2005) Variability or volatility in household consumption which brings the household below the poverty line in at least one time-period is termed transient poverty if the household's long-term level of consumption is above the poverty line, but becomes chronic poverty if the household experiences so many time periods living in poverty that its long term level of consumption falls below the poverty line.

However, maintaining pre-shock levels of consumption may not be the best indicator; households may employ various financial and non-financial coping mechanisms at different time points following a health shock in order to maintain pre-shock levels of consumption. These coping mechanisms may or may not allow household members to maintain pre-shock levels of consumption, potentially at the risk to their longer-term welfare, especially if those coping mechanisms include taking on interest-bearing debt; liquidating or reducing investment in physical capital; or reducing investment human capital (in this case, foregoing medical care). (Berman et al., 2010; Mitra et al., 2016) This is in part because the risk coping and risk management strategies used by private individuals are less effective in alleviating the consequences of a realized risk than formal social protection systems, and in part because risk coping methods may have a ceiling; for example, households will have a fixed amount of physical capital to sell or precautionary savings to spend down, and likely have limits on the extent to which their informal insurance networks are willing or able to extend support. Even if the existing risk coping mechanisms allow the household to weather the current shock, additional shocks – health related or not – may not be so easily absorbed. Exhausting one's personal safety net or engaging in hardship financing could lead to a poverty trap, in which the means to escape poverty are no longer available to the individual or household. Alternatively, households may anticipate falling into a poverty trap should they engage in such potentially maladaptive coping strategies, and choose to let near term consumption vary to the extent that it meaningfully affects welfare. (Carter & Lybbert, 2012; Genoni, 2012; G. T. H. Nguyen, White, & Ma, 2008; Zimmerman & Carter, 2003)

c. Intrahousehold Allocation: Inequality in Resource and Risk Sharing

The study of intrahousehold allocation seeks to understand how different preferences and differential access to power across multiple actors within the household shape how resources are distributed amongst household members. The first examinations of household behavior treated households as single entities, assuming that income and time were pooled within the household, that altruism was the dominant mode of interaction among household members, and that the head of household was a benevolent dictator with perfect information about the preferences and activities of other household members. (Haddad et al., 1997) This unitary model of household behavior has given way to various collective models of household interaction, characterized by both altruism and conflict, incomplete income pooling, and divergent preferences amongst household members or groups of household members. Interactions among household members are defined by cooperative bargaining and/or non-cooperative conflict (game theory), and allocations to one household member affect those received by another. This change in the understanding of allocation within the household has been a foundation for such policy instruments as conditional cash transfers and the targeting of microcredit towards women. (Fiszbein & Schady, 2009)

Measurements of poverty usually involve measuring total household consumption or expenditure and dividing it by the number of individuals within the household, perhaps using an adult equivalency to account for the smaller consumption needs of children. This division assumes that each household member receives an equitable share of total household consumption. However, a recent study has found that around half of the underweight women and children in sub-Saharan African were in the wealthiest 60% of households. (Brown et al., 2017) Using the most stringent definition of poverty, the inability to obtain enough calories for healthy bodily functioning, this implies that half of impoverished women do not live in impoverished households. In other words, there are many poor people living in non-poor households. Ignoring the potential for inequitable intrahousehold allocation therefore results in underestimates of the prevalence of poverty in a society.

While intrahousehold allocation is often taken to refer to resource-sharing in the context of improving targeting for safety-net and anti-poverty programs, it has not been extensively studied in the context of the risk sharing amongst individuals within a household. Intrahousehold allocation may change in response to a recent event, such as a realized risk. In times of crisis, particular individuals or types of individuals may bear the majority of the welfare costs on behalf of households; or, the household may have more or less willingness to engage in risk coping methods based on patient or injury characteristics, resulting in differential financial protection or even health outcomes. For example, one study in Pakistan found that the choice of provider type and the delays in seeking health care for children were differential by gender, with male patients receiving care at perceived higher quality providers and having smaller delays between event and receipt of care. (Haddad et al., 1997) The authors also found that intrahousehold inequalities disappeared among higher income households; this larger income elasticity for the health of daughters indicates that within lower income households, which face a more severe budget constraint, some individuals face two forms of inequality, both between and within households. However, these choices need to be based on immutable characteristics such as gender; households may make different choices based on factors such as the importance of the patient's economic productivity to the household prior to the health shock, or factors related to the injury mechanism (such as intentionality).

The Case of Vietnam: Transitioning to Universal Health Coverage

Up until the economic and social reforms of the mid 1980s ("Doi Moi"), Vietnam's health system followed a socialist model of direct provision of care, a Beveridge model. During this period of transition, private health care providers, user fees, and health insurance were introduced along with a host of other economic liberalization policies. (Somanathan et al., 2014) Vietnam was reclassified in 2010 from a low income country to a lower-middle income country. However, even before Vietnam crossed into middle income status, its health system problems reflected those of a middle income country rather than a low income country: rather than being unable to provide health services to the population, Vietnam has been able to connect people to health services to a greater extent than countries of a similar level of national income per capita. However, health financing policies were and are unable to provide complete financial protection against the cost of those health services. (Lieberman & Wagstaff, 2009)

Universal health coverage involves providing effective care equitably with financial protection, promoting and subsidizing both the supply and demand for health care simultaneously. Prior to the period of social and economic liberalization, Vietnam health policy focused on building and managing supply-side infrastructure. Post-liberalization, health policy has paid greater attention to financial protection and equity in financial accessibility, increasing attention to demand-side subsidies for health care. (Somanathan, Dao, & Tien, 2013) Beginning in the early 1990s, Vietnam introduced, even experimented with, various targeted health insurance programs and payment mechanisms, starting with programs for the civil service (1993), then a program for those below the poverty line and for ethnic minorities (the Health Care Fund for the Poor, 2003), and finally the Social Health Insurance program, which was mandatory for formal sector workers (2005). In 2009, the Health Care Fund for the Poor was merged with the Social Health Insurance program, combining into a nominal single-payer insurance system with social health insurance contributions from employers and employees and tax-based financing for several demographic and social segments of the population. (Lieberman & Wagstaff, 2009) Despite the consolidation in policy, this single payer system existed mostly in theory, as risk pools were fragmented across Vietnam's 63 provinces and the various different health insurance membership groups. However, due to underutilization of services by marginalized groups, poor individuals and poor provinces; capitation rates at district hospitals set through historical norms; the emphasis on higher levels of care rather than primary care; and the allowance for transfers of surpluses amongst provinces, the revenue sources for social health insurance have so far not been pro-poor. (Somanathan et al., 2014) Family members and dependents of formal sector employees and informal sector workers and their dependents living above Vietnam's fairly low poverty line were allowed but not mandated to enroll in social health insurance, but were ineligible for full tax-based subsidization. Students and those near the poverty line were also not mandated to enroll, but were eligible for partial subsidization of social health insurance contributions. (Somanathan et al., 2014) This limited mandate led to adverse selection into the risk pool, as those in the voluntary contributory categories were more likely to be enrolled if they had suffered a period of ill health in the past year, and average expenditures exceeded the contributions for the voluntary category. (Lieberman & Wagstaff, 2009)

Vietnam has had a classic problem of the "missing middle" in which the highest and lowest income groups have higher rates of health insurance enrollment, but the near poor, particularly those above the poverty line in the informal sector, have very low enrollment rates, as these groups were neither required to have health insurance not were not eligible for subsidized social health insurance contributions. (Somanathan et al., 2013) The Health Insurance Law of 2014 expanded the categorical groups entitled to full subsidization of social health insurance, which now includes the elderly, children under 6, those living below the poverty line, the near-poor who have recently escaped poverty, ethnic minorities, and “meritorious” individuals such as war heroes. Students and individuals living near the poverty line are entitled to partial subsidization. All segments of the population are now mandated to have social health insurance, including those employed in the informal sector and living in households above the poverty line. (National Assembly of the Socialist Republic of Vietnam, 2014) This law went into effect on January 1, 2015.

The 2012 Master Plan for Universal Health Coverage, approved by the Prime Minister, has three explicit goals: increase financial protection to reduce impoverishment and financial catastrophe; increase enrollment to include all household members rather than just a head of household; and increase demand for health care while maintaining financially sustainability. (Somanathan et al., 2014) Vietnam has shown itself interested in vulnerability to poverty and poverty transitions, as the 2014 Health Insurance Law waives user fees for those who had recently risen above the poverty line, and partially subsidize households close to the poverty line which have not recently changed their poverty status. (National Assembly of the Socialist Republic of Vietnam, 2014) Currently, the Ministry of Labor, Invalids, and Social Affairs estimates about a third of households which have moved above the poverty line will fall back below it. (Ministry of Labor, Invalids and Social Affairs (MOLISA), 2015) Additionally, Vietnam has shown that it is interested in increasing demand for health care, evidenced by concomitant investment in health care infrastructure and human resources for health with policies aimed at expansion of health insurance coverage. (Somanathan et al., 2014)

Vietnam originally had aimed to achieve universal coverage by 2010; however, it now aims to achieve 80% coverage by 2020. (Barroy, Jarawan, & Bales, 2014; Somanathan et al., 2014)

As a middle-income country which has made a public policy commitment to universal health coverage, Vietnam is struggling to balance breadth, depth, scope and effectiveness of coverage with financial sustainability. (Barroy et al., 2014; Lieberman & Wagstaff, 2009; Somanathan et al., 2013, 2014) Vietnam's growing economy had provided some of the fiscal space needed to increase public expenditures on health, both in absolute and relative terms; public expenditure has increased from 26% in 2005 to 54% in 2014, and the expansion of the breadth of coverage has been funded by tax revenues rather than social health insurance contributions from the formal sector. (Somanathan et al., 2014; World Health Organization, 2020) However, as there is no additional fiscal space for increase public expenditures, financial sustainability must turn to consolidating risk pools, changing from passive to strategic purchasing mechanisms, and enforcing mandatory enrollments. (Somanathan et al., 2014)

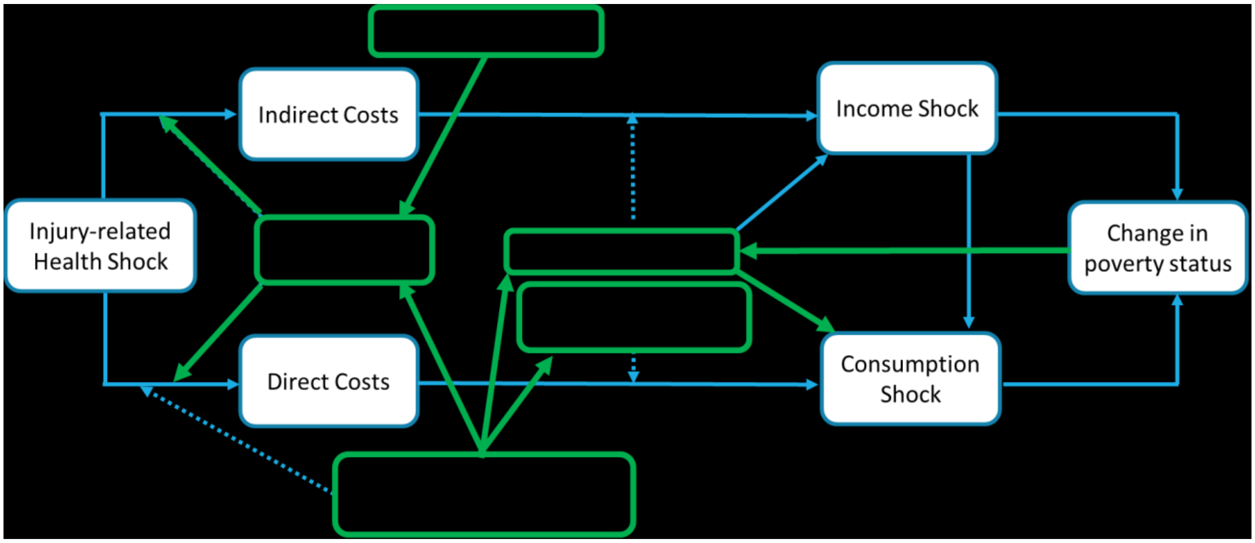
Table 1: Timeline of Health Financing, Governance, and Related National Events in Vietnam

Year	Event
1954	❖ Vietnam gains independence from France
1975	❖ Political reunification of North and South Vietnam following the end of the Second Indochina War, also called the Vietnam War or the American War
1986	❖ Beginning of the *Doi Moi* ("renovation") economic and social policy reforms
1988	❖ Land Law allows private land use rights, but ownership of land retained by the state ❖ User fees introduced for inpatient hospitalization ❖ Physicians allowed to open private medical practices
1989	❖ Health insurance piloted
1993	❖ Civil Servants, employees of state enterprises, pensioners incorporated into social insurance programs, including health insurance
1995	❖ Health services fee schedule introduced; hospitals paid through a combination of global budgets and fee-for-service
1998	❖ Legislators, teachers, and social welfare groups incorporated in social insurance programs, including health insurance
2003	❖ The Health Care Fund for the Poor provides different levels of subsidies to ethnic minorities, and individuals below and within 150% of the national poverty line, as defined by the Ministry of Labor, Invalids, and Social Affairs
2005	❖ Formal sector workers incorporated into social insurance programs, including health insurance ❖ Children under 6 and individuals below the poverty line mandated to enroll in the Health Care Fund for the Poor with fully subsidized health insurance premiums
2006	❖ Devolved decision-making and hospital financial autonomy policies implemented
2009	❖ A nominal single-payer system developed through merging the Health Care Fund for the Poor with the social insurance programs for formal sector workers.
2009	❖ Case-based payments for select conditions piloted in two hospitals in Hanoi
2010	❖ Students incorporated into social insurance programs, including health insurance
2010	❖ Vietnam reclassified from a low income country to a lower-middle income country
2012	❖ Master Plan for Universal Health Coverage developed and approved by Prime Minister: Increase breadth of coverage to 100% of population; increase depth of coverage; and 'rationalize' service coverage/benefits package. ❖ Fee schedule updated for the first time since implemented in 1995
2015	❖ Health Insurance Law of 2014: All supply-side supports withdrawn, insurance reimbursement set at 100% of cost recovery, the categories of citizens eligible for

	fully subsidized health insurance premiums were expanded, and all citizens mandated to have health insurance, but without any enforcement mechanism ❖ Fee schedule updated
2020-2021	❖ Covid-19 pandemic causes widespread economic dislocation; Vietnam responds by incorporating individuals traditionally excluded from social protection systems, such as those in the informal sector, through extending sickness benefits and making unemployment benefits in cash available to those whose livelihoods were affected.

Conceptual Frameworks

Figure 1: The relationship of injury-related health shocks to poverty transitions, moderated by formal social protections, health insurance and financial and non-financial coping mechanisms



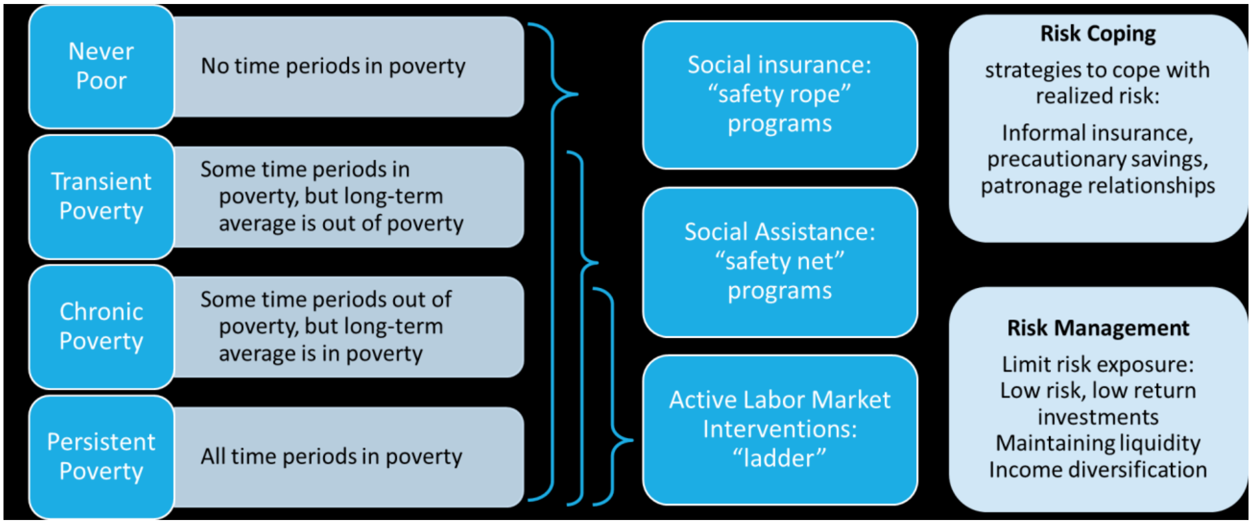
As discussed, health shocks can have both direct and indirect costs for households. Direct costs refer to the outlays of funds paid for health care or to access health care, while indirect costs are the loss of income or productivity due to temporary or permanent disability. Whether those direct costs result in an income shock, a reduction in income, is mediated by access to formal social protections such an unemployment insurance or disability supports, anti-poverty programs which provide income support, and the ability of the individual or household to substitute the labor of another for the lost labor or productivity of the patient. Should an income shock materialize, it may lead to a reduction in consumption or may place the household below the poverty line, if using income as a basis for poverty measurement. The reduction of consumption below a certain level is one definition of poverty, while income below a certain level is another definition of poverty; both definitions are used in Vietnam by different Ministries and Agencies, for different purposes.

The impact of a health shock on direct costs is mediated by access to formal health insurance, with the depth of that insurance determining how much of the direct costs materialize and are borne as out-of-pocket costs. Whether those direct costs result in a significant reduction in household consumption - a consumption shock - is mediated by the ability to spend savings, participation in informal risk sharing or insurance arrangements, and the leveraging of financing coping mechanisms. Spending savings and selling non-productive assets may reduce the household's cushion to cope with future shocks, while selling productive assets or taking on interest bearing debt (hardship financing) may reduce the household's productive capacity in the next time period, potentially leading to an income shock. However, high socioeconomic status households may be less affected by hardship financing methods than lower socioeconomic status households. The ability to use hardship financing, dissaving, and to draw on informal insurance networks may be affected by previous shocks, as households may have used their available resources. Importantly in the current Vietnamese health insurance policy context, the penetration of formal insurance may reduce the pool of social contacts willing to participate in informal insurance arrangements.

Hardship financing mechanisms are important to this conceptual framework. The decision to use a risky financial coping mechanism might be made in an environment of need; if the risk does not pay off, such efforts to avoid consumption and income shocks may instead actually result in a shock that leads to a change in poverty status. Similarly, foregoing medical care in an effort to avoid immediate direct health care costs may result in increased indirect costs in the mid- to long-term.

Much of this conceptual framework has been developed from literature from other social, economic, and policy contexts; one objective of this research is to understand the applicability of this conceptual framework to Vietnam in the present.

Figure 2: Poverty flows in relation to social protection and social security programs



Krishna (2010) argues for a four-fold classification of households according to their poverty flow over time: a) those who leave poverty; b) those who descend into poverty; c) those who remain in poverty; and d) those who remain non-poor. Jalan and Ravallion (1999) present a model classifying households according to their experience of poverty transitions which highlights the common experience of multiple transitions over time. This conceptual framework presents a problem for measurement of poverty transitions over time; when measurement is done retrospectively using average income or consumption over a time period, it is not possible to distinguish between those who never experience poverty and those who experience transient poverty, as those two populations both have long-term average income above the poverty line. Similarly, it is not possible to distinguish between those experiencing chronic and persistent poverty, as their long-term average incomes are below the poverty line. However, these different experiences have different implications for human welfare.

There is a distinction to be made between social insurance programs and anti-poverty programs. Anti-poverty programs target particular *people*, based on their current level of income or expenditure, and attempt to lift their *mean* expenditure over time, or prevent it from falling below some specified threshold. Social insurance programs, by contrast, target particular *events*, such as a health shock, unemployment, or poor harvest, and their aim is to reduce the *variability* in expenditure over time. Pritchett (2000) offers a useful metaphor, describing the difference between anti-poverty programs and social insurance programs as the difference between a trapeze artist's safety net, which prevents a fall below a common threshold, and a mountain climber's safety rope, which prevents a fall below the current height climbed. Outcomes of the success of universal health coverage-oriented policies are measured in both ways: the goal of preventing impoverishment due to health care costs is a measure of how well the safety *net* works, whereas the goal of preventing catastrophic health care costs is a measure of how well the safety *rope* works. Health insurance, which targets direct medical expenditures, or unemployment insurance, which targets indirect medical expenditure, are examples of social insurance programs.

Incorporating the work of Dercon (2005) and Pritchett (2000), the framework identifies that insurance programs are not necessarily intended to be anti-poverty programs, to promote individuals ascending out of poverty; rather, they are "safety rope" programs intended to prevent descents into poverty or deeper poverty in the case of individuals who are already poor; yet, insurance programs in targeting the event often only cover the costs directly related to that even, such as health insurance covering only direct costs. As such, insurance is intended to replace welfare-reducing risk-coping strategies, rather than reduce costly risk management strategies.

Innovation: Injuries as Idiosyncratic Health Shocks with a Clear Time Origin

An injury, unlike an infectious disease outbreak or pandemic, extreme weather event, or financial crisis, is an individual or idiosyncratic shock, as compared to a covariate shock, which may affect all members of a community or mutual support network. Covariate shocks may negatively affect the efficacy of many of the pathways that a household may take to cope with a realized risk. Households may be socially connected in informal risk sharing arrangements with individuals living close by, who are also affected by the shock and therefore limited in their ability to provide informal transfers or loans. Additionally, if many households are affected by a covariate shock, many may choose to sell assets at the same time, flooding the market and driving down the price. (Dercon, 2005) In the absence of formal insurance, risk coping mechanisms are expected to be the most effective at promoting consumptions smoothing for idiosyncratic shocks.

Independent variable definition. The concept of a "health shock" has been defined and measured in a variety of ways, including self-reported health status; anthropometry; reductions in labor supply; functional limitations such as in activities of daily living; seeking or using inpatient or outpatient medical care; and medical diagnoses. (Currie & Madrian, 1999) These differences in measurement are non-trivial, as several studies examining the effect of a health shock on various economic outcomes have seen results change in magnitude, statistical significance and even the direction of the relationship between health and various economic outcomes depending on the variable used to represent a health shock. (Gertler & Gruber, 2002; Mitra et al., 2016; Wagstaff, 2007) For these studies, the definition of a health shock was usually driven by the data the authors had available; the observed measurements dictated the variable definition, rather than the other way around. (Mitra et al., 2016) However, when the independent variable measured with error, this can introduce endogeneity and therefore misspecification of the relationship between the independent and dependent variables, whereas mismeasurement of the dependent variable error will introduce imprecision into models. Some authors have attempted to avoid endogeneity by using instrumental variables, but these IVs have been only weakly correlated with health shocks. (Islam & Maitra, 2012) Indeed, looking at a narrower question in a single country, Indonesia, three different studies using three different specifications of a health shock led to the conclusions that household are not able (Gertler & Gruber, 2002), are able (Genoni, 2012), or depending on pre-shock socioeconomic status may be able (Sparrow et al., 2014) to smooth consumption following a health shock.

Establishing a time origin. One challenge may be that for most studies there is no clear time origin for a health shock. Much of the literature examining the impact of health events on household consumption, earnings, and coping strategies is cross-sectional or uses panel data, which retrospectively aggregates together unexpected, sudden serious health events with gradual, chronic or intermittent events. (Alam & Mahal, 2014; Genoni, 2012; Gertler & Gruber, 2002; Hasegawa, 2017; Mitra et al., 2016; K. T. Nguyen et al., 2012; Sparrow et al., 2014; Thanh et al., 2006; Wagstaff, 2005, 2007) These designs were appropriate for these studies, which intended to compare households which a member who had experienced a health shock with those who had not. However, a change in health status towards a chronic illness, rather than a sudden or intermittent illness, is associated with a lower impact on indirect health costs. (Gertler & Gruber, 2002) When an illness has a gradual onset, or becomes chronic, predictable and known, there is the possibility for longer-term adaptation by the household to maintain earnings or cope with costs, as opposed to an injury, which is unpredictable and sudden. While at a population level, ongoing regular health care costs may contribute more to impoverishment and change in lifestyle, as captured by catastrophic costs, an injury of sufficient severity to land the patient in a hospital for 24 hours or more has the potential to be a single, costly event – a financial shock. However, while an injury provides a suitable context for examining potentially maladaptive household financial decisions, the conclusions from this study about household decision-making might not, therefore carry over for households with a member facing chronic or intermittent illness. By contrast, the data for the current study uses a longitudinal follow-up design, in which the initial direct health care costs and the severity of the injury are measured prospectively and using hospital records.

One study does utilize injury to measure the impact of health shocks on consumption, holding that injuries are health shocks exogenous to level of household consumption. (Mohanan, 2013) This study evaluates the effect of road traffic injuries on consumption and the use of coping mechanisms to maintain consumption by comparing individuals injured in bus accidents matched to passengers riding similar routes a year later. The study found that for the injuries sustained in the sample, households with an injured member were able to maintain food and non-food consumption, but were significantly more likely to have borrowed money in the year following the injury; were more likely to be in debt a year after the injury; and the average amount of debt was much higher, as compared to households without an injury. However, the purpose of the study was to investigate whether households were able to smooth consumption in the face of a health shock, and whether they used certain coping mechanisms, without examining issues related to intrahousehold allocation. Further, the sample size of those who suffered from injuries was less than 90 individuals, leaving some aspects of the study underpowered. Additionally, the study has the potential to suffer from recall bias, as the questionnaire was administered a year following the index injury. Perhaps most importantly, the social, economic and health financing policy context was South India in 2005, which is quite different from Vietnam in 2015-2016.

Intrahousehold allocation. Even among those prospective studies that exist, none focus on the roles or characteristics of individuals within the household or their health condition, but rather treat the household as a unified whole. (Hang, Byass, & Svanström, 2004; H. Nguyen, Ivers, Jan, Martiniuk, & Pham, 2013) At a population level, catastrophic or impoverishing health care expenditure may be driven by the accumulation of expenses incurred by multiple individuals within the household. In addition to obscuring the time origin for a health shock, it does not allow for an analysis of whether factors specific to an individual within a household might influence decision-making around using different financial coping strategies. There may be different coping processes put into place when attempting to cope with numerous, small expenses distributed over a period of time, rather than a single, large event, such as a hospitalization from an injury. I have not found any studies which have evaluated how intrahousehold allocation changes in response to an injury-related health shock based on household member characteristics, during a transition from informal to formal insurance.

Vietnam. Catastrophic direct and indirect costs resulting from injuries have been documented in Vietnam in the period following the merge of the National Health Insurance scheme and the Health Care Fund for the Poor. (K. T. Nguyen et al., 2012) One study has evaluated the impact of health shocks on economic outcomes in Vietnam, including whether those outcomes were mediated by employing various financial coping mechanisms. (Mitra et al., 2016) The sample chosen was taken from a nationally representative rotating panel, allowing the author to compare economic outcomes among those who did and did not experience health shocks. However, as a result, the sub-sample of those who did experience a health shock was somewhat small. When conducting sub-sample analysis to evaluate the outcomes among those who did and did not employ financial coping mechanisms, some of the results were unstable and unexpected, attributed to the low sample size of those exposed to a health shock. Additionally, results in this study differed by the choice of definition of a health shock, and only considered health shocks of working age adults, without considering how a health shock by other family members might influence household decision-making. Finally, this study included a sample from 2004 to 2008, significantly prior to the introduction of the new health insurance law in 2015.

Overall methodology

a. Parent Project: The Health, Economic and Long-term Social Impact of Injuries (HEALS) Study

Parent study objectives: The current study involves a secondary analysis of data which was collected in 2015 and 2016 in Vietnam as part of a larger study. The HEALS study was designed to meet three research objectives. The first objective was to examine the epidemiology of traumatic injuries, including injury type, body location and mechanism; behavioral risk factors associated with injury; intentionality behind the injury; time, place and activity performed when the injury occurred; and patient demographics, pre-injury health status, and socioeconomic status. The second objective was to measure the mid- to long-term economic and social impact of injuries not only on the patient, but also the household in which the individual is embedded, including time-varying self-rated disability; time-varying ability to perform activities of daily living; time spent away from work, and changes in work schedule, tasks, position, and income; changes in household income and food expenditure; and ongoing direct and indirect medical costs. Finally, the third objective of this study was to measure health and economic coping strategies, including the use of labor substitution within households and families; borrowing money, selling assets, and spending down savings; the use of rehabilitative services and treatment; and access to and use of health insurance, formal social protection systems, and charitable assistance.

Parent study design: The study was conducted in four countries: Vietnam, Cambodia, Malaysia, and Kenya. The study used a prospective cohort design, with hospital-based recruitment from one hospital in Vietnam, three different hospitals in Cambodia, two in Malaysia, and one in Kenya. The Ninh Bình hospital, a provincial public hospital in Vietnam, is the country's largest trauma hospital, located in the district capital of Ninh Bình province, a largely rural province adjacent to Hanoi. Patients were eligible for participation in the study if they met the following conditions: they had suffered an injury which was severe enough to require hospitalization for at least 24 hours; they were at least 18 years old when contacted by the study team; they were able to communicate in the language of the survey, and were physically and emotionally stable enough to give consent and complete the baseline questionnaire. Patients admitted for a scheduled medical procedure related to an older injury, or who were transferred shortly after admission, or who lived further than 90 km away from the hospital were excluded from participation. Baseline data collection occurred on two dates during hospitalization: on the second day of hospitalization, to collect information about the injury event, the patient's demographics, and his or her pre-injury health status. Data was again collected at hospital discharge, from the patient, medical providers and the medical record, to provide a detailed account of clinical diagnosis, pre-hospital and hospital interventions and medical services, costs associated with medical care, and supports from family and social contacts, government programs, and charitable associations. Follow-up data collection to assess ongoing medical care and costs, self-rated disability, formal and informal supports, and social and financial coping strategies, took place in the patient's home at one, two, four, and twelve months following discharge.

Variables collected**:** Baseline data collection included detailed information about injury epidemiology, patient demographics, patient pre-injury health status, patient and household socioeconomic status, detailed hospital bill charges, and any health insurance payments, formal social protection program support, charitable assistance, and informal support from family and social contacts, as described above. Follow-up data collection collected time-varying information on: self-reported level of disability, ongoing medical and rehabilitative care, time spent away from work, ability to perform activities of daily living, medical costs, financial coping mechanisms, and access to formal and informal economic supports.

b. Ethical Review and Clearance

The portion of this dissertation that involves secondary data analysis already has been reviewed by the JHSPH Institutional Review Board.

References

Alam, K., & Mahal, A. (2014). Economic impacts of health shocks on households in low and middle income countries: a review of the literature. *Globalization and Health*, *10*(1), 21. https://doi.org/10.1186/1744-8603-10-21

Barroy, H., Jarawan, E., & Bales, S. (2014). *Vietnam - Universal health coverage for inclusive and sustainable development : country summary report*. Retrieved from http://documents.worldbank.org/curated/en/827041468329937967/Vietnam-Universal-health-coverage-for-inclusive-and-sustainable-development-country-summary-report

Berman, P., Ahuja, R., & Bhandari, L. (2010). The Impoverishing Effect of Healthcare Payments in India: New Methodology and Findings. *Economic and Political Weekly*, *XLV*(16), 65–71. https://doi.org/10.2307/25664359

Brown, C., Calvi, R., & Penglase, J. (2018). Sharing the Pie: Undernutrition, Intra-Household Allocation, and Poverty. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3199129

Brown, C., Ravallion, M., & van de Walle, D. (2017). *Are Poor Individuals Mainly Found in Poor Households? Evidence Using Nutrition Data for Africa*. The World Bank. https://doi.org/10.1596/1813-9450-8001

Carter, M. R., & Lybbert, T. J. (2012). Consumption versus asset smoothing: Testing the implications of poverty trap theory in Burkina Faso. *Journal of Development Economics*, *99*(2), 255–264. https://doi.org/10.1016/j.jdeveco.2012.02.003

Currie, J., & Madrian, B. C. (1999). Health, health insurance and the labor market. In O. Ashenfelter, R. Layard, & D. Card (Eds.), *Handbook of Labor Economics* (Vol. 3, Part C, pp. 3309–3416). Elsevier. Retrieved from https://econpapers.repec.org/bookchap/eeelabchp/3-50.htm

Dercon, S. (2005). Risk, Insurance, and Poverty: a Review. In S. Dercon (Ed.), *Insurance against Poverty* (pp. 9–37). New York : Oxford University Press .

Dercon, S., & Krishnan, P. (2000). In Sickness and in Health : Risk Sharing within Households in Rural Ethiopia. *Journal of Political Economy*, *108*(4), 688–727.

Doorslaer, E. Van, Donnell, O. O., Rannan-eliya, R. P., Herrin, A. N., Lee, T., Leung, G. M., & Lu, J. R. (2005). *Paying Out-Of-Pocket for Health Care in Asia : Catastrophic and Poverty Impact* (No. 2).

Dutta, I., Foster, J., & Mishra, A. (2011). On measuring vulnerability to poverty. *Social Choice and Welfare*, *37*(4), 743–761. https://doi.org/10.1007/s00355-011-0570-1

Fafchamps, M. (1999). *Rural Poverty, Risk and Development*. Oxford. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.95.7536&rep=rep1&type=pdf

Fiszbein, A., & Schady, N. (2009). *Conditional Cash Transfers: Reducing Present and Future Poverty*. Washington, D.C.: The World Bank Group.

Flores, G., Krishnakumar, J., O'Donnell, O., & Van Doorslaer, E. (2008). Coping with Health-Care Costs: Implications for the Measurement of Catastrophic Expenditures and Poverty. *Health Economics*, *17*, 1393–1412. https://doi.org/10.1002/hec.1338

Foster, J., Greer, J., & Thorbecke, E. (1984). A Class of Decomposable Poverty Measures. *Econometrica*, *52*(3), 761–766. Retrieved from https://oied.ncsu.edu/selc/wp-content/uploads/2013/03/A-Class-of-Decomposable-Poverty-Measures.pdf

Genoni, M. E. (2012). Health Shocks and Consumption Smoothing: Evidence from Indonesia. *Economic Development and Cultural Change*, *60*(3), 475–506. https://doi.org/10.1086/664019

Gertler, P., & Gruber, J. (2002). Insuring Consumption Against Illness. *Am Econ Rev*, *92*(1), 51–70.

Goldstein, M. (1999). Chop time, no friends: Intrahousehold and individual insurance mechanisms in Southern Ghana. *University of California at Berkeley, Department of Agricultural and Resource Economics*, 1–59. Retrieved from http://aida.econ.yale.edu/~cru2/pdf/insurancev2.pdf

Haddad, L., Hoddinott, J., & Alderman, H. (1997). *Intrahousehold Resource Allocation in Developing Countries: Methods, Models, and Policy*. *IFPRI*. Baltimore and London: Johns Hopkins University Press. https://doi.org/10.1016/S0306-9192(98)00011-6

Hang, H. M., Byass, P., & Svanström, L. (2004). Incidence and seasonal variation of injury in rural Vietnam: a community-based survey. *Safety Science*, *42*(8), 691–701. https://doi.org/10.1016/J.SSCI.2003.12.001

Hasegawa, M. (2017). Risk-Coping Measures against Health Shocks during the Process of Penetration of Health Insurance in Vietnam. *Asian Economic Journal*, *31*(2), 139–164. https://doi.org/10.1111/asej.12118

Islam, A., & Maitra, P. (2012). Health shocks and consumption smoothing in rural households: Does microcredit have a role to play? *Journal of Development Economics*, *97*(2), 232–243. https://doi.org/https://doi.org/10.1016/j.jdeveco.2011.05.003

Jalan, J., & Ravallion, M. (1999). Are the poor less well insured? Evidence on vulnerability to income risk in rural China. *Journal of Development Economics*, *58*(1), 61–81. Retrieved from https://econpapers.repec.org/RePEc:eee:deveco:v:58:y:1999:i:1:p:61-81

Krishna, A. (2010). *One illness away : why people become poor and how they escape poverty*. Oxford University Press.

Leive, A., & Xu, K. (2008). Coping with out-of-pocket health payments: Empirical evidence from 15 African countries. *Bulletin of the World Health Organization*, *86*(11), 849–856.

https://doi.org/10.2471/BLT.07.049403

Lieberman, S., & Wagstaff, A. (2009). *Health financing and delivery in Vietnam: looking forward*. Washington, DC. Retrieved from http://documents.worldbank.org/curated/en/295021468124767254/Health-financing-and-delivery-in-Vietnam-looking-forward

Ministry of Labor, Invalids and Social Affairs (MOLISA),. (2015, February 7). Poverty reduction still has many challenges. Retrieved from http://www.molisa.gov.vn/en/Pages/Detail-news.aspx?IDNews=2169

Mitra, S., Palmer, M., Mont, D., & Groce, N. (2016). Can Households Cope with Health Shocks in Vietnam? *Health Economics (United Kingdom)*, *25*(7), 888–907. https://doi.org/10.1002/hec.3196

Mohanan, M. (2013). Causal effects of health shocks on consumption and debt: Quasi-experimental evidence from bus accident injuries. *Review of Economics and Statistics*, *95*(2), 673–681. https://doi.org/10.1162/REST_a_00262

Morduch, J. (1994). Poverty and Vulnerability. *The American Economic Review*, *84*(2), 221–225. https://doi.org/10.2307/2117833

National Assembly of the Socialist Republic of Vietnam. Vietnamese Law on Health Insurance of 2014 (2014). Government of Vietnam; Hanoi, Vietnam.

Nguyen, G. T. H., White, B., & Ma, C. (2008). When Faced with Income and Asset Shocks, Do Poor Rural Households in Vietnam Smooth Food Consumption or Assets? *The Journal of Development Studies*, *55*(9). https://doi.org/10.1080/00220388.2018.1528350

Nguyen, H., Ivers, R., Jan, S., Martiniuk, A., & Pham, C. (2013). Catastrophic household costs due to injury in Vietnam. *Injury*, *44*(5), 684–690. https://doi.org/10.1016/j.injury.2012.05.006

Nguyen, K. T., Hai Khuat, O. T., Ma, S., Pham, D. C., Hong Khuat, G. T., & Ruger, J. P. (2012). Coping with health care expenses among poor households: Evidence from a rural commune in Vietnam. *Social Science and Medicine*, *74*(5), 724–733. https://doi.org/10.1016/j.socscimed.2011.10.027

O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2008a). Catastrophic Payments for Health Care. In *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation* (pp. 203–212). Washington, DC. https://doi.org/10.1596/978-0-8213-6933-3

O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2008b). Measurement of Living Standards. In *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation* (pp. 69–82). Washington, D.C. Retrieved from http://web.worldbank.org/archive/website01411/WEB/IMAGES/HEALTHEQ.PDF

Pritchett, L. (2000). Quantifying vulnerability to poverty : a proposed measure, applied to Indonesia. (S. Sumarto & A. Suryahadi, Eds.). Washington, DC : World Bank, East Asia and Pacific Region, Environment and Social Development Sector Unit. Retrieved from http://elibrary.worldbank.org/doi/book/10.1596/1813-9450-2437

Sepehri, A. (2014). Does Autonomization of Public Hospitals and Exposure to Market Pressure Complement or Debilitate Social Health Insurance Systems? Evidence from a Low-Income Country. *International Journal of Health Services*, *44*(1), 73–92. https://doi.org/10.2190/HS.44.1.e

Somanathan, A., Dao, H. L., & Tien, T. Van. (2013). *Integrating the Poor into Universal Health Coverage in Vietnam*. World Bank, Washington DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/13315

Somanathan, A., Tandon, A., Dao, H. L., Hurt, K. L., & Fuenzalida-Puelma, H. L. (2014). *Moving towards Universal Health Coverage of Social Health Insurance in Vietnam: Assessment and*

Options.Directions in Development. Washington, D.C.: The World Bank Group. https://doi.org/10.1596/978-1-4648-0261-4

Sparrow, R., de Poel, E. Van, Hadiwidjaja, G., Yumna, A., Warda, N., & Suryahadi, A. (2014). Coping with the Economic Consequences of ill Health in Indonesia. *Health Economics*, *23*(6), 719–728. https://doi.org/10.1002/hec.2945

Teo, H. S., Bales, S., Bredenkamp, C., & Cain, J. S. (2019). *The Future of Health Financing in Vietnam: Ensuring Sufficiency, Efficiency, and Sustainability*. New York.

Thanh, N. X., Hang, H. M., Chuc, N. T. K., Rudholm, N., Emmelin, A., & Lindholm, L. (2006). Does "the injury poverty trap" exist?: A longitudinal study in Bavi, Vietnam. *Health Policy*, *78*(2), 249–257. https://doi.org/https://doi.org/10.1016/j.healthpol.2005.10.003

Vian, T., Brinkerhoff, D. W., Feeley, F. G., Salomon, M., & Vien, N. T. K. (2012). Confronting corruption in the health sector in vietnam: Patterns and prospects. *Public Administration and Development*, *32*(1), 49–63. https://doi.org/10.1002/pad.1607

Vietnam Ministry of Health, Institute, H. S. and P., Bank, W., & Organization, W. H. (2011). *Lessons for Hospital Autonomy: Implementation in Vietnam from International Experience*. Washington, DC: World Bank, Washington, DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/27800

Wagstaff, A. (2005). *The Economic Consequences of Health Shocks*. *Policy Research Working Paper*. Washington, DC: The World Bank.

Wagstaff, A. (2007). The economic consequences of health shocks: Evidence from Vietnam. *Journal of Health Economics*, *26*(1), 82–100. https://doi.org/https://doi.org/10.1016/j.jhealeco.2006.07.001

World Health Organization. (2020). Global Health Expenditure Database. Retrieved from http://apps.who.int/nha/database/ViewData/Indicators/en

Zimmerman, F. J., & Carter, M. R. (2003). Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints. *Journal of Development Economics*, *71*, 233–260. https://doi.org/10.1016/S0304-3878(03)00028-2

Alam, K., & Mahal, A. (2014). Economic impacts of health shocks on households in low and middle income countries: a review of the literature. *Globalization and Health*, *10*(1), 21. https://doi.org/10.1186/1744-8603-10-21

Barroy, H., Jarawan, E., & Bales, S. (2014). *Vietnam - Universal health coverage for inclusive and sustainable development : country summary report*. Retrieved from http://documents.worldbank.org/curated/en/827041468329937967/Vietnam-Universal-health-coverage-for-inclusive-and-sustainable-development-country-summary-report

Berman, P., Ahuja, R., & Bhandari, L. (2010). The Impoverishing Effect of Healthcare Payments in India: New Methodology and Findings. *Economic and Political Weekly*, *XLV*(16), 65–71. https://doi.org/10.2307/25664359

Brown, C., Calvi, R., & Penglase, J. (2018). Sharing the Pie: Undernutrition, Intra-Household Allocation, and Poverty. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3199129

Brown, C., Ravallion, M., & van de Walle, D. (2017). *Are Poor Individuals Mainly Found in Poor Households? Evidence Using Nutrition Data for Africa*. The World Bank. https://doi.org/10.1596/1813-9450-8001

Carter, M. R., & Lybbert, T. J. (2012). Consumption versus asset smoothing: Testing the implications of poverty trap theory in Burkina Faso. *Journal of Development Economics*, *99*(2), 255–264. https://doi.org/10.1016/j.jdeveco.2012.02.003

Currie, J., & Madrian, B. C. (1999). Health, health insurance and the labor market. In O. Ashenfelter, R. Layard, & D. Card (Eds.), *Handbook of Labor Economics* (Vol. 3, Part C, pp. 3309–3416). Elsevier. Retrieved from https://econpapers.repec.org/bookchap/eeelabchp/3-50.htm

Dercon, S. (2005). Risk, Insurance, and Poverty: a Review. In S. Dercon (Ed.), *Insurance against Poverty* (pp. 9–37). New York : Oxford University Press .

Dercon, S., & Krishnan, P. (2000). In Sickness and in Health : Risk Sharing within Households in Rural Ethiopia. *Journal of Political Economy*, *108*(4), 688–727.

Doorslaer, E. Van, Donnell, O. O., Rannan-eliya, R. P., Herrin, A. N., Lee, T., Leung, G. M., & Lu, J. R. (2005). *Paying Out-Of-Pocket for Health Care in Asia : Catastrophic and Poverty Impact* (No. 2).

Dutta, I., Foster, J., & Mishra, A. (2011). On measuring vulnerability to poverty. *Social Choice and Welfare*, *37*(4), 743–761. https://doi.org/10.1007/s00355-011-0570-1

Fafchamps, M. (1999). *Rural Poverty, Risk and Development*. Oxford. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.95.7536&rep=rep1&type=pdf

Fiszbein, A., & Schady, N. (2009). *Conditional Cash Transfers: Reducing Present and Future Poverty*. Washington, D.C.: The World Bank Group.

Flores, G., Krishnakumar, J., O'Donnell, O., & Van Doorslaer, E. (2008). Coping with Health-Care Costs: Implications for the Measurement of Catastrophic Expenditures and Poverty. *Health Economics*, *17*, 1393–1412. https://doi.org/10.1002/hec.1338

Foster, J., Greer, J., & Thorbecke, E. (1984). A Class of Decomposable Poverty Measures. *Econometrica*, *52*(3), 761–766. Retrieved from https://oied.ncsu.edu/selc/wp-content/uploads/2013/03/A-Class-of-Decomposable-Poverty-Measures.pdf

Genoni, M. E. (2012). Health Shocks and Consumption Smoothing: Evidence from Indonesia. *Economic Development and Cultural Change*, *60*(3), 475–506. https://doi.org/10.1086/664019

Gertler, P., & Gruber, J. (2002). Insuring Consumption Against Illness. *Am Econ Rev*, *92*(1), 51–70.

Goldstein, M. (1999). Chop time, no friends: Intrahousehold and individual insurance mechanisms in Southern Ghana. *University of California at Berkeley, Department of Agricultural and Resource Economics*, 1–59. Retrieved from http://aida.econ.yale.edu/~cru2/pdf/insurancev2.pdf

Haddad, L., Hoddinott, J., & Alderman, H. (1997). *Intrahousehold Resource Allocation in Developing Countries: Methods, Models, and Policy*. *IFPRI*. Baltimore and London: Johns Hopkins University Press. https://doi.org/10.1016/S0306-9192(98)00011-6

Hang, H. M., Byass, P., & Svanström, L. (2004). Incidence and seasonal variation of injury in rural Vietnam: a community-based survey. *Safety Science*, *42*(8), 691–701. https://doi.org/10.1016/J.SSCI.2003.12.001

Hasegawa, M. (2017). Risk-Coping Measures against Health Shocks during the Process of Penetration of Health Insurance in Vietnam. *Asian Economic Journal*, *31*(2), 139–164. https://doi.org/10.1111/asej.12118

Islam, A., & Maitra, P. (2012). Health shocks and consumption smoothing in rural households: Does microcredit have a role to play? *Journal of Development Economics*, *97*(2), 232–243. https://doi.org/https://doi.org/10.1016/j.jdeveco.2011.05.003

Jalan, J., & Ravallion, M. (1999). Are the poor less well insured? Evidence on vulnerability to income risk in rural China. *Journal of Development Economics*, *58*(1), 61–81. Retrieved from https://econpapers.repec.org/RePEc:eee:deveco:v:58:y:1999:i:1:p:61-81

Krishna, A. (2010). *One illness away : why people become poor and how they escape poverty*. Oxford

University Press.

Leive, A., & Xu, K. (2008). Coping with out-of-pocket health payments: Empirical evidence from 15 African countries. *Bulletin of the World Health Organization*, *86*(11), 849–856. https://doi.org/10.2471/BLT.07.049403

Lieberman, S., & Wagstaff, A. (2009). *Health financing and delivery in Vietnam: looking forward*. Washington, DC. Retrieved from http://documents.worldbank.org/curated/en/295021468124767254/Health-financing-and-delivery-in-Vietnam-looking-forward

Ministry of Labor, Invalids and Social Affairs (MOLISA),. (2015, February 7). Poverty reduction still has many challenges. Retrieved from http://www.molisa.gov.vn/en/Pages/Detail-news.aspx?IDNews=2169

Mitra, S., Palmer, M., Mont, D., & Groce, N. (2016). Can Households Cope with Health Shocks in Vietnam? *Health Economics (United Kingdom)*, *25*(7), 888–907. https://doi.org/10.1002/hec.3196

Mohanan, M. (2013). Causal effects of health shocks on consumption and debt: Quasi-experimental evidence from bus accident injuries. *Review of Economics and Statistics*, *95*(2), 673–681. https://doi.org/10.1162/REST_a_00262

Morduch, J. (1994). Poverty and Vulnerability. *The American Economic Review*, *84*(2), 221–225. https://doi.org/10.2307/2117833

National Assembly of the Socialist Republic of Vietnam. Vietnamese Law on Health Insurance of 2014 (2014). Government of Vietnam; Hanoi, Vietnam.

Nguyen, G. T. H., White, B., & Ma, C. (2008). When Faced with Income and Asset Shocks, Do Poor Rural Households in Vietnam Smooth Food Consumption or Assets? *The Journal of Development Studies*, *55*(9). https://doi.org/10.1080/00220388.2018.1528350

Nguyen, H., Ivers, R., Jan, S., Martiniuk, A., & Pham, C. (2013). Catastrophic household costs due to injury in Vietnam. *Injury*, *44*(5), 684–690. https://doi.org/10.1016/j.injury.2012.05.006

Nguyen, K. T., Hai Khuat, O. T., Ma, S., Pham, D. C., Hong Khuat, G. T., & Ruger, J. P. (2012). Coping with health care expenses among poor households: Evidence from a rural commune in Vietnam. *Social Science and Medicine*, *74*(5), 724–733. https://doi.org/10.1016/j.socscimed.2011.10.027

O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2008a). Catastrophic Payments for Health Care. In *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation* (pp. 203–212). Washington, DC. https://doi.org/10.1596/978-0-8213-6933-3

O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2008b). Measurement of Living Standards. In *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation* (pp. 69–82). Washington, D.C. Retrieved from http://web.worldbank.org/archive/website01411/WEB/IMAGES/HEALTHEQ.PDF

Pritchett, L. (2000). Quantifying vulnerability to poverty : a proposed measure, applied to Indonesia. (S. Sumarto & A. Suryahadi, Eds.). Washington, DC : World Bank, East Asia and Pacific Region, Environment and Social Development Sector Unit. Retrieved from http://elibrary.worldbank.org/doi/book/10.1596/1813-9450-2437

Sepehri, A. (2014). Does Autonomization of Public Hospitals and Exposure to Market Pressure Complement or Debilitate Social Health Insurance Systems? Evidence from a Low-Income Country. *International Journal of Health Services*, *44*(1), 73–92. https://doi.org/10.2190/HS.44.1.e

Somanathan, A., Dao, H. L., & Tien, T. Van. (2013). *Integrating the Poor into Universal Health Coverage in Vietnam*. World Bank, Washington DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/13315

Somanathan, A., Tandon, A., Dao, H. L., Hurt, K. L., & Fuenzalida-Puelma, H. L. (2014). *Moving towards Universal Health Coverage of Social Health Insurance in Vietnam: Assessment and Options.Directions in Development.* Washington, D.C.: The World Bank Group. https://doi.org/10.1596/978-1-4648-0261-4

Sparrow, R., de Poel, E. Van, Hadiwidjaja, G., Yumna, A., Warda, N., & Suryahadi, A. (2014). Coping with the Economic Consequences of ill Health in Indonesia. *Health Economics*, *23*(6), 719–728. https://doi.org/10.1002/hec.2945

Teo, H. S., Bales, S., Bredenkamp, C., & Cain, J. S. (2019). *The Future of Health Financing in Vietnam: Ensuring Sufficiency, Efficiency, and Sustainability*. New York.

Thanh, N. X., Hang, H. M., Chuc, N. T. K., Rudholm, N., Emmelin, A., & Lindholm, L. (2006). Does "the injury poverty trap" exist?: A longitudinal study in Bavi, Vietnam. *Health Policy*, *78*(2), 249–257. https://doi.org/https://doi.org/10.1016/j.healthpol.2005.10.003

Vian, T., Brinkerhoff, D. W., Feeley, F. G., Salomon, M., & Vien, N. T. K. (2012). Confronting corruption in the health sector in vietnam: Patterns and prospects. *Public Administration and Development*, *32*(1), 49–63. https://doi.org/10.1002/pad.1607

Vietnam Ministry of Health, Institute, H. S. and P., Bank, W., & Organization, W. H. (2011). *Lessons for Hospital Autonomy: Implementation in Vietnam from International Experience*. Washington, DC: World Bank, Washington, DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/27800

Wagstaff, A. (2005). *The Economic Consequences of Health Shocks*. *Policy Research Working Paper*. Washington, DC: The World Bank.

Wagstaff, A. (2007). The economic consequences of health shocks: Evidence from Vietnam. *Journal of Health Economics*, *26*(1), 82–100. https://doi.org/https://doi.org/10.1016/j.jhealeco.2006.07.001

World Health Organization. (2020). Global Health Expenditure Database. Retrieved from http://apps.who.int/nha/database/ViewData/Indicators/en

Zimmerman, F. J., & Carter, M. R. (2003). Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints. *Journal of Development Economics*, *71*, 233–260. https://doi.org/10.1016/S0304-3878(03)00028-2

Paper 1: The Types and Timing of Financial Coping Mechanism Use: The Interplay among Individual Factors, Household Characteristics, and Health Financing

Introduction

Risk protection against the economic impacts of health shocks is measured in a population along three different dimensions: population coverage, or the proportion of a population which has access to formal financial protection against the costs of health services; service coverage, or the number and type of different health services which are covered; and financial coverage, the amount of direct medical costs which are covered by formal financial protection programs. (WHO, 2015) Health financing systems must balance coverage amongst all three dimensions within the available fiscal space.

Where there are gaps in coverage, a household may fall into a gap in population coverage and not be covered at all; a gap in service coverage, where some but not all of health services needed or utilized may be covered; or a gap in financial coverage, where there is cost-sharing between formal financial protection programs and the household for services. Households which experience one or more of these gaps – who are uninsured or underinsured – may protect against the economic impact of a health shock by employing various financial and non-financial coping mechanisms. These can include strategies to increase income, through borrowing money with or without interest, selling productive or non-productive assets, dissaving, labor substitution, and/or seeking support from government, non-governmental/charitable institutions. Households may also employ strategies to decrease expenditure through forgoing medical care, reducing consumption, or changing consumption patterns.

The family is historically the first source of risk protection and risk pooling, and in societies with underdeveloped social protection systems, the family or household continues to serve as the primary source of risk protection. In more developed societies, formal social protections displace the family role in coping and responding to shocks. (Strauss & Thomas, 1995) While the household may serve as the first source of risk protection, it does not necessarily serve all members equally. (Duflo & Udry, 2004) The consequences of a health shock to a household are not necessarily borne equally by all members. In times of crisis, particular individuals or types of individuals may bear the majority of the welfare costs on behalf of households. The ability and willingness of the household to leverage coping mechanisms, or the choice of coping mechanism, may depend on the form of intrahousehold risk-sharing, resulting in differential financial protection or even health outcomes.

The form of intrahousehold risk-sharing and the choice of coping strategy by the household may be understood using an ecological systems lens, with factors related to the individual patient, the household, the larger health financing policy context, and interactions amongst these three levels. Studies examining the interactions amongst individual characteristics, household socioeconomic status, and risk protection policy environment have largely focused on the role of patient sex, looking at how in the absence of insurance or complete insurance, the type of risk-sharing or the group with whom risk is shared may be different by patient characteristics. One study in Pakistan found that the choice of provider type and the delays in seeking health care for children were differential by sex, with male patients receiving care at perceived higher quality providers and having smaller delays between event and receipt of care. (Haddad, Hoddinott, & Alderman, 1997) The authors also found that intrahousehold inequalities disappeared among higher income households; this larger income elasticity for the health of daughters indicates that within lower income households, which face a more severe budget constraint, some individuals face two forms of inequality, both between and within households. Another study in Ghana found that when a man experiences a realized risk that has the potential to reduce consumption in the household, other members of the household reduce their consumption and/or engage in labor substitution, particularly women. However, when a woman undergoes the same experience, she shares the risk with non-familial women in her social network and the men in the household generally do not share in consumption reduction or engage in labor substitution. (Goldstein, 1999) A final study in Ethiopia found that when any member of the household experiences a health shock, women were more likely to experience a decrease in food consumption than other household members. (Dercon & Krishnan, 2000)

However, these choices need not be based only on the social position or demographics of the patient. Households may choose to share risk and make choices about coping strategies based on a range of patient characteristics, the nature of the health shock, and household socioeconomic status. Patient-related factors may include the patient's demographic characteristics, such as age, sex, or marital status; the patient's productive role within the household, such as occupation or the proportion of total household income which is earned or produced by the patient; the patient's health insurance status; and the nature of the health shock, such as injury cause, severity, and ongoing physical limitations or resulting disability. Household-related factors may include residence in a rural or urban area; socioeconomic status; and household size and composition, including dependency ratio. These may interact with the larger health financing policy context, particularly in a context like Vietnam where the history of incremental policy changes and the differential access to subsidized health insurance premiums have left socioeconomic and demographic patterns among the uninsured. Households may make different choices about coping strategies based on immutable characteristics of the patient, the household's financial dependency on the patient, the pre-injury economic status of the household, post-injury change in economic status, and/or features of the health shock itself, in this case the injury, with insurance coverage playing a moderating role in these choices.

While anti-poverty programs may attempt to influence the household characteristic of socioeconomic status, and conditional cash transfer programs may attempt to influence static intrahousehold *resource* sharing, the design of a social protection programs such as health insurance can be used to influence or modify patterns of intrahousehold *risk* sharing. Such patterns of intrahousehold risk sharing are not universal; they may vary by geographic region, policy context, or socioeconomic status. The influence of and interactions amongst individual, household, and health financing policy context on household choice of coping strategy and the distribution of risk following a shock is as yet unstudied in Vietnam.

An injury is a unique health shock, in that it is idiosyncratic, i.e. experienced by a single individual within their household and community context. An injury is also, by definition, sudden, and frequently unexpected, and therefore precludes the possibility that the household can financially plan for it – the way that a household can plan for a pregnancy, or for a slowly developing and ongoing chronic illness. Households can only plan for an injury in the general way that households in an environment of incomplete risk protection can manage and plan to cope with risk.

This paper uses descriptive analysis to explore the patterns of coping strategies households employ in the year following a health shock, using an injury as a sudden, idiosyncratic health shock which sets a time origin for household decision-making. Logistic mixed methods regression modeling is used to explore the factors associated with hardship financing in particular, including individual, household, and having health insurance, and the nature of the relationships among them. In particular, this paper attempts to answer whether in Vietnam, access to insurance influences that nature of intrahousehold risk sharing, particularly when coping with risk may entail maladaptive coping mechanisms, such as foregoing health care, borrowing money, and selling assets.

Methods

a. Variable definitions

Outcomes and independent variables were derived from the HEALS cohort data, and defined using prevailing definitions in existing academic and gray literature; the distribution of responses; the available measurement in the dataset; and, for independent variables, observed relationships between parameterizations and the outcomes of interest.

i. Outcomes: Coping Mechanisms and Hardship Financing

Coping mechanisms evaluated during hospitalization and over the year of follow up included borrowing money, selling assets, spending savings, and hardship financing. These coping mechanisms are measured with differing levels of detail at baseline and the four follow-ups. At baseline, households are asked if they had borrowed money during their hospitalization as a result of their injury, and were asked as a single question if they had sold assets or spent savings during the same time period and for the same reason. Asset sale and dissaving are therefore collapsed into a single outcome at baseline. The follow-up surveys provide greater detail on from who the household borrowed, how much money was borrowed, and the type of asset sold. This allows for additional classification of borrowing and asset sale into borrowing with and without interest and sale of productive and non-productive assets, using some assumptions. The type of asset sold was provided in response to an open-ended question and then classified as farmland/paddy; crops; animals or livestock; household items; or transportation/equipment. Source of borrowed money is classified as from parents or relatives; friends or neighbors; landlord; employer; a bank; or another specified source. Borrowing from a bank can be safely assumed to be with interest.

Hardship financing was defined as selling productive assets, borrowing money with interest, or both. (Amponsah, 2016; Binnendijk, Koren, & Dror, 2012; Flores, Krishnakumar, O'Donnell, & Van Doorslaer, 2008; Kruk, Goldmann, & Galea, 2009) Productive assets were considered to be those assets which can serve to produce income or material goods for home use, including farm equipment, livestock, land, and means of transportation. Non-productive assets were goods that did not carry a productive use to earn income in a following time period, such as a television set, jewelry, furniture, or farm produce. Borrowing with interest was defined as borrowing from one's landlord, employer, or a bank, whereas borrowing from parents and friends was deemed to be borrowing without interest, based on inputs from key informants in Vietnam. Non-interest bearing loans were considered to be exercising participation in an informal insurance network, and the sale of non-productive assets were considered a form of dissaving. (Dercon, 2005) As the type of asset sold and from who the household borrowed was not collected at baseline, but was collected at each of the four follow-ups, hardship financing is only defined after hospital discharge.

ii. Demographics

Patients self-reported at baseline their sex, date of birth, occupation, marital status, highest level of education completed, and whether they lived in an urban or rural area. Sex was classified into either male or female. Age was defined as age in completed years on the date of the patient's injury, taken as the difference between date of injury and date of birth. Age categories were developed using international guidelines to represent stages of family formation and household composition, classifying individuals 25-64 years into 10-year age groups, with patients under 25 (18-25 years) classified together. (Department of International and Social Affairs Statistical Office, 1982) Respondents reported their occupation as either a farmer, civil servant, a semi-government employee, private employee, self-employed, student, homemaker, retired, or unemployed for a health or other reason. Formal occupations were defined as civil servants, semi-government employees, and private employees, while farmers and the self-employed were classified as being a part of the informal sector, following guidance from the International Labour Organization. (International Labour Organization (ILO), 1993) Students, homemakers, and individuals who were retired or unemployed were not included in either definition of the wage labor force. Marital status was self-reported as single, married, widowed, divorced, or separated. Respondents reported whether they had completed some primary school, all of primary school, secondary school, various types of higher education (technical, college, graduate, or professional education), or had no formal education. As there were limited numbers of patients who had completed more than high school, all levels of higher education were grouped together, and all those who had complete primary education or less were also grouped together.

Household size was self-reported at baseline and the four follow-ups, while household composition in terms of the number of working age adults, children under 18, and individuals over 60 under was self-reported during the four follow-up interviews. The child dependency ratio was defined as ratio of the number of children to the number of adults within the household. The number of children at baseline was imputed as the number of children captured at one month following discharge, after assessing for stability in the number of children within households over follow-ups using descriptive analysis, and under the assumption that changes in household composition following injury would not involve sending children away from the household or inviting new children into the household within just one month after hospital discharge; this assumption was deemed reasonable as changes in labor supply and education participation by children, rather than changes in the number of children, is more commonly found in the literature. (Alam & Mahal, 2014)

iii. Health Insurance Status

Patients self-reported whether they had insurance and what form of insurance, including all types of insurance which existed in Vietnam in 2015, prior to health insurance reform, or an alternate form. These included being uninsured; receiving a full or a partial subsidy from the Vietnamese government;

student insurance; personal voluntary insurance; other types of voluntary insurance; a write-in category; or more than one form of the above.

Patients were also asked to report whether they had received any insurance reimbursement, both during hospitalization and following hospital discharge. Individuals who reported themselves to be uninsured yet received insurance reimbursement were reclassified as insured at baseline, but those individuals who reported themselves insured yet did not receive insurance reimbursement were not reclassified, as it is possible to be formally insured and yet not be covered, but it is not possible to be formally uninsured and obtain coverage.

iv. Direct Medical and Non-Medical Costs

Direct medical costs during hospitalization, disaggregated by service type, were obtained by surveyors from the patient's bills or medical charts just prior to discharge, rather than relying on self-report. However, at follow-up surveys, patients self-reported their direct medical costs since the last interview attributable to the injury, as patients could not be expected to retain bills for several weeks to months in between interviews. Direct medical costs also included self-reported expenditure on medical equipment and over-the-counter medicines which did not appear on patients' medical bills, both prior to and following discharge. The amount of coverage by insurance was also similarly collected, with the amount of insurance coverage during hospitalization, again disaggregated by service type, obtained from bills or medical charts, and insurance coverage for any medical services post-discharge recorded through patient self-report. Out-of-pocket direct medical costs were taken as the difference between direct medical costs incurred and the amount of insurance coverage at each of the five interviews, with the percentage of monthly household income spend on direct medical care calculated using out-of-pocket costs as a percentage of post-injury monthly income. This percentage was then parameterized as a categorical variable due to observed relationships between direct medical costs as a percentage of monthly post-injury income and definitions from literature on catastrophic direct medical costs. (Flores et al., 2008)

Direct non-medical costs were self-reported by patients according to how much they and their household members had spent on transportation, food, and accommodation, and other items. These are not covered by social protection programs in Vietnam and therefore coverage or reimbursement amount was zero for all patients. (The World Bank, 2017)

v. Indirect Costs

In this study, indirect costs are defined and measured as the income losses by patients and household members using a human capital approach. (Drummond, Sculpher, Claxton, Stoddart, & Torrance, 2015) A human capital approach takes the perspective of the patient and household to define opportunity costs attributable to the health state, incorporating not only those productivity losses experienced directly by the patient, but also losses experienced by other members of the household. (Liljas, 1998) Including household members' losses is appropriate, as the patient is embedded within a household unit and the indirect costs borne by household members also affect the welfare of the patient, and both types of costs may be expected to bear directly on a household's choice of strategies to cope with the injury. The losses of paid labor include both lost time otherwise devoted to paid labor and lost productivity per unit of time spent on paid labor. This study measures indirect costs as lost gross income, which avoids parsing the difference between lost time and lost productivity for the patient and household members, as the agents making the decision to employ various coping strategies.

Differences between pre- and post-injury household income may be due to both indirect costs related to the injury and other factors such as seasonal variability in income or changes in work or work hours due to other causes. Therefore, patients were asked to report the amount of income losses by themselves and household members which were attributable to their injury, and to separately report their personal income and their total household income, both during their hospitalization and during the year following hospital discharge. Prior to hospital discharge, patients reported their and their household members' income losses while in hospital, regardless of the length of time in hospital. Patients were then also asked to report lost income in the month prior to the survey at 1, 2, 4, and 12 months following hospital discharge, referring to the time between discharge and one month following; one to two months following discharge; three to four months following discharge; and 11 to 12 months following discharge. The total indirect costs were taken as sum of the lost income or paid productivity of the patient and of household members.

vi. Household Living Standards

Patients' household living standards in this study was measured using income, rather than consumption/expenditure or an asset index, other common options for assessing living standards. Income, particularly for households in the informal sector, is expected to be variable over shorter periods of time, while consumption is smoothed over shorter time periods and may therefore, in the short term, more accurately represent current living standards. (Haughton & Khandker, 2009; Morduch, 1994; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008) An asset index, in contrast to both income and consumption, is intended to measure longer-term standards of living reflected in accumulated wealth. (Filmer & Pritchett, 2001) However, for the purposes of understanding household strategies for coping with the economic impact of an injury in the short- to mid-term, during hospitalization and over the course of the year following discharge, income is preferred to either expenditure measurement or an asset index. Household consumption patterns may reflect expenditures made using both income earned through wages and unearned income gained through borrowing, selling assets, and spending savings. (Flores et al., 2008) Indeed, households are commonly documented to engage in these financial coping strategies as a way to maintain living standards in the face of the loss of or variability in income. (Berman, Ahuja, & Bhandari, 2010; Collins, Morduch, Rutherford, & Ruthven, 2009) Using a measure of longer-term wealth, such as an asset index, would likely conceal shorter-term and less transformational changes in living standards, except for those households which engaged in the sale of assets that might be included in an asset index. In both cases, the measurement of living standards using expenditure or an asset index could be endogenous to the outcomes of interest, financial coping. Although individuals may tend to under-report their income in household surveys, and not all income may be used for consumption, income is independent of these financial coping strategies. (Haughton & Khandker, 2009)

As mentioned, income may be variable over time due to factors separate from the injury, particularly for those households whose members mostly work in the informal sector. (Morduch, 1994) In order to obtain a measure of income prior to the injury which would be independent of such variability, patients were asked to report their own and their household's monthly incomes prior to the injury during the baseline survey. Following discharge, patients were asked to report their own and their household's incomes in the month immediately prior to the survey, in order to capture shorter-term variability in income following the injury. Such income variability was not assumed to be related only to the injury; as mentioned above, patients were separately asked to quantify their own and their household member's income losses attributable to the injury, both during hospitalization and for the month preceding each follow-up interview. If patients did not report their personal or household income, these incomes were imputed using multiple imputation by chained equations, described further below, rather than assuming no underlying variability and calculating income as the difference between average income prior to the injury and the reported losses.

The Ministry of Labor, Invalids, and Social Affairs (MOLISA) classifies households into three categories: poor, near poor, and not poor, according to the household's per capita monthly income and residency in a rural or urban area. The poverty line is set higher for urban households than rural households, and near-poverty defined as being between 100% and 150% of the poverty line. (Demombynes & Vu, 2015)

MOLISA poverty lines are set using a cost-of-basic needs approach every five years, but are not adjusted for inflation in between revisions. Yearly revisions are made through consultation with village-level local officials. However, while these poverty lines are used within country to determine eligibility for a variety of social service and protection programs, including subsidies for health insurance, the poverty line in Vietnam is generally agreed to be low relative to international standards. (Demombynes & Vu, 2015) In 2015, the poverty line was set at 615,000 VND a month for rural areas and 760,000 VND for urban areas, or about I$2.17 and I$2.68 per day respectively. (General Statistics Office, 2016)

Therefore, in order to provide meaningful categorizations, households were classified according to established international poverty lines in international dollars (I$), which use a purchasing power parity conversion. (Jolliffe & Prydz, 2016; World Bank Group, 2020) In order to better capture the wide differences in per capita income observed among the patients in the HEALS cohort, three poverty lines were used: the international poverty line of I$1.90 a day, the lower-middle income country poverty line of I$3.20 a day, and the upper-middle income country poverty line of I$5.50 a day. Poverty lines in Vietnamese Dong (VND) were calculated using a 2011 purchasing power parity conversion, inflated to 2015 prices using domestic consumer price index information. (International Comparison Program, 2018; PovcalNet, n.d.) No adult equivalency or economies of scale factor was used since both the use of these factors, and the choice of values to assign to each, is still a matter of much debate, and is not used by the Vietnamese General Statistics Office, by MOLISA, or by the World Bank, when calculating the poverty headcount in Vietnam. (Demombynes & Vu, 2015; Haughton & Khandker, 2009; H. White & Masset, 2003)

In order to assess whether the decision to engage in different financing coping mechanisms was related to the level of income or to a change in income, patients' households were classified in two ways: first, by the level of daily per capita income they reported, and second, by whether they had been living in that income category prior to the injury or had fallen into that income category following the injury (but not necessarily attributable to the injury alone). This allowed for a comparison between, for example, households whose members were living below I$1.90 a day both before and after the injury and households whose members had been living above that threshold prior to the injury but fell below it following the injury.

Finally, the percent of total household income prior to the injury earned by the patient was used as a measure of the importance of that patient to total household production.

vii. Alternative Coping Mechanisms: Consumption Reduction and Support from Government and Civil Society

Consumption reduction was defined as reductions in food consumption, given the availability of data. During hospitalization, patients were asked to report their average monthly household food expenditure prior to the injury. Patients were also asked at each of the four follow-up interviews whether they knew the amount their household had spent on food in the month prior to the interview, and if so, the amount in Vietnamese Dong. This value was converted to international dollars (I$) using the same method used to calculate the international poverty lines.

Patients also reported whether and what type of support they received from governmental and non-governmental sources, including monetary assistance; health and rehabilitative services, food assistance; childcare; and caretaking or support with daily activities. Patients also reported whether and what type of support they received from governmental and non-governmental sources, including monetary assistance; health and rehabilitative services, food assistance; childcare; and caretaking or support with daily activities.

viii. Injury Characteristics and Self-Reported Functional Limitations

The cause and intentionality of the injury which brought the patient into the hospital were self-reported by the patient during their hospitalization. The cause was classified as an injury due to a road traffic collision, fall, burn, sharp object, blunt object, poisoning, electrocution, suffocation, drowning, an explosion, contact with an animal or insect, or a medical 'accident'. Intent was classified as unintentional, intentional self-harm, or intentional interpersonal violence or assault.

Injury severity was scored using an estimated Injury Severity Score (eISS), an ordinal scale of injury severity ranging from 0 (no injury) to 75 (potentially fatal despite medical care). Severity is judged from the amount of energy needed to inflict the injury, the mortality risk from the injury, the risk for temporary and permanent impairment, and the intensity of required medical intervention to treat the injury. ISS is usually assigned from an examination of medical records. The ISS is not sensitive to how an injury may affect a particular type of patient, as it does not incorporate information about the patient's health, impairment, or frailty prior to the injury; in application, ISS assumes that the patient was in good health prior to the injury and received all necessary medical care. (Segui-Gomez & Lopez-Valdes, 2012) In the absence of medical records, this study calculated an eISS using a combination of information about the location of injuries with assumptions made about severity through examining the nature of those injuries (e.g. contusion; closed or open fracture; crush injury; etc.). (Hung et al., 2017)

Patients were asked during hospitalization to describe their level of functioning or limitation in the 30 days prior to the injury using the 12-item World Health Organization Disability Assessment Schedule, 2.0 (WHODAS). The WHODAS assesses health states across six domains of activity and participation, a dimension of the International Classification of Functioning, Disability, and Health (ICF), and has been found to be reliable and valid; not illness-, injury-, or culturally-specific; appropriate for use with a general adult population and with individuals experiencing a variety of health states; and able to be self-administered or administered by an individual without medical or public health training. (Üstün, Kostanjsek, Chatterji, & Rehm, 2010) The 12-item assessment measures level of difficulty in the 30-day period prior to the interview in the areas of cognition (understanding and communicating); mobility; self-care (eating, dressing, hygiene); interpersonal interactions; life activities (wage work, school, household responsibilities); and community participation. How much difficulty is reported by the patient using a five-item Likert scale with the options of none, mild, moderate, severe, and extreme/cannot do, scored from 0 to 4, respectively. (Üstün et al., 2010) A total score is calculated by summing the values of the individual responses and scaling them to be between 0 and 100% (WHODAS = (sum of item scores/48)%). The WHODAS was repeated at each of the four follow-up interviews, providing comparisons between functioning pre-injury and post-discharge over the year following hospitalization.

While the WHODAS provides an assessment of impairment prior to the injury and in the year following hospital discharge, and the ISS is intended to provide a more objective description of the severity of the injury, neither provides a measure of the patient's own assessment of their level of health and well-being during hospitalization. Prior to discharge and at each follow-up visit, the patient was asked to rate how good or bad they felt on that day on a scale from 0 to 100, using a visual aid. In this study, the Visual Analogue Scale (VAS) provides a comparison of unidimensional, subjective health across all time points, from hospitalization through one, two, four and twelve months following hospital discharge. The VAS is a commonly used tool in clinical practice to assess pain, and while it is measured on a scale of 0 to 100, empirically holds properties of an ordinal scale rather than an interval measure. (Carlsson, 1983)

ix. Time

Participants in the HEALS cohort were admitted into the study on a rolling basis over the course of a year, from January 1, 2015 to December 31, 2015. Participants were interviewed just prior to hospital discharge, and one, two, four, and twelve months following discharge from hospital. For longitudinal analysis, time was parameterized as the five discrete measurement instances, baseline and four follow-ups, as the outcomes of interest were measured by measurement instance rather than calendar time.

b. Data Analysis

Descriptive analysis was used to understand patterns of coping mechanisms that households used over time and by the covariates discussed above; to parameterize important covariates; and to assess assumptions for the choice of modeling strategy. Logistic linear mixed modeling was used to understand the relationships between variables of interest and financial coping mechanisms and to understand predictors of missingness on key variables of interest. The results of the descriptive analysis, as well as further exploratory data analysis, were used to parameterize the mean models built for the financial coping mechanisms of interest: borrowing, dissaving, selling assets, and subsets of these defined as hardship financing. These four logistic longitudinal mixed models were developed assessing for confounding and interactions in a step-wise fashion, with mediation assessed using methods described by Baron and Kenny (1986).

Covariates were grouped into several domains, including patient demographics; household size and financial or child dependency on the patient; injury severity, location, and type, as well as time-variable patient level of functional impairment; insurance status, direct and indirect costs of the injury, and pre-injury and post-injury daily household per capita income; patient return to activities of daily living, return to work, and utilization of medical and rehabilitative services. Given the distinct socioeconomic and demographic patterns left by the incremental approach to achieving population breadth of insurance coverage, insurance status was tested for interactions with many variables to assess whether any effect on financial coping mechanisms might be modified by various socioeconomic and demographic categories.

Each model for borrowing, selling assets, dissaving, and hardship financing was constructed using the four time points after hospital discharge, due to the latter three outcomes being measured only following hospital discharge, and measuring the patient's functional status using the WHODAS; as noted above, the WHODAS was only assessed after hospital discharge. However, unlike other outcomes, borrowing was measured both before and after hospital discharge. A separate logistic model using the cross-sectional data collected during hospitalization was constructed. This was preferred to interacting time with various covariates, as not only did covariate change their relationship with borrowing between hospitalization and the year following discharge, but also different covariates were relevant to borrowing during hospitalization and post-discharge.

i. Descriptive analysis

Descriptive analysis was used to understand the types of coping mechanisms households mobilized during hospitalization and in the year following discharge. The outcomes of interest for descriptive analysis include accessing formal government or non-governmental supports, foregoing medical care, spending savings, taking on debt with or without interest, selling productive or non-productive assets, and reduction in food expenditure. Bivariate and tri-variate descriptive analysis was used to assess the prevalence, timing, and co-occurrence of different coping mechanisms, as well as associations of these coping mechanisms with patient-level characteristics, including demographics, injury characteristics, health care utilization and cost, insurance status, and productive role in the household; and household-level characteristics, including size, dependency ratio, and living standards.

As the effect of insurance on coping mechanisms was of particular interest, associations between continuous variables and insurance status and were evaluated using t-tests and analysis of variance for normally distributed variables and the Wilcoxon Rank-Sum test for non-normally distributed variables. Normality was assessed graphically through normal probability (quantile-quantile) plots and histograms plotted against normal distributions, as well as through the Shapiro-Wilk test for normality. Associations between binary variables and insurance status were assessed using two-sample tests of proportions, and associations between categorical variables and insurance status were assessed using chi-squared tests of independence.

ii. Temporal Patterns in Rolling Cohort Admission

Households were asked prior to hospital discharge and at each follow-up interview whether and how much income they and their household members had lost due to the injury. We relied on households parsing the difference between income losses due to usual fluctuations and income losses attributable to the injury in their responses. However, as patients in the informal sector were more likely to have variable income, we did assess whether there was any temporal pattern in hospital discharge – the time origin for the study – by patient formality of occupation. As income may exhibit seasonal variation, particularly for informal occupations, a multiple logistic regression of patient formality of occupation was modeled on patient demographics, including sex, age category, occupation, marital status, rural or urban residence, and level of education; injury cause and intentionality; patient pre-injury self-reported disability level; whether the patient was uninsured; household living standards; and discharge week, using a flexible function of discharge time. The coefficients for time were then examined for significant relationship with formality of occupation, and the predicted adjusted probabilities were plotted against time. As seasonal variation may be particularly high for patients whose main occupation is in agriculture, a multiple logistic regression was conducted for whether the patient was a farmer versus had another occupation, controlling for the same set of covariates, except occupation. Again, temporal association was checked through hypothesis testing of the coefficients for time, and a plot of predicted adjusted probabilities against time was reviewed. Similarly, a multiple linear regression of household daily per capita income was conducted, using the same set of independent variables (omitting household living standards and including occupation), again using a combination of hypothesis tests and a review plot of predicted adjusted means against time to assess for any association.

Finally, in order to assess whether there was progressive implementation of the insurance mandate over time, temporal trends in insurance status were assessed by fitting a logistic model for being uninsured on the same set of covariates, excluding insurance status. As with the other analyses for temporal trends, the coefficients for time were then examined for significant relationship with the patient's insurance status, and the predicted adjusted probabilities were plotted against week of the patient's hospital discharge.

iii. Multiple Imputation by Chained Equations for Independent Variables

Descriptive and graphical analysis was used to understand the extent of missing observations and to define patterns of missing follow-ups as monotonic (drop-out) or non-monotonic (intermittent). As it was possible for a patient to complete a survey at a particular time point, but yet to have missing values on several independent variables, descriptive analysis was also used to understand the extent of missingness of independent variables within the existing data. Whole-wave missingness is treated differently than within-wave missingness by most statistical software; the statistical software used for these analyses (Stata 15) uses complete case analysis for within-wave missingness. (Young & Johnson, 2015) Descriptive analysis of missing data among independent variables examined patterns over time, by other independent variables in the dataset, and, for follow-up observations, by lagged values of the time-varying independent variables.

Since the results of these analyses showed that missingness of independent variables after baseline was both covariate- and lagged-value dependent, the available data could not be said to be missing completely at random (MCAR) (i.e. a random subset of all data, both observed and unobserved), making an analysis restricted to the complete cases subject to potential bias. (Fitzmaurice, Laird, & Ware, 2011c)

As these analyses also showed that overall missingness and independent variable missingness included non-monotonic patterns, an iterative imputation procedure was required. Multiple imputation by chained equations (MICE) is an iterative multiple imputation procedure appropriate for intermittent missing data patterns where the variables to be imputed do not follow a multivariate normal distribution. (Fitzmaurice, Laird, & Ware, 2011b)

MICE involves the sequential, iterative, univariate imputation of missing variables, incorporating many of the same features as multiple imputation (MI). The first step in MI is to develop a model of a variable that has missingness at a particular moment in time as a function of other variables at that moment in time and across time, as well as that of same variable across time. This model is used to predict a conditional mean for the variable of interest and developing a residual distribution for that conditional mean with a particular variance. Since an imputation made singly using the predicted conditional mean would reduce variability in the data, potentially increasing the chance of committing a Type I error, multiple imputation incorporates uncertainly by randomly drawing a value of a residual from the conditional distribution of the missing variable – in effect, randomly selecting a value for an error term from the distribution of residuals and adding it to the predicted value of the missing variable. However, since the parameters in the model predicting the variable which has missingness and which were used to impute missing values are themselves estimated, they should not be treated deterministically. The uncertainty around the parameter estimates and the variance of the residual distribution in an imputation model are therefore themselves randomly perturbed in each imputation. This results in multiple copies of the dataset, each with slightly different imputed missing values. An analysis procedure is then performed on each copy of the dataset separately, to avoid inflating the overall sample size, and the parameter estimates are then averaged together.

Building on MI, MICE requires the specification of a separate imputation model regressing the variable with missing data at a particular observation period onto both prior and future observations of that variable as well as other variables which are related to the value of the missing variable or the fact of its missingness. Using both other variables and the entire vector of values of the variable over time as predictors, separate imputation regression models are developed for missing values at each time period. The first regression model estimated, which is at one particular time point, uses only the observed data, but all subsequent models for other time points use both observed and imputed data to develop parameter estimates. After each regression model to impute missing values for the variable of interest has been estimated at each time point, the cycle is repeated using the observed and imputed values of the variable. Across cycles, the parameter estimates and residual variance are randomly perturbed, as mentioned above. When the parameter estimates for the series of chained equations stabilize, after multiple "burn-in" cycles, then imputation of missing values begins. For the sake of simplicity, the following illustration uses three time points instead of five as exists in this study:

Let:

- Z_{ij} be the values of a variable for patient *i* at time *j*.
- Z_{ij}^{M} refer to missing but imputed values of that variable, and Z_{ij}^{O} refer to observed values
- X_{ij} indicate other variables which are related to values of Z_{ij} and/or to the fact of missingness itself
- *j take on three values: 1, 2, 3*
- Z_{i2} have the least missingness of each time point

The series of equations to be estimated, in order:

1. $f(Z_{i2} \mid Z_{i1}^{O}, Z_{i3}^{O}, X_{ij})$, based only on the observed data, and including data that preceded and followed the time period
2. $f(Z_{i1} \mid Z_{i2}^{O+I}, Z_{i3}^{O}, X_{ij})$, based on observed and imputed values of Z_{i2}, and observed values of Z_{i3}, which has yet to be imputed
3. $f(Z_{i3} \mid Z_{i1}^{O+I}, Z_{i2}^{O+I}, X_{ij})$, based on observed and imputed values of Z_{ij} at other time points
4. $f(Z_{i2} \mid Z_{i1}^{O+I}, Z_{i3}^{O+I}, X_{ij})$, in which the cycle of estimating these chained equations begins to repeat
5. etc.

Prior to each imputation, 20 “burn-in” cycles were run and trace plots examined for stability and lack of any trend. Overall, 50 imputed datasets were created in order to ensure both statistical efficiency and reproducibility of standard errors with complex longitudinal models. (Royston & White, 2011; Von Hippel, n.d.; I. R. White, Daniel, & Royston, 2010; I. R. White, Royston, & Wood, 2011) The sensitivity of longitudinal regression results to the imputation models was tested using two variations of the imputation model. The final specifications were found to be appropriate, and regression results were not highly sensitive (defined as <10% difference in coefficients) to the differences in MICE model specification.

In the baseline data, there were four variables which were incomplete and which were multiply imputed: age (1 missing observation), household income prior to the injury (49 missing observations), the percent of household income earned by the patient prior to injury (79 missing observations), and pre-hospital medical care (56 observations). In the follow-up data, only household income was imputed. Household income, both before and after the injury, and age were imputed using linear regression; the percent of household income earned by the patient prior to injury was imputed using multivariable ordinal logistic regression; and pre-hospital medical care was imputed using multivariable logistic regression.

Imputations used demographics (age category, sex, occupation, rural or urban residence, level of education, marital status, and household size); insurance status; health care usage (the patient’s status at discharge, and whether the patient received medical interventions prior to hospitalization); economic status and dependency prior to the injury (household income categorization prior to the injury and the percent of household income earned by the patient prior to injury) and injury-related variables (self-reported functional impairment prior to injury as measured by WHODAS, injury cause, and injury severity). Pre-hospital medical care was also imputed using the department of admission, the source of hospital referral (self- or provider-referred), and the patient's Glasgow Coma Scale at arrival. While there were also four patients who were missing an injury severity score, ISS could not be predicted from the available data, and so was not imputed.

For food consumption, the extent of missingness was greater than 50% at each time period, which we judged to be too extensive for any multiple imputation procedure. (Allison, 2002; Jakobsen, Gluud, Wetterslev, & Winkel, 2017; Madley-dowd, Hughes, Tilling, & Heron, 2019) Food consumption missingness was mostly invariable over the study period, making longitudinal analysis of factors associated with missingness over time not possible. Therefore, to evaluate the factors predicting missingness of food consumption data, a logistic model was constructed using data at the first follow-up after discharge.

iv. Longitudinal Mixed Modeling

A logistic mixed model accounts for baseline heterogeneity amongst households to engage in financial coping mechanisms, and the use of a random intercept accounts for and defines the within-subject correlation in responses over time. The association amongst the outcomes from a single individual arise from having shared random effect in linear mixed models. (Fitzmaurice, Laird, & Ware, 2011a) The use of a mixed model is indicated due to the unbalanced nature of the data, both in design and implementation. The data collection instances in this study were not designed to be equally spaced, but were intended to occur at hospital discharge and 1, 2, 4, and 12 months following discharge. However, follow-ups for many respondents actually occurred more than two weeks before or after each scheduled follow-up time. Additionally, there is further imbalance in the number of measurements per person, as the dataset shows some loss to follow-up as well as various patterns of intermittent, or non-monotonic, missingness; a little less than 30% of the respondents are missing one or more of the four follow-up surveys, with a little under 5% of the data having a non-monotonic missing data pattern. Mixed models use likelihood-based estimation procedures, which allow for a less stringent assumption about the process that caused missing data; namely that data are missing at random (MAR), meaning that missingness may be informed by covariates and by previous outcomes. Other estimating procedures for longitudinal data analysis require that data be missing completely at random (MCAR), i.e. that missingness is potentially dependent on the covariates alone. (Fitzmaurice et al., 2011a)

Finally, a key feature of the conceptual framework is that the ability to leverage financial coping mechanisms may depend on previous leveraging: an individual may not endlessly borrow money and the availability of savings and assets to sell have a limit. Alternatively, engaging in these financial coping mechanisms in previous periods may alleviate the need to engage in those financial coping mechanisms in the future. However, marginal models for longitudinal data require the assumption that the response depends only on the independent variables, not on previous outcomes. Given that the responses at one period of time are hypothesized to depend on previous responses, (as is explored in Chapter 3), a marginal approach is not appropriate, and a mixed effects model is required. In a mixed model, by contrast, the outcomes are conditional only on covariates and on the random effect, avoiding the assumption that current responses are independent of previous responses.

An example of a model to test for whether the odds of borrowing varies by baseline economic variables is below. Categories of covariates are represented together in this model only for brevity (i.e. “demographics” rather than marital status, age, sex, etc., separately, and “injury” rather than injury mechanism and severity). For outcomes which are only measured during the four follow-up surveys, baseline use of financial coping mechanisms would be included as a covariate, and time adjusted to include values only from 1 to 4 (follow-ups at 1 month to 12 months following hospital discharge, value 0).

$$log\left(\frac{\Pr(borrowing_{ij}=1|b_{0i},time_{ij,}X_i,X_{ij})}{\Pr(borrowing_{ij}=0|b_{0i},time_{ij,}X_i,X_{ij})}\right) = (\beta_0 + b_{0i}) + \beta_1 time_{i1} + \beta_2 time_{i2} + \beta_3 time_{i3} + \beta_4 time_{i4} + \beta_5 demographics_i + \beta_6 injury_i + \beta_7 baseline\ economic\ variables_i + \beta_8 disability_{ij} + \beta_9 time\ varying\ coping\ mechanism_{ij} + \beta_{10} time_{i1} \cdot baseline\ economic\ variables_i + \beta_{11} time_{i2} \cdot baseline\ economic\ variables_i + \beta_{12} time_{i3} \cdot baseline\ economic\ variables_i + \beta_{13} time_{i4} \cdot baseline\ economic\ variables_i$$

Where:

- The binary response is thought of as a dichotomization of an underlying latent continuous response, a propensity to use financial coping mechanisms, in this case, to borrow. The proportion of the total variance in the data which arises because of the variance in the random intercepts is also the correlation amongst responses at two time points *j* and *k*, given by: $ICC = \frac{{\tau_0}^2}{{\tau_0}^2 + \frac{\pi}{3}} = \rho_{Yij,\ Yik}$
- *i* signifies the individual patients from 1 to a maximum of 1,022 individuals
- *j* and *k* signify the measurement instance for a patient, from 0 (baseline) to a maximum of 4 (total of five measurements
- X_i are time-invariant covariates, while X_{ij} are time-varying covariates
- β_0 is the intercept for the "average" patient, i.e. the patient with a random effect of $b_{0i} = 0$, (and b_{0i} is the random effect or deviation from the intercept of the average patient)
- The distribution of the random effect follows an approximately normal distribution: $b_{0i} \sim N(0, {\tau_0}^2)$
- $log\left(\frac{\Pr(borrowing_{ij}=1|b_{0i},time_{ij,}X_i,X_{ij})}{\Pr(borrowing_{ij}=0|b_{0i},time_{ij,}X_i,X_{ij})}\right)$ is the ratio of log odds of the outcome at time *j* (1 to 4) compared to discharge for the "average" patient with a particular baseline and time-varying covariate pattern
- The significance and magnitude of β_{10} through β_{13} allow for testing whether and to what degree baseline economic variables influence the odds of the outcome at a particular follow-up period, compared to hospital discharge for the "average" patient.
- The coefficients should not be interpreted as population-wide log odds ratios, but relationships for the "average" patient, that is, the patient with $b_{0i} = 0$ (see marginalization discussion below).

v. Estimation procedure

The maximum likelihood estimation procedure gives the coefficients (β) and random intercept variance (${\tau_0}^2$) which makes the observed data (Y_{ij}) the most likely. However, the random intercepts are unobservable, and a likelihood function for such an estimation procedure would involve conditioning on unobservables. The estimation procedure for a mixed-effects logistic regression involves using an integral to average out the unobserved random intercepts, which is commonly approximated using a quadrature approach, a geometric calculation of the area under the curve. Ordinary quadrative, however, does not perform well if the clusters are large relative to the overall sample size, or if the intracluster correlation (ICC), a measure of within-subject uniformity in responses, is high. Adaptive quadrature, in which initial values are estimated and then revised until the likelihood is maximized, is the therefore the most common method for approximating this integral. (Fitzmaurice et al., 2011a; Rabe-Hesketh & Skrondal, 2008) However, quadrature is potentially sensitive to the number of quadrature points used, making the estimate itself potentially sensitive to the estimation method. Increasing the number of quadrature points increases the accuracy but also complexity of and time to complete the calculation. Testing the sensitivity of the estimated odds ratio to the estimation procedure requires varying (both increasing and decreasing) the number of quadrature points until the estimation no longer changes; a common rule of thumb is for the relative difference in estimated coefficients to vary by more than 0.01% (0.0001 variation in coefficient estimation). (Rabe-Hesketh & Skrondal, 2008) Estimates for logistic mixed models were derived using mean-variance adaptive Gauss–Hermite quadrature, with the number of quadrature points increased until the estimates using more or less quadrature points did not vary by more 0.01% (10^{-4}) in either direction. All analyses were performed using Stata version 15. (StataCorp, 2017)

vi. Marginalization

Due to the unbalanced nature of this dataset, a marginal model would be likely to yield biased estimates of the relationships of interest, and so a conditional model is required. In the case of continuous outcomes, the average of the subject-specific regression coefficients also has a population average or marginal interpretation, since the subject-specific coefficients are individual averages and an average of individual averages is the population average. However, in a logistic setting, there are implications for the interpretation of the regression coefficients, depending how we frame the source of the within-subject correlation. In this model, which uses a random intercept to define the within-subject correlation for a binary outcome, the average of the exponentiated regression coefficients is no longer the population average coefficient, due to the presence of the random intercept – an average of individual odds is not equivalent to the population-wide odds. Instead, regression coefficients have individual interpretations: the effect of a covariate on an outcome for a subject with a particular random effect. For example, a coefficient for sex would be interpreted as how the log odds of the outcome would vary had that subject been the other sex. These coefficients are not of interest in answering the research question; they do not make sense when speaking about time-invariant covariates (such as sex, in this context); and, for both time-varying and time-invariant independent variables, they imply a counterfactual comparison for which there may not or cannot be any empirical evidence for a particular individual. (Fitzmaurice et al., 2011a) However, there is a formula using the variance of the random intercept which allows us to convert these conditional, subject-specific coefficients to an approximation of the marginal, population-wide coefficients, and thus cope with missing or otherwise unbalanced data: (Hedeker, du Toit, Demirtas, & Gibbons, 2018)

$\beta \approx (0.346\tau_0^2 + 1)^{-1/2}\beta^*$, where β is the marginal estimate of interest and $\beta^*$is the conditional estimate

Using this formula, conditional, or individual, estimates are converted into marginal, or population-wide, estimates, following which odds were converted into probabilities using the standard conversion formula of probability = (odds)/(1+odds).

Results

a. The HEALS Cohort

i. Demographics, Household Living Standards, and Health Insurance Status

There were 1,022 individual patients incorporated into the study during their hospitalization between January and December 2015. The cohort was majority male (n=729, 71.33%), with a high school education (n=774, 75.73%), married (n=705, 68.98%), residing in a rural area (n=808, 79.06%), with an average age of approximately 41 years old. (Table 2) Given the overwhelmingly rural nature of the cohort, it is unsurprising that the most common occupation was farmer (n=470, 45.99%).

The HEALS cohort, at admission, was weighted towards the middle-income groups relative to the general Vietnamese population in 2015. In 2016, 29.0% of the Vietnamese population as a whole was below the I$5.50/day poverty line, compared to 51.86% of the HEALS cohort. (World Bank Group, 2019) (Table 3) However, comparable proportions of the HEALS cohort were below the I$3.20 and I$1.90/day poverty lines: in 2016, the proportions of the Vietnamese population below the lower-middle and international poverty lines were 8.4% and 2.0% respectively, which was comparable to 7.53% and 2.74% below these poverty lines in the HEALS cohort. (World Bank Group, 2019) (Table 3)

Overall, 470 (45.99%) had at least one form of insurance. (Table 2) Of those with insurance, the vast majority of respondents received a partial subsidy from the Vietnamese government (n=405, 86.17% of those with insurance). With 54.01% without any form of insurance prior to their injury, the HEALS cohort was disproportionately uninsured compared to the general population of Vietnam in 2015, in which only 37% were uninsured. (Somanathan, Tandon, Dao, Hurt, & Fuenzalida-Puelma, 2014)

There were distinct demographic and socioeconomic patterns by insurance status. Patients who worked in the formal sector were significantly more likely to be insured than those who worked in the informal sector, as farmers or other self-employed positions: 63.55% of informal sector employees were uninsured as compared to 43.72% of formal sector employees ($p<0.001$) Further, patients whose per capita income prior to their injury was in the middle deciles of the distribution were more likely to be uninsured than those in either the lower or in the upper income deciles (68.32% uninsured among middle-income patients, versus 50.97% uninsured in either low or high income patients, $p<0.001$ from two-sample test of proportions). (Table 3 and Figure 3) Additionally, patients who were elderly were the least likely to be uninsured (59.32% under 65 uninsured compared to 11.40% 65 and above, $p<0.001$; 62.91% under 55 uninsured compared to 26.40% 55 and older, $p<0.001$). The majority of the sample self-admitted to hospital (82.39%, n=842), although patients who had any form of insurance were more likely to be referred by a practitioner or another hospital than to be self-admitted ($p<0.001$). (Table 5) Finally, men were more likely to be uninsured than women, with only 41.02% (299/729) of men being insured, compared to 58.36% (171/293) of women being insured.

Figure 3: HEALS cohort: Proportion without any form of insurance by pre-injury income decile

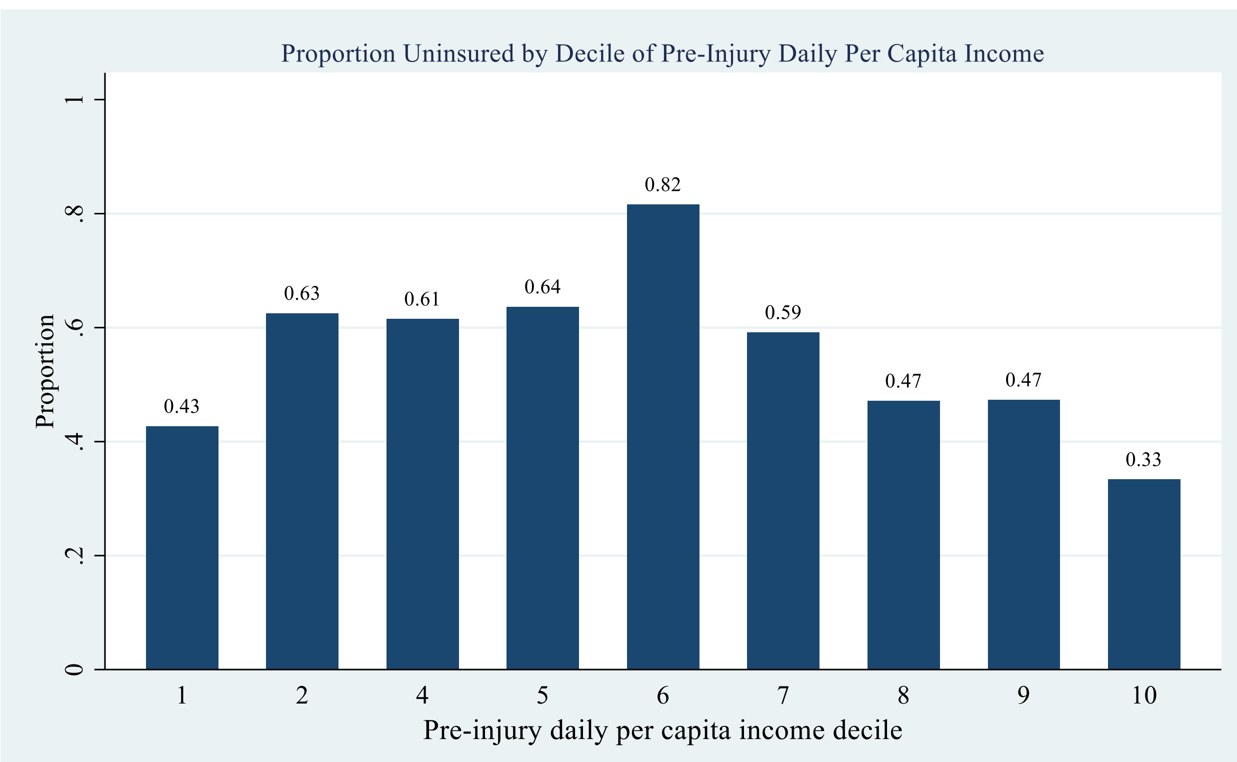


Table 2: Patient demographics by insurance status

Variables	Insured n (col %)	Uninsured n (col %)	p-value	Total n (col %)
Total	470 (45.99%)	552 (54.01%)	N/A	1022 (100%)
Sex			<0.001	
Male	299 (63.62%)	430 (77.90%)		729 (71.33%)
Female	171 (36.38%)	122 (22.10%)		293 (28.67%)
Age Category			<0.001	
18-24	77 (16.38%)	152 (27.54%)		229 (22.41%)
25-34	68 (14.47%)	160 (28.99%)		228 (22.31%)
35-44	69 (14.68%)	97 (17.57%)		166 (16.24%)
45-54	72 (15.32%)	76 (13.77%)		148 (14.48%)
55-64	83 (17.66%)	53 (9.60%)		136 (13.31%)
65+	101 (21.49%)	13 (2.36%)		114 (11.15%)
Occupation			<0.001	
Farmer	175 (37.23%)	295 (53.44%)		470 (45.99%)
Civil servant / semi-gov. employee	59 (12.55%)	33 (5.98%)		92 (9.00%)
Private employee	20 (4.26%)	26 (4.71%)		46 (4.50%)
Self-employed	90 (19.15%)	167 (30.25%)		257 (25.15%)
No wage labor	126 (26.81%)	31 (5.62%)		157 (15.36%)
Highest Level of Education Completed			<0.001	
Primary school or less	65 (13.83%)	17 (3.08%)		82 (8.02%)
Secondary school	288 (61.28%)	486 (88.04%)		774 (75.73%)
More than secondary	116 (24.68%)	49 (8.88%)		165 (16.14%)
Missing	1 (0.21%)	0 (0.00%)		1 (0.10%)
Marital Status			<0.001	
Single	108 (22.98%)	195 (35.33%)		303 (29.65%)
Married	349 (74.26%)	356 (64.49%)		705 (68.98%)
Widowed	10 (2.13%)	0 (0.00%)		10 (0.98%)
Divorced	2 (0.43%)	0 (0.00%)		2 (0.20%)
Separated	1 (0.21%)	1 (0.18%)		2 (0.20%)
Residence			0.004	
Rural	353 (75.11%)	455 (82.43%)		808 (79.06%)
Urban	117 (24.89%)	97 (17.57%)		214 (20.94%)

Table 3: Pre- injury household economic variables by insurance status

Variables	Insured n (col %)	Uninsured n (col %)	p-value	Total n (col %)
Household Daily Per Capita Income			<0.001	
More than I$5.50	230 (48.94%)	262 (47.46%)		492 (48.14%)
I$3.21 to 5.50	159 (33.83%)	245 (44.38%)		404 (39.53%)
I$1.91 to 3.20	31 (6.60%)	18 (3.26%)		49 (4.79%)
I$1.90 or less	22 (4.68%)	6 (1.09%)		28 (2.74%)
Missing	28 (5.96%)	21 (3.80%)		49 (4.79%)
Percent of Household Income Earned by Patient, Pre-Injury			0.026	
0%	53 (11.28%)	51 (9.24%)		104 (10.18%)
>0%, <25%	24 (5.11%)	26 (4.71%)		50 (4.89%)
>=25%, <50%	96 (20.43%)	139 (25.18%)		235 (22.99%)
>=50&, <75%	184 (39.15%)	242 (43.84%)		426 (41.68%)
>=75%, <=100%	62 (13.19%)	45 (8.15%)		107 (10.47%)
Missing	51 (10.85%)	49 (8.88%)		100 (9.78%)

There were also several economic and demographic patterns by whether patients resided in rural or urban areas. Patients living in rural areas were less likely to come from households where the daily per capita income was above I$5.50 per day and more likely to come from households living between I$3.21 and I$5.50 a day (p<0.001). (Figure 4) Rural patients were also more likely to be working, particularly in an informal occupation (p<0.001), and to have only a primary or secondary school education as compared to urban households (p<0.001). (Figure 4) Following hospital discharge, patients who came from an urban area were more likely to report having savings at each time point as compared to urban households. (Figure 5) However, there were no statistically significant or meaningful differences between rural and urban patients by age (p=0.556) or sex (p=0.653). (Figure 6)

Figure 4: Household socioeconomic status prior to injury by patient residence: Percent of Households

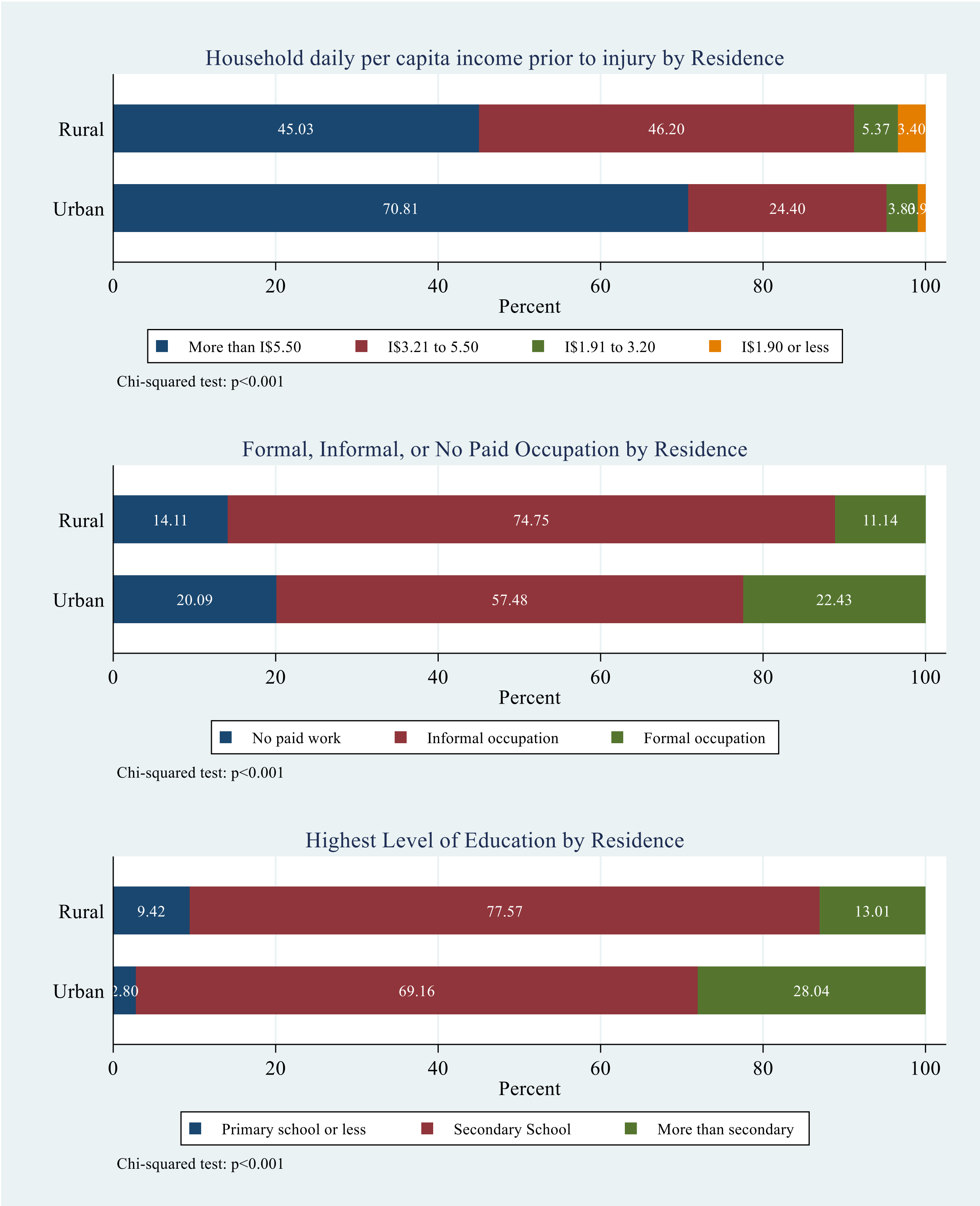


Figure 5: Whether household has savings: by patient residence and time since hospital discharge: Percent of Households

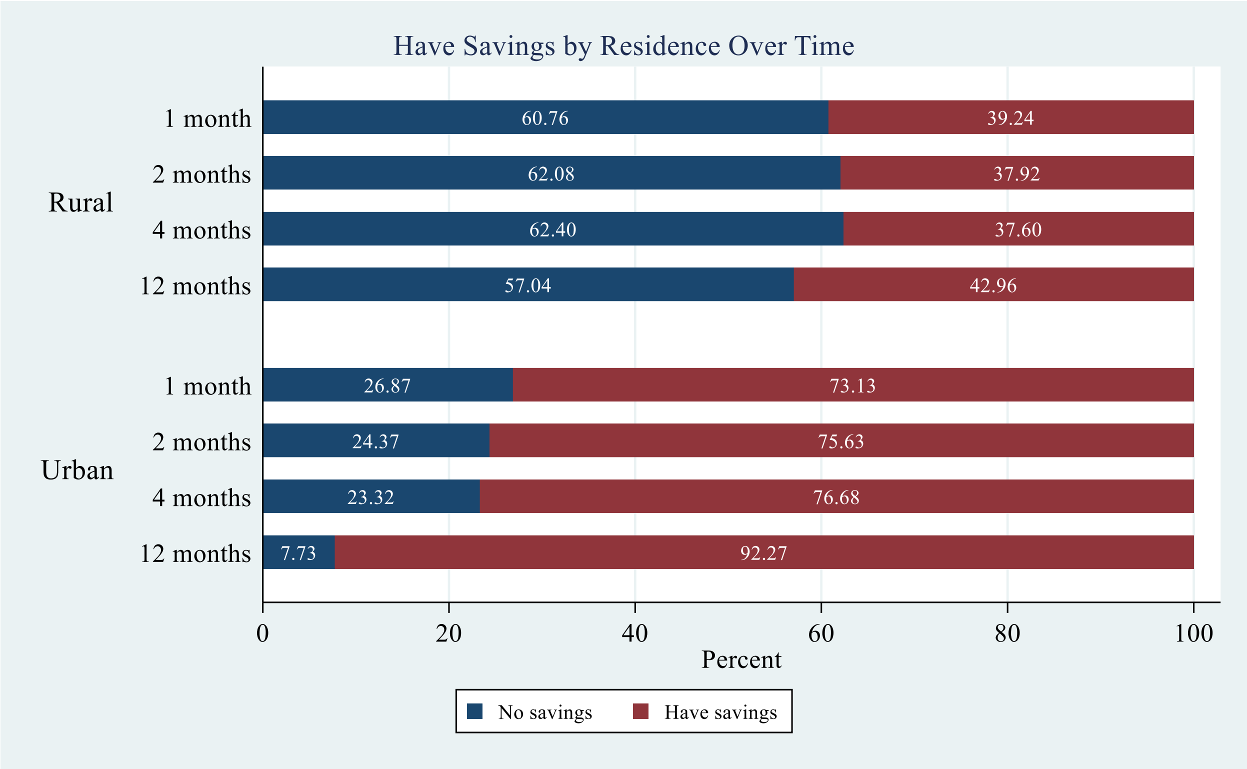
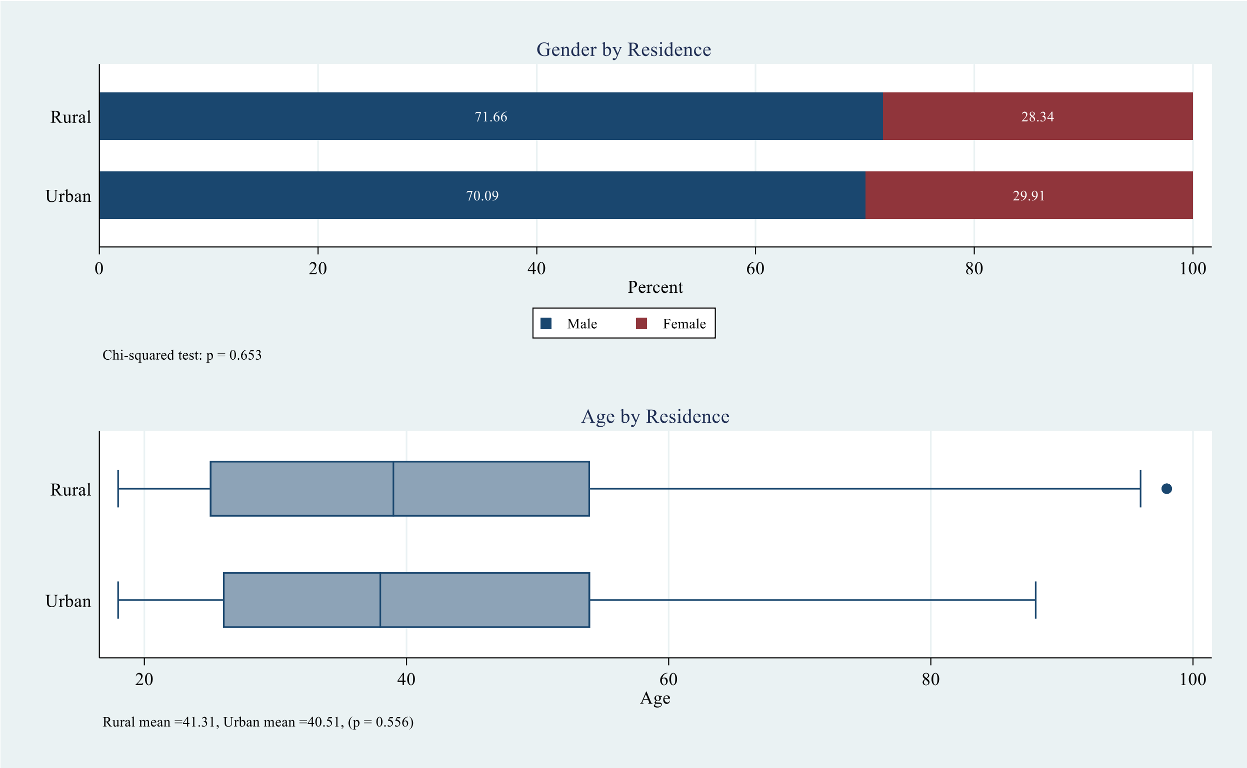


Figure 6: Patient sex and age by residence: Percent of Patients



ii. Injury Characteristics, Outcomes, and Pre-injury Self-Rated Health

Among this cohort, the most common injury cause was road traffic collisions, with a little over 60% (n=620) of the sample admitted due to road traffic injuries. (Table 5) Next most common were falls, which were increasingly predominant among progressively older age groups, with 49.39% of all falls in the cohort occurring among patients over age 55, and the average age of fall patients being 53 years. As older adults were more likely to be insured, patients injured in falls were more likely to be insured than uninsured.

Patients who were insured had higher levels of impairment prior to injury, as measure by the WHODAS, though this can be partially explained by the higher levels of impairment reported by patients over age 65 and patients living below the international poverty line of I$1.90 per day, both of which are overrepresented among the insured. A linear regression for pre-injury WHODAS scores showed that patients who were insured had higher self-reported levels of impairment pre-injury as compared those who are uninsured, after controlling for age, sex, occupation, marital status, level of education, household size, household per capita daily income pre-injury, and rural residence (Table 4; marginal predictions of WHODAS scores: 3.89 among the insured versus 0.85 among those without insurance, p=0.011).

Injury severity was also found to be statistically significantly higher among insured patients as compared to uninsured patients, as measured by eISS (p = 0.027). However, this difference, of 0.41 points on the ISS scale, translated into a 2.88 longer length of stay among insured patients as compared to those without insurance. The percent of uninsured patients who left hospitalization against medical advice was almost twice that of insured patients (27.36% vs 14.47%). These differences are explored in Paper 2.

Table 4: Regression of WHODAS scores prior to injury

Variables	Adjusted coefficient	p-value
Insurance Status		
Insured	ref	
Uninsured	-1.063	0.018
Age*		
18-45 years	-0.089	0.015
46-65 years	0.173	<0.001
66+ years	0.689	<0.001
Daily per capita income prior to injury		
More than I$5.50	ref	
I$3.21 to 5.50	-0.213	0.632
I$1.91 to 3.20	0.573	0.555
I$1.90 or less	1.874	0.175
Marital Status		
Single	ref	
Married	1.938	0.003
Other	6.463	<0.001
Highest Level of Education Completed		
Primary school or less	ref	
Secondary school	-2.490	0.006
More than secondary	-4.186	<0.001
Occupation		
Farmer	ref	
Gov. or semi-gov. employee	2.469	0.010
Private employee	0.708	0.513
Self-employed	0.249	0.637
No wage labor	-0.0294	0.970
Sex		
Male	ref	
Female	-0.235	0.610
Residence		
Rural	ref	
Urban	-0.141	0.785
Household size	1.169	<0.001
Constant	0.778	0.613
Observations	1,002	

* Per one year increase in age, with splines at ages 45 and 65 years old.

Table 5: Pre-injury level of physical limitation, injury characteristics, health care utilization, and outcome in hospital, by insurance status

Variables	Insured n (col %) mean (sd)	Uninsured n (col %) mean (sd)	p-value	Total n (col %) mean (sd)
Injury Cause and Intentionality			<0.001	
Road traffic	273 (58.09%)	347 (62.86%)		620 (60.67%)
Fall	110 (23.40%)	56 (10.14%)		166 (16.24%)
Burn	7 (1.49%)	7 (1.27%)		14 (1.37%)
Sharp object	21 (4.47%)	26 (4.71%)		47 (4.60%)
Animal/insect-related	4 (0.85%)	3 (0.54%)		7 (0.68%)
Blunt object	14 (2.98%)	22 (3.99%)		36 (3.52%)
Electrocution	3 (0.64%)	1 (0.18%)		4 (0.39%)
Self-harm	8 (1.70%)	9 (1.63%)		17 (1.66%)
Assault/interpersonal violence	22 (4.68%)	79 (14.31%)		101 (9.88%)
Referral or Self-admission			<0.001	
Referred from another hospital	58 (12.34%)	37 (6.70%)		95 (9.30%)
Health center/General Practitioner	50 (10.64%)	35 (6.34%)		85 (8.32%)
Self-admission	362 (77.02%)	480 (86.96%)		842 (82.39%)
WHODAS score, pre-injury	3.91 (10.04)	0.88 (3.78)	<0.001	2.27 (7.50)
Estimated Injury Severity Score (0-75)	4.64 (4.01)	4.21 (4.86)	0.024	4.41 (4.49)
Length of stay in hospital in days	9.31 (5.48)	6.43 (4.88)	<0.001	7.76 (5.36)
Outcome			<0.001	
Fully recovered	239 (50.85%)	260 (47.1%)		499 (48.83%)
Temporarily disabled	150 (31.91%)	130 (23.55%)		280 (27.4%)
Permanently disabled	3 (0.64%)	0 (0%)		3 (0.29%)
Transferred	8 (1.7%)	10 (1.81%)		18 (1.76%)
Left against medical advice	68 (14.47%)	151 (27.36%)		219 (21.43%)
Severe, take home upon family request	2 (0.43%)	1 (0.18%)		3 (0.29%)

b. Parameterization for Regression Analysis

i. Temporal Patterns in Rolling Cohort Admission

Hypothesis testing did not show a relationship between week of discharge from hospital and insurance status, patient formality of occupation, patient being a farmer, or household per capita income prior to the injury, after controlling for the other factors in the multivariable logistic or linear regressions. Predicted probabilities for binary outcomes and predicted means for continuous outcomes were plotted against week of hospital discharge to evaluate any temporal trend in hospital discharge by insurance status (Figure 7), whether the patient had a formal or informal occupation (Figure 8), whether the patient was a farmer (Figure 9), or reported household per capita monthly income prior to injury (Figure 10).

Figure 7: Temporal trend in hospital discharge by patient being uninsured versus having any form of insurance

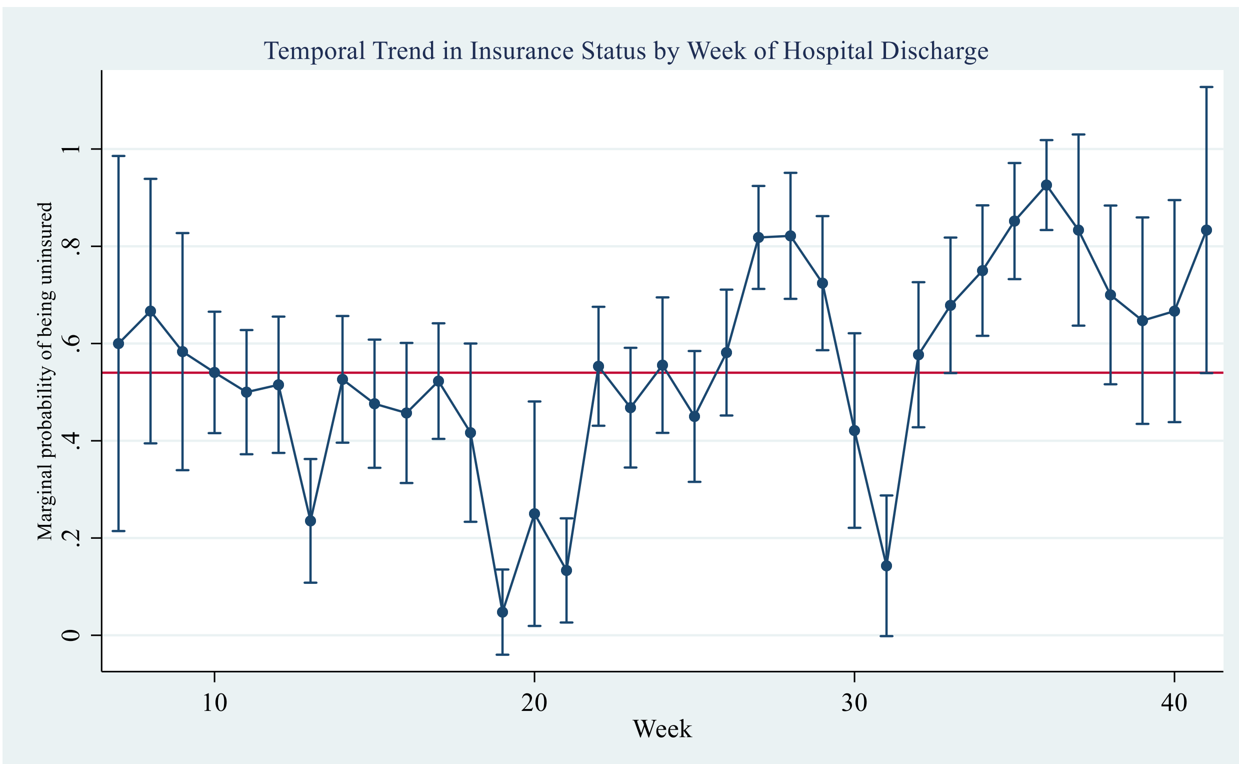


Figure 8: Temporal trend in hospital discharge by patient having a formal vs. informal occupation

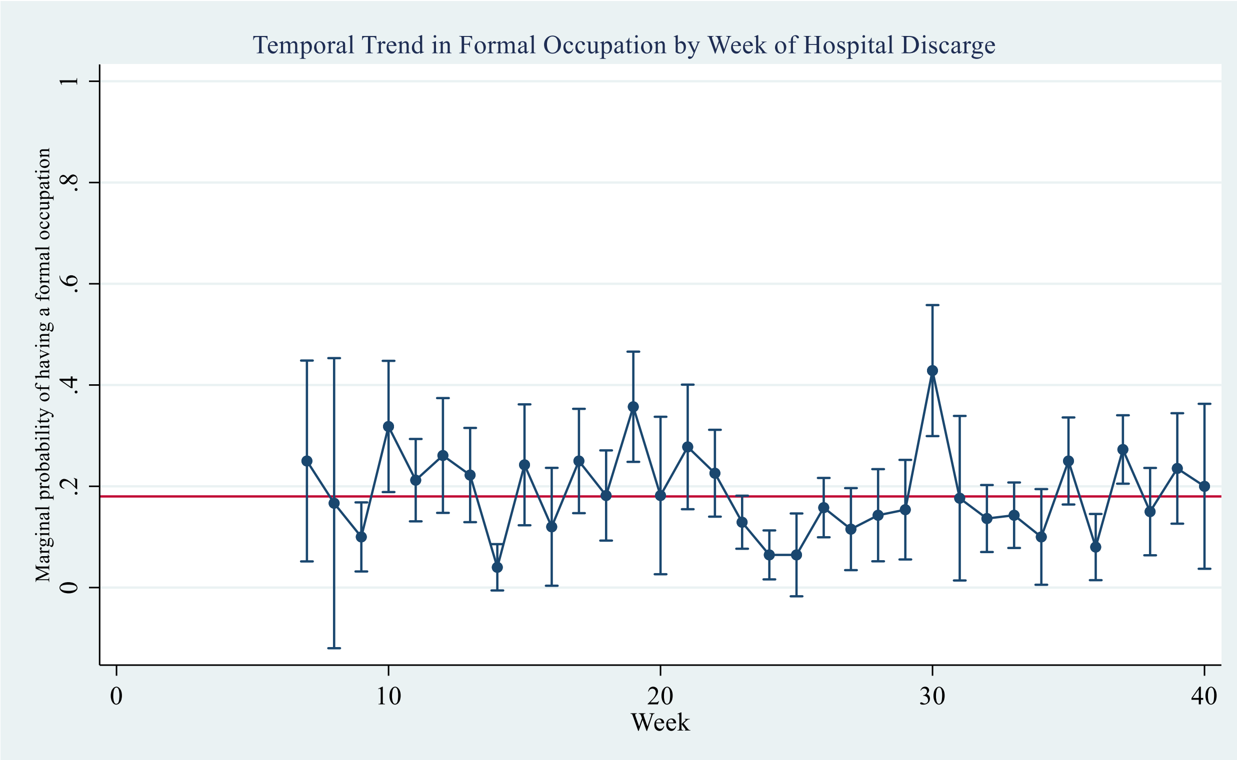


Figure 9: Temporal trend in hospital discharge by patient main occupation as a farmer

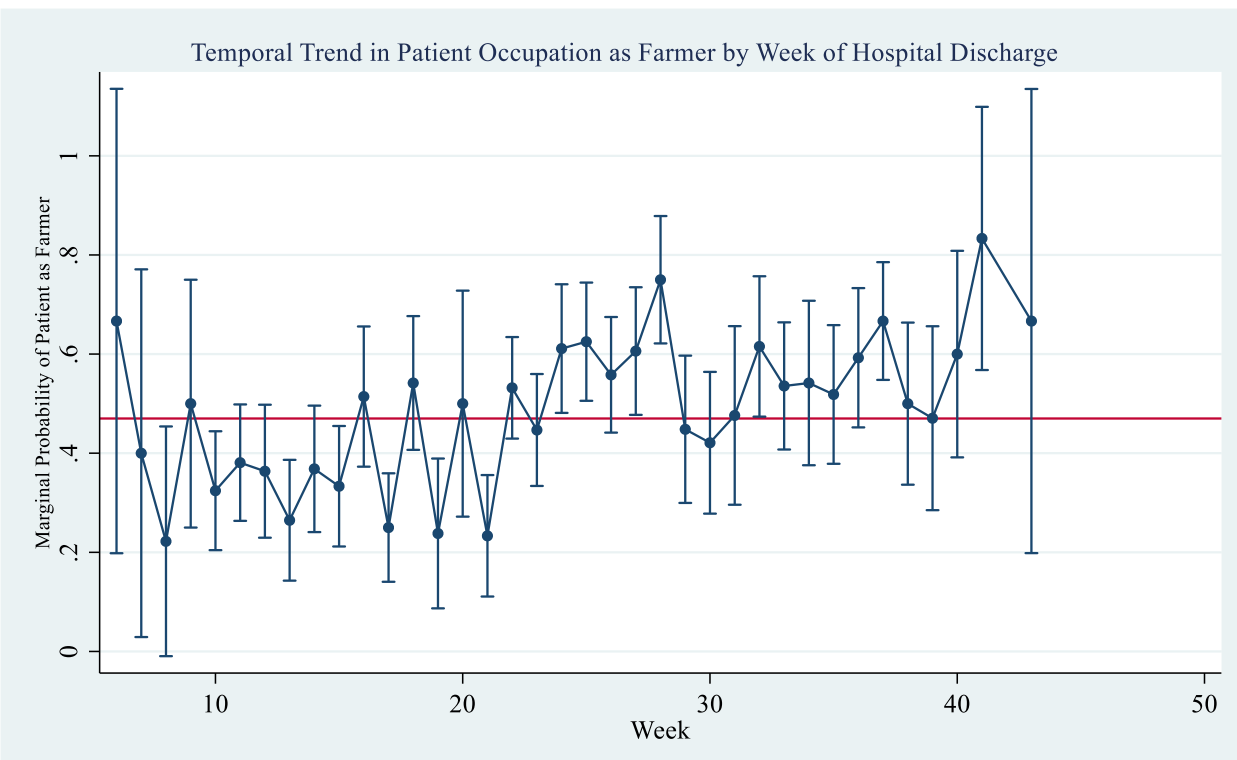
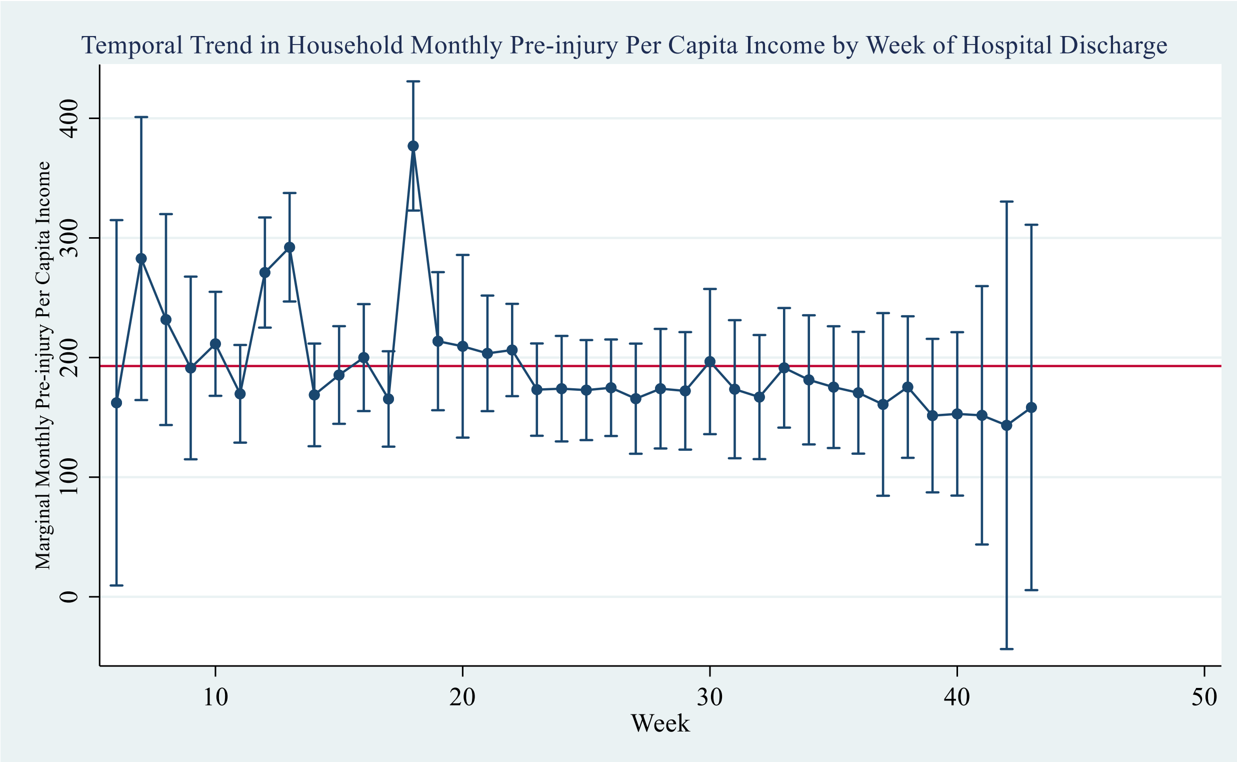


Figure 10: Temporal trend in hospital discharge by household daily per capita income prior to injury



ii. Missing Data Patterns: Multiple Imputation by Chained Equations

A little over 720 (70.45%) of the 1022 patients admitted into the HEALS cohort completed all five interviews, with 252 (24.66%) dropping out at some point. 50 patients (4.88%) missed one or more interviews after the first one, but then rejoined the cohort and completed additional interviews. (Table 6) Although most of the missing data follows a monotonic pattern, the small percentage of non-monotonic missing data confirms that a logistic mixed methods modeling strategy is appropriate, as other regression methods cannot appropriately handle non-monotonic data. (Fitzmaurice et al., 2011a)

Table 6: Missing data patterns among 1,022 patients in HEALS cohort

Pattern of Missing Data	n	(%)
Complete Cases	720	(70.45%)
Monotonic	252	(24.66%)
Non-monotonic	50	(4.88%)
Total	1022	(100%)

Four variables had any missingness at baseline, including age (1 missing observation), household income prior to the injury (49 missing observations), the percent of household income earned by the patient prior to injury (79 missing observations), and pre-hospital medical care (56 observations). Post-injury household income was missing for 68, 64, 37, 41, and 27 patients in hospital, and at 1, 2, 4, and 12 months following hospital discharge. In total, 50 datasets were imputed, each with 20 burn-in imputations prior to the actual imputation being stored. Trace plots of these 20 burn-in imputations which preceded each of the 50 imputations shows stability and convergence. (Figure 11) For each plot, the lack of any trend in the burn-in imputations indicates reasonable convergence and stability in the estimates. There were several observations for each variable which could not be imputed using the specifications which provided the most stable and consistent estimates. (Table 7) Imputation models were not altered further, as doing so reduced the stability of imputations.

Figure 11: Multiple Imputation by Chained Equations for baseline data: Trace plot showing convergence pattern from 20 'burn-in' imputations prior to each of 50 stored imputations

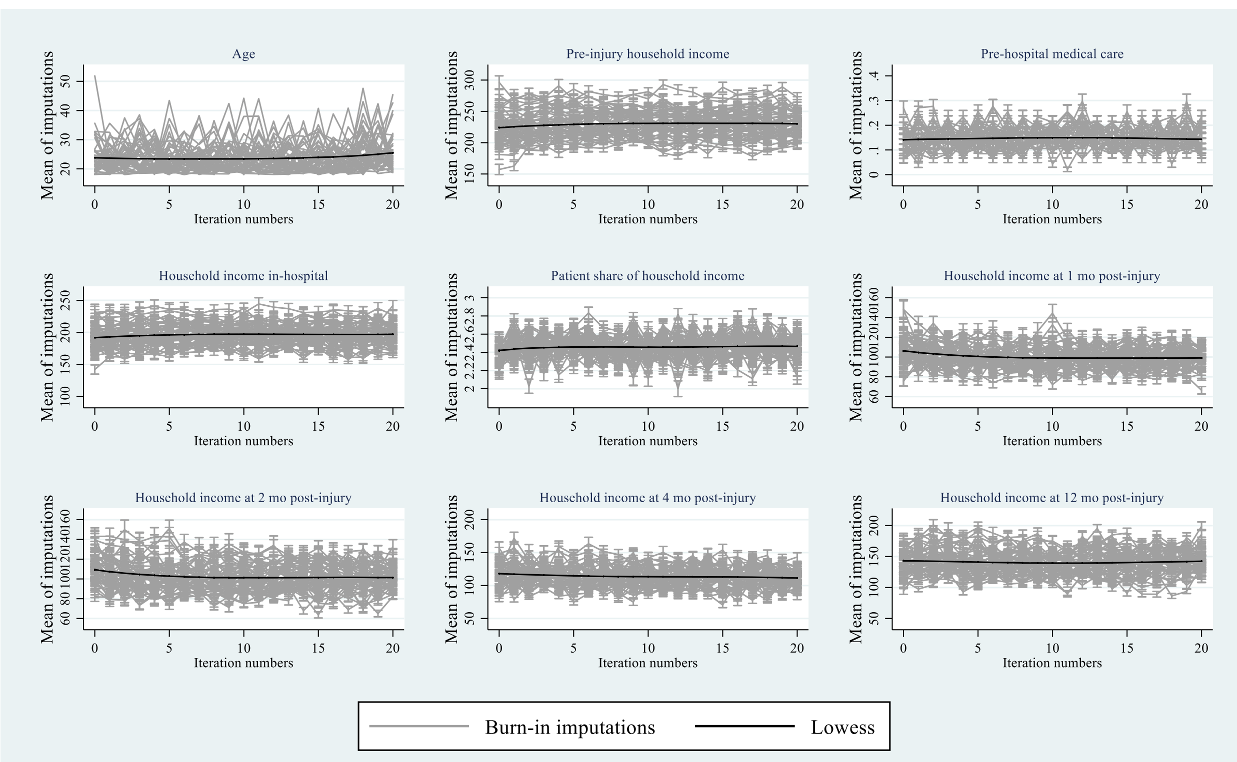


Table 7: Missing and imputed observations using Multiple Imputation by Chained Equations

Variables	Complete observations	Missing observations	Imputed observations	Observations not imputed	Total
Household income, pre-injury	973	49	29	20	1022
Household income, post-injury in-hospital	954	68	41	27	1022
Household income, 1 mo. after discharge	797	64	49	15	861
Household income, 2 mo. after discharge	785	37	33	4	822
Household income, 4 mo. after discharge	753	41	37	4	794
Household income, 12 mo. after discharge	742	27	22	5	769
Age in years at time of injury	1021	1	1	0	1022
Proportion of household income earned by patient, pre-injury	922	100	72	28	1022
Patient pre-hospital care	966	56	47	9	1022

iii. Household Food Expenditure Missing Data

Due to the construction of the skip patterns in the questionnaire, each patient reported an estimate of their monthly household food expenditure prior to the injury while still hospitalized. However, at each follow-up, respondents who said that they did not know the amount were not asked to provide an estimate. At each follow-up, the majority of respondents denied knowledge of their household food expenditure in the month before the interview. (Table 8)

Table 8: Missing food expenditure by study visit

Study Visit	Missing		Non-Missing		Total	
During Hospitalization	0	(0.00%)	1022	(100.00%)	1022	(100.00%)
1 Month after Discharge	491	(57.03%)	370	(42.97%)	861	(100.00%)
2 Months after Discharge	486	(59.12%)	336	(40.88%)	822	(100.00%)
4 Months after Discharge	487	(61.34%)	307	(38.66%)	794	(100.00%)
12 Months after Discharge	494	(64.24%)	275	(35.76%)	769	(100.00%)
Total	1958	(60.32%)	1288	(39.68%)	3246	(100.00%)

Patients were highly consistent over time in reporting whether or not they knew their household food expenditure: the intra-cluster correlation coefficient was (ICC) 0.934. With such consistent results over time, longitudinal analysis was not possible, as estimates derived from a logistic mixed model remained highly sensitive to the quadrature estimation method.

A cross-sectional logistic mixed model using data at the first follow up, one month following discharge, showed that this missingness was not random; knowledge of household food expenditure was significantly associated with patient demographics, including sex and marital status; pre-injury household food expenditure; and post-injury household living standards. (Regression table not included) Women had significantly higher odds of knowing the household food expenditure as compared to men (aOR = 1.381, p=0.041), as did patients who were married, compared to unmarried patients (aOR=1.833, p<0.001) or formerly married patients (aOR = 2.921, p= 0.078). Patients living in households which were in the lower two quintiles of pre-injury per capita household food expenditure (aOR = 1.515, p=0.004), and post-injury had per capita incomes less than I$3.20/day (aOR=1.802, p<0.001), were more likely to have information about household food expenditure, as compared to patients living in households with the higher food expenditure quintiles and above the I$3.20/day poverty line.

Due to the combination of the extent of the missingness and the demonstrable selection bias in missingness, reduced food expenditure could not be further evaluated as a potential coping mechanism.

c. Descriptive and Graphical Analysis

i. Supports from Government or Civil Society

There were very few patients or households which received supports from government or civil society, either during or after hospitalization. One month following discharge, 2.56% received government supports (22 of 861), and 0.46% (4 of 861) received support from a non-governmental organization. One patient received both government and non-government support. There were no patients during hospitalization, or at the 2-, 4-, or 12-month follow-ups who received supports.

ii. Health Care Utilization, Insurance Status, Functional Impairment, and Costs

At each time point following hospital discharge, patients who accessed formal medical services such as receiving care from a doctor or hospital or to using rehabilitative services reported greater average functional impairment compared to those who accessed only informal providers; those who accessed formal or informal health services reported greater functional impairment than those who did not use any health care. (Figure 12) Patients who were insured were also more likely to use health care and to use formal medical services at each time point during the year following hospital discharge. (Figure 13) However, factors other than insurance were associated with the choice of health care services. Interestingly, patients living in rural areas were more likely to use health care services from doctors and hospitals, more likely to access rehabilitation services, and less likely to use informal care or no care as compared to patients living in urban areas, at all time points following hospital discharge. (Figure 14)

Both insured and uninsured patients whose health care utilization included visiting a doctor, hospital, and/or using rehabilitative services paid a greater share of their monthly household income for those services as compared to patients who used only informal providers or purchased pharmaceuticals. (Figure 15) Although uninsured patients paid significantly more than insured patients in total out-of-pocket costs during hospitalization, this difference reduced over the period of follow-up as fewer uninsured patients accessed any care. (Figure 16) In-hospital health care costs were also greater as a proportion of monthly household income for uninsured patients, with health care costing insured patients 50% and uninsured patients almost 80% of their total household income on average during hospitalization. In the month following hospital discharge, OOPs cost insured and uninsured patients 1.5 and almost twice their monthly household incomes, on average, in uncovered costs for those patients who accessed a doctor, hospital, or rehabilitation services.

Patients reported their highest indirect costs during the month following hospital discharge. Although all patients were considered to be not currently working during their hospitalization, given that the length of stay across patients averaged to a little less than 8 days, it is not surprising that higher indirect costs would be incurred over the thirty days following hospital discharge. Following hospital discharge, patients who had returned to work reported less functional impairment and lower indirect costs than those patients who had not yet returned to work. (Figure 17 and Figure 18) While not returning to work lead to higher indirect costs and lower income, the relationship between lower income and higher functional impairment does not only flow through whether or not the patient returned to work. WHODAS scores showed a gradient by the households living standards, as measured by daily per capita income, both prior to the injury and at each time point over the year following hospital discharge, with patients from progressively lower income households showing higher levels of functional impairment. (Figure 19)

Figure 12: WHODAS scores by type of health care utilization over time

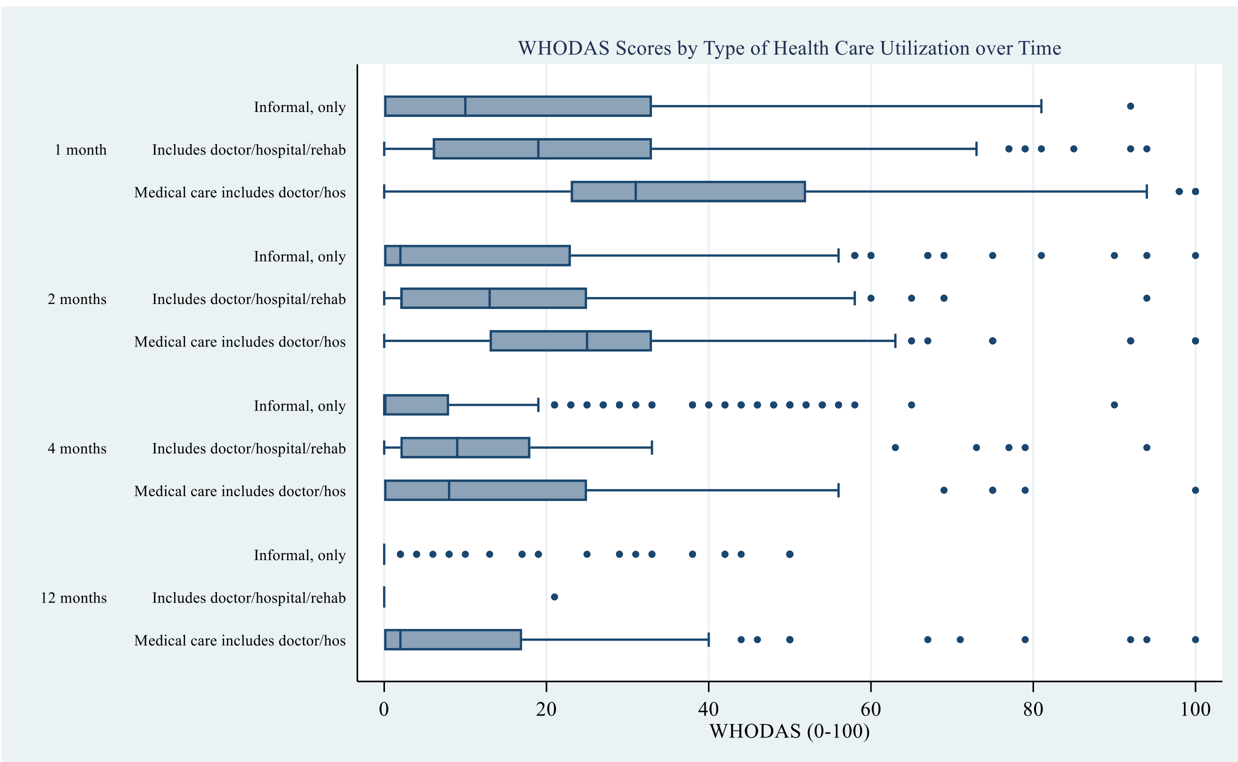


Figure 13: Type of medical care used by insurance status and time

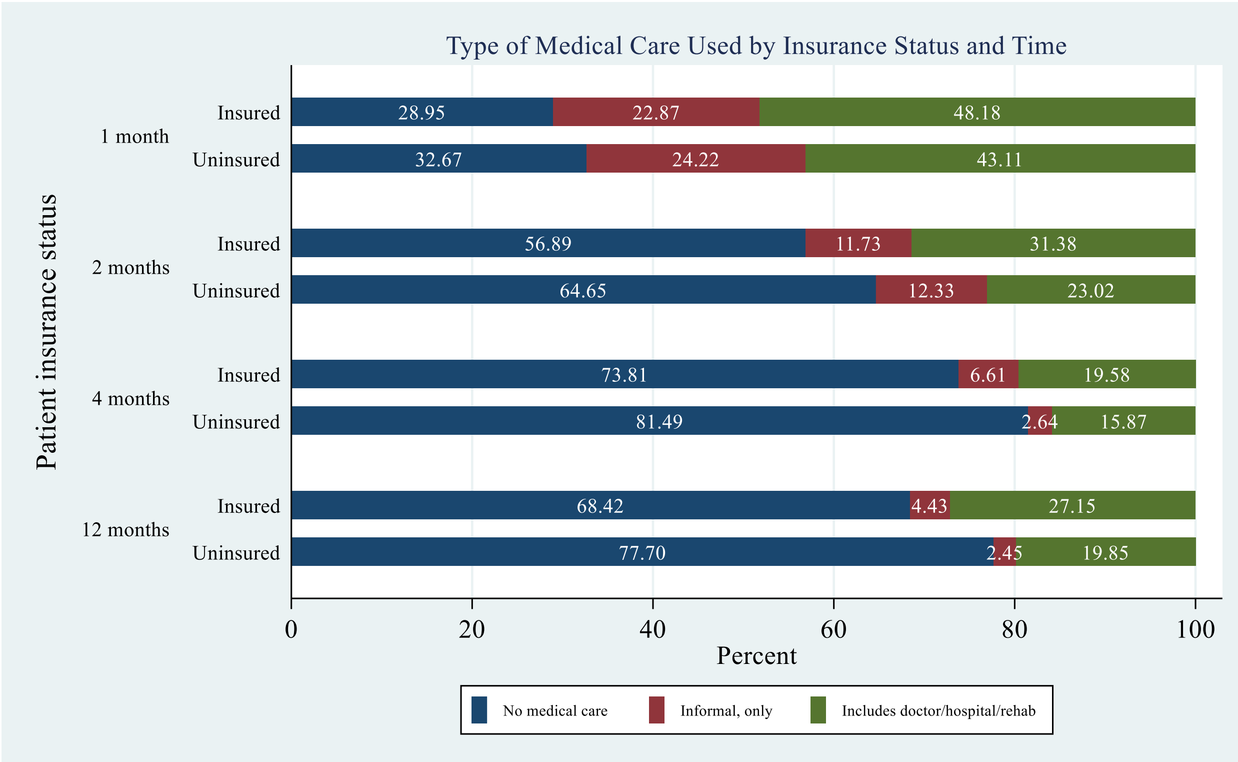


Figure 14: Type of medical care used by rurality and time

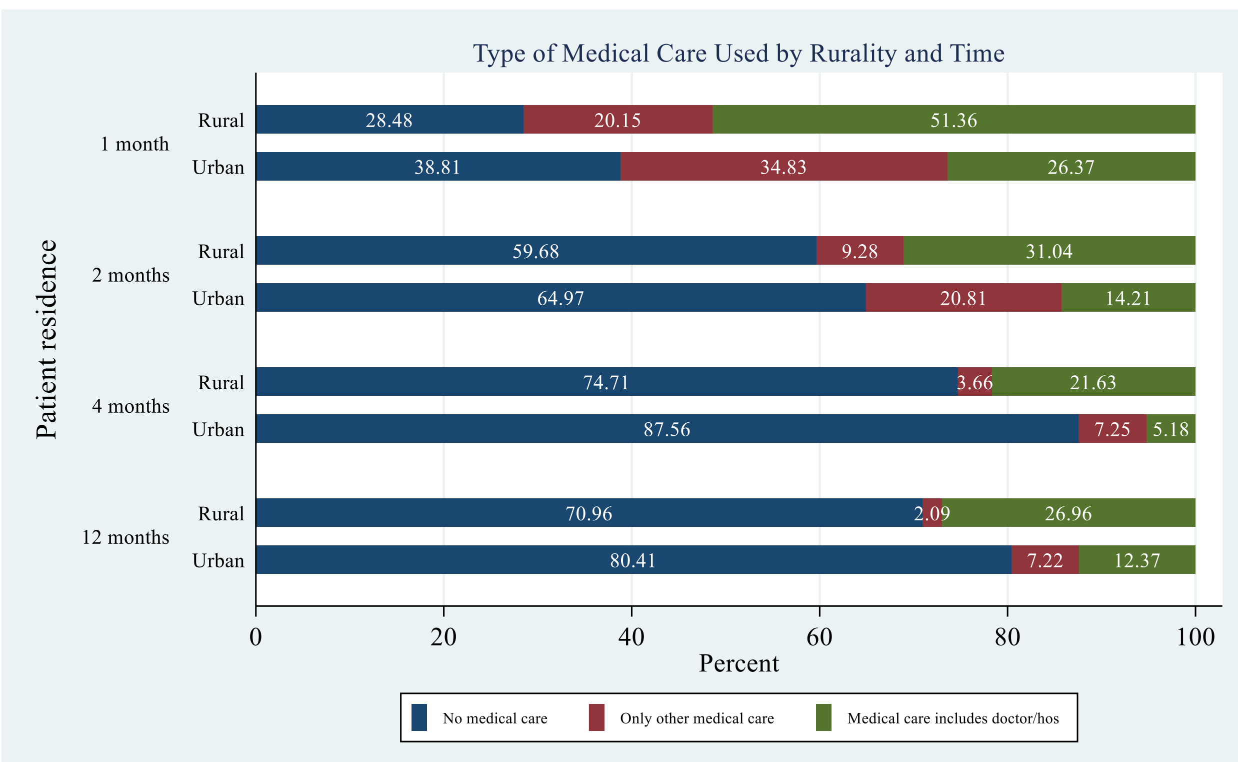


Figure 15: Out-of-pocket direct medical costs as a proportion of monthly household income by insurance status and type of care over time

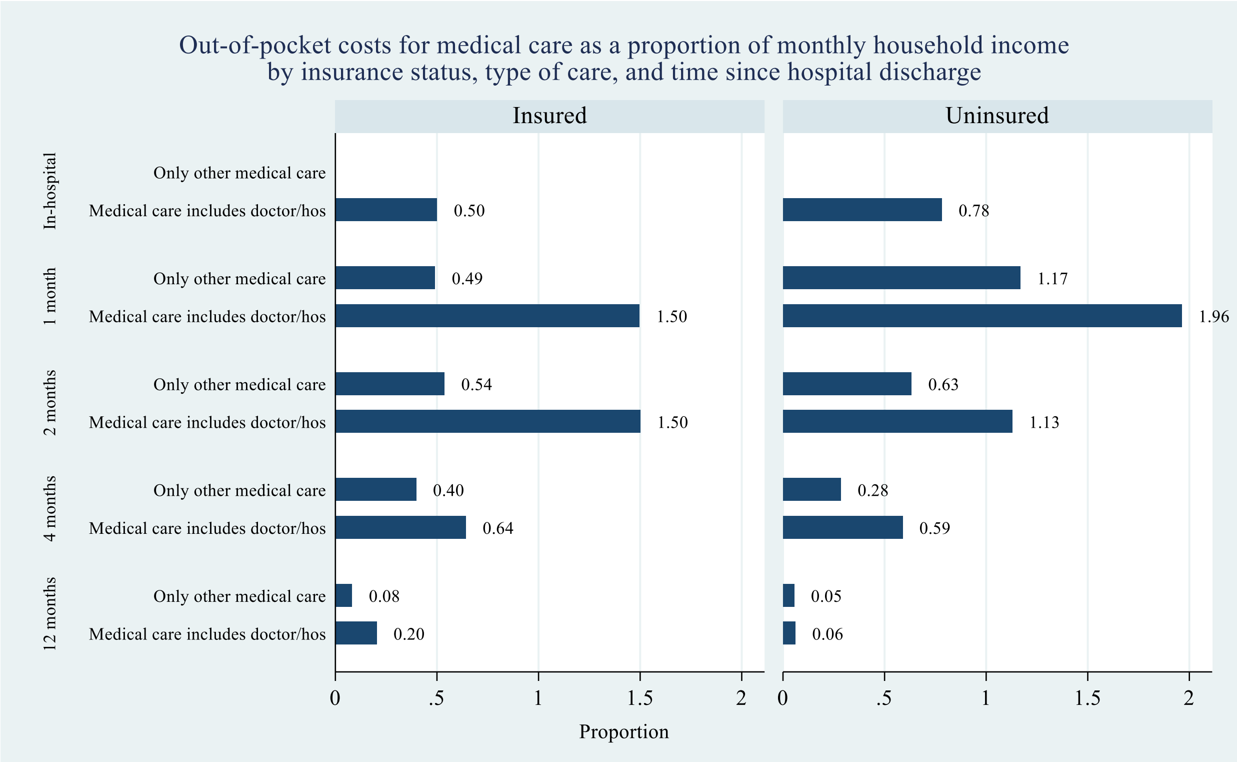


Figure 16: Direct medical out-of-pocket costs by insurance status over time: Mean and 95% confidence intervals

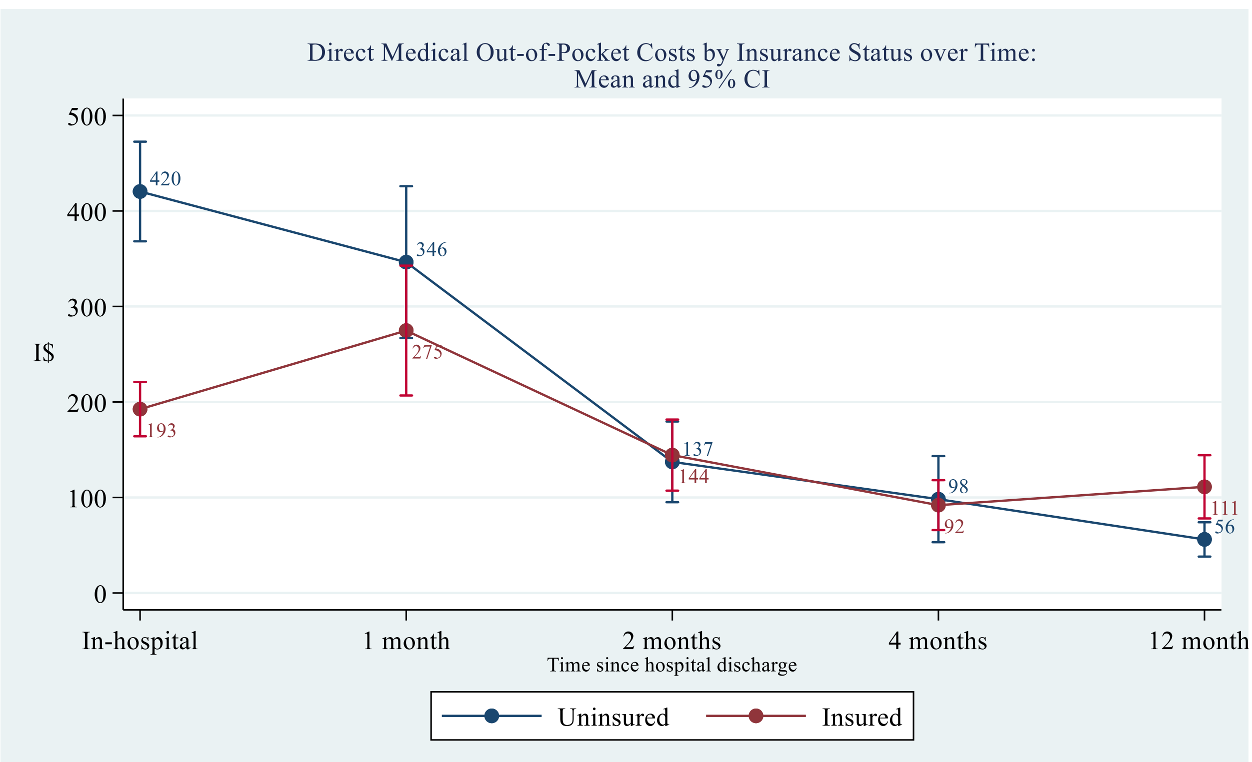


Figure 17: WHODAS scores by whether patient returned to work/main occupation over time

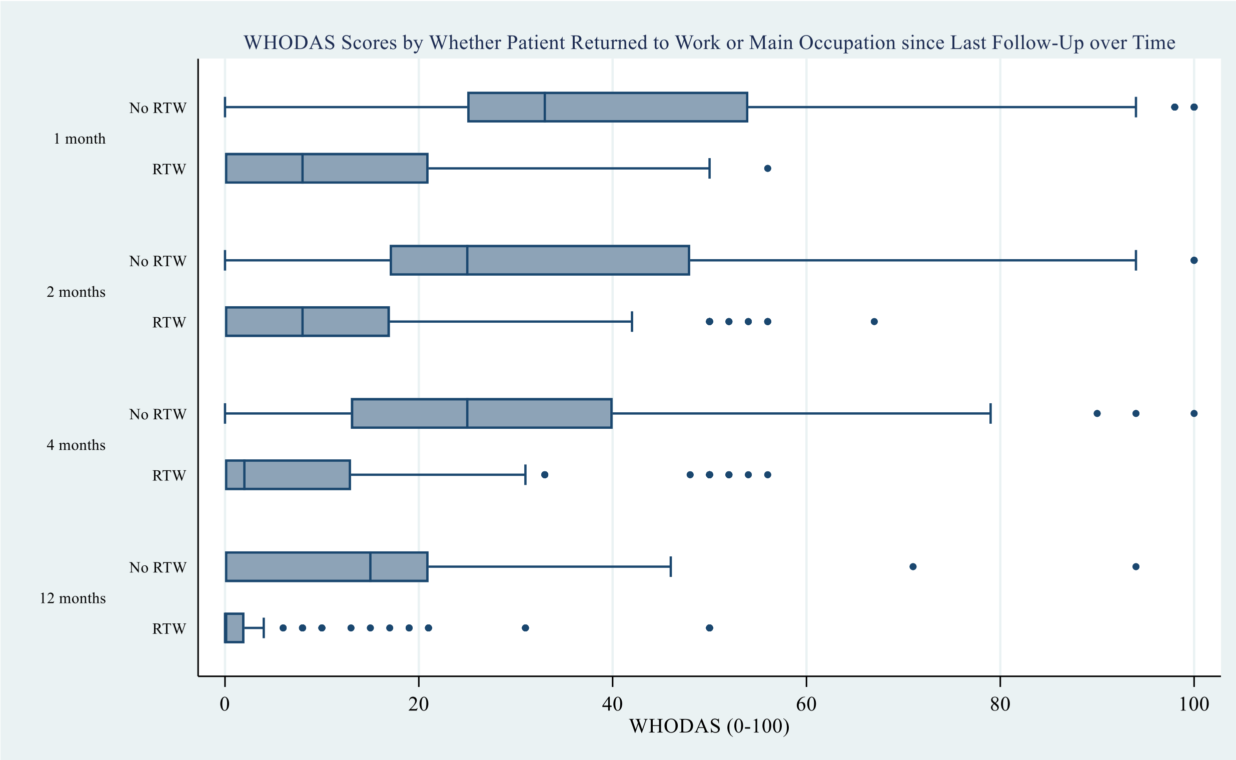


Figure 18: Total Household Indirect Costs as a Percentage of Pre-Injury Income by Whether Patient Has Returned to Work or Main Occupation over Time

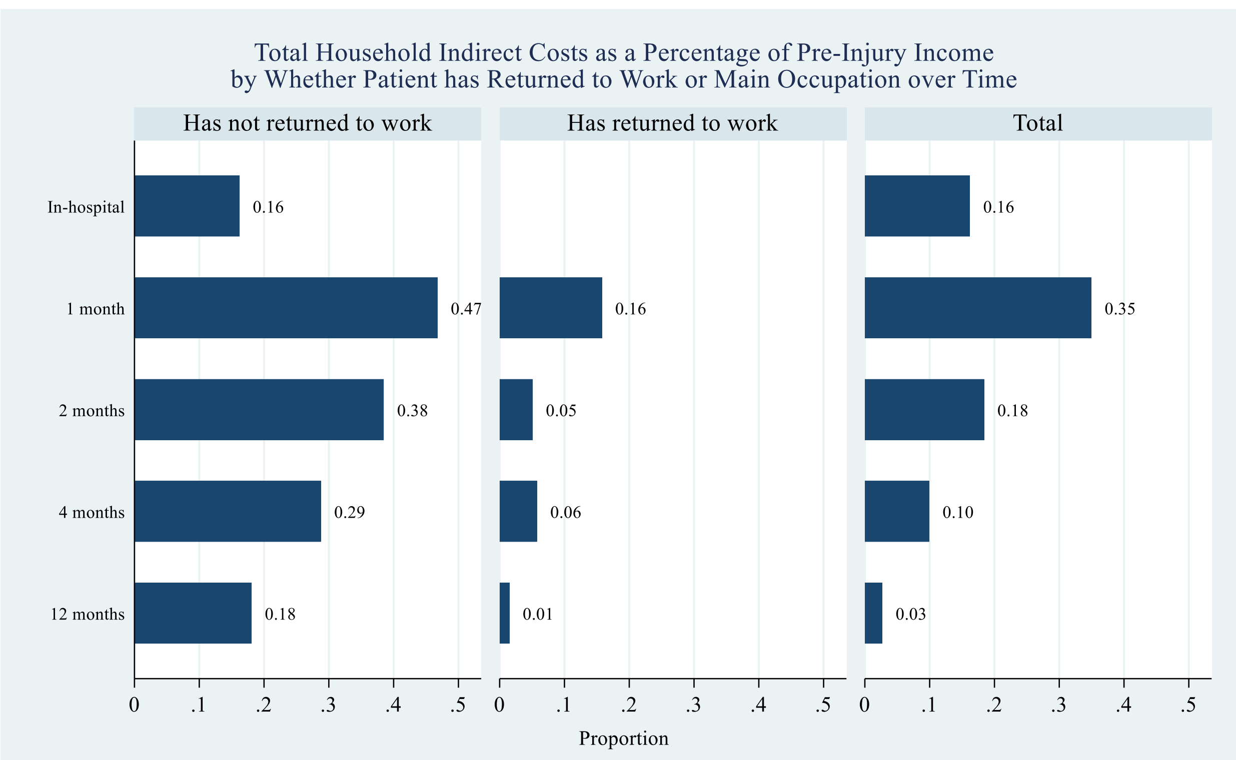
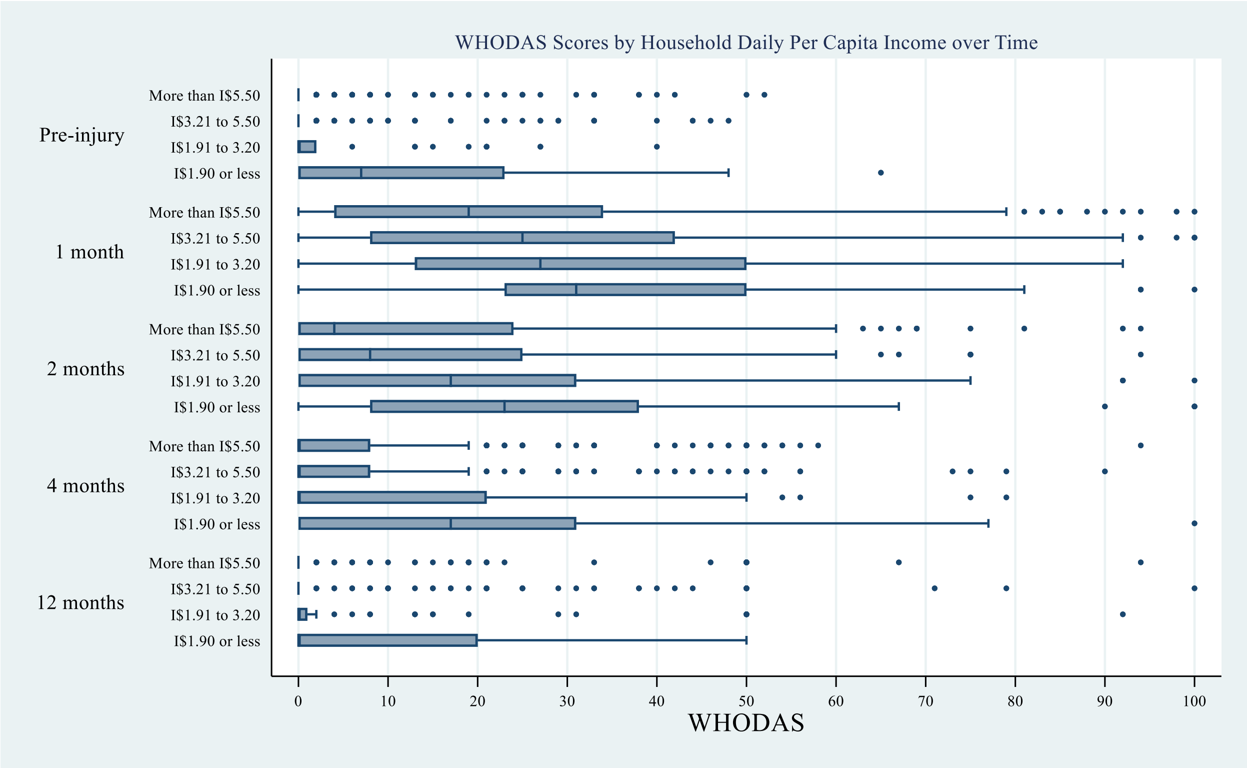


Figure 19: WHODAS Scores by Household Daily Per Capita Income over Time



iii. Borrowing, Selling Assets, Spending Savings, and Hardship Financing

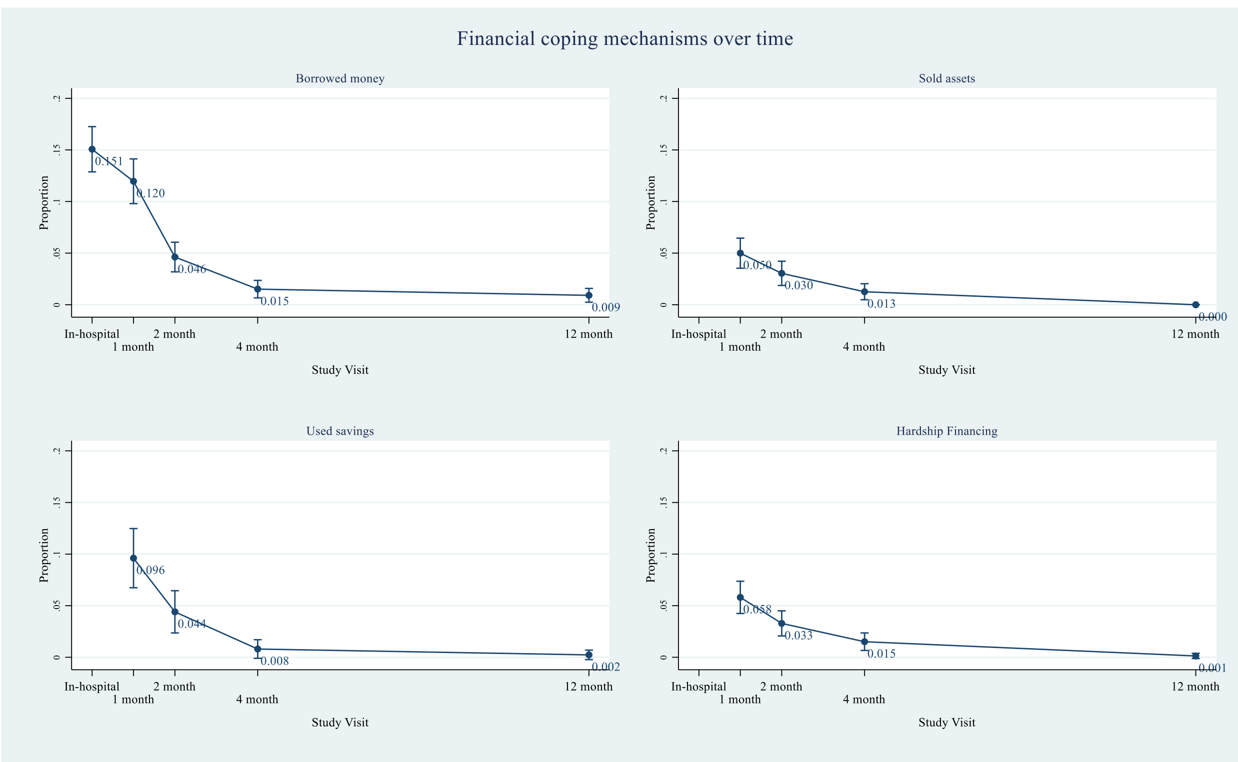
Overall, almost one quarter (24.27%) of the sample ever borrowed money during the study, 8.07% ever spent savings, 5.62% ever sold assets, and 6.65% ever used hardship financing to cope with the injury. (Table 9) Across time, financial coping was the most common prior to discharge from hospitalization, with decreasing proportions of the sample using any of these coping mechanisms over time. (Table 10 and Figure 20) Prior to hospital discharge, almost 20% of the sample used one or more financial coping mechanism, with that number dwindling to just over 1% by the end of the study. Borrowing was the most common coping strategy used within each time point, with asset sale the least common across time, except at 4 months after discharge.

Table 9: Financial coping mechanisms: Percent of sample ever used by insurance status

	Insured % (n)	Uninsured % (n)	p-value*	Total % (n)
Borrow money	87 (18.05%)	162 (29.35%)	0.002	249 (24.27%)
Sell assets	20 (4.77%)	29 (6.37%)	0.560	49 (5.62%)
Dissave‡	22 (9.09%)	19 (7.14%)	0.565	41 (8.07%)
Hardship financing	25 (5.97%)	33 (7.25%)	0.819	58 (6.65%)
One or more FCM	132 (27.39%)	194 (35.14%)	0.078	325 (31.80%)

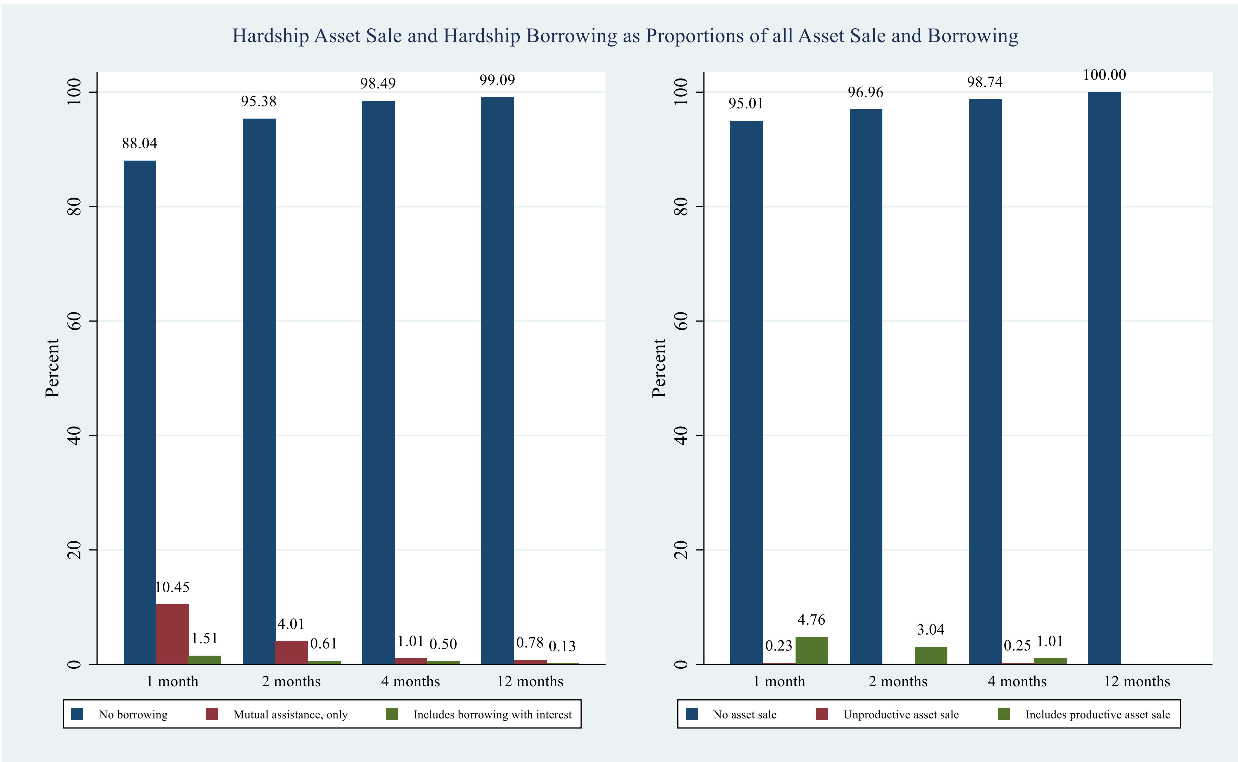
* P-value is from a simple logistic longitudinal model.
‡ This is among households which reported that they had savings. Households were not screened for if they had assets or if they had further contacts or formal sources from which to borrow; questions about asset sale or borrowing were asked from all respondents.

Figure 20: Financial coping mechanisms over time



The majority of patients who borrowed money did so only from family or friends, rather than from sources which would charge interest at each time point following hospital discharge. (Figure 21) By contrast, the majority of patients who sold assets included productive assets, such as farm animals, machinery, or land use rights.

Figure 21: Hardship asset sale and hardship borrowing as proportions of all asset sale and borrowing



Patterns of coping did not appear to vary by insurance status. Across the study period, a larger percentage of households where the patient was uninsured ever borrowed money, though this was driven by differences prior to hospital discharge (29.35% vs 18.05%, p=0.002). Prior to hospital discharge, almost twice as many uninsured patients borrowed money than insured patients (0.19 versus 0.10; Figure 22). However, there were no differences by insurance status in the proportion of patients who used any financial coping mechanism following hospital discharge. Post-discharge, a slightly larger proportion of uninsured households ever sold assets (6.37% vs 4.77%, p = 0.560) as compared to insured patients; whereas by contrast, those who were insured were more likely to ever spend savings as compared to those who were uninsured (9.09% vs 7.14%, p=0.565), though neither of these differences was statistically significant. Hardship financing was also not statistically significantly different by insurance status.

Table 10: Financial coping mechanisms: Percent of sample used over time

	In-hospital	1 mo. post-discharge	2 mo. post-discharge	4 mo. post-discharge	12 mo. post-discharge
Borrow money	15.07%	11.96%	4.62%	1.51%	0.91%
Sell assets	N/A*	4.99%	3.04%	1.26%	0%
Dissave	N/A*	9.61%	4.40%	0.80%	0.23%
Hardship financing	N/A*	5.81%	3.28%	1.51%	0.13%
One or more FCM	19.96%	16.96%	7.79%	2.64%	1.04%

Among patient factors examined, rural residence had the strongest association with using financial coping mechanisms, with the proportion of rural residents who borrowed money, spent savings, and used hardship financing far exceeding the proportions of urban residents at each time point. (Figure 23) Asset sale was an exclusively rural phenomenon for the entirety of follow-up, while borrowing and hardship financing were exclusively rural after two months following discharge, with dissaving exclusively rural after one month following discharge. Each type of financial coping mechanism – borrowing money, using savings, selling assets, and hardship financing – were associated with visiting a doctor or a hospital in first month or two months following hospital discharge, but not afterwards. (Figure 24) Finally, returning to work was associated with a lower probability of using savings following hospital discharge, and a slightly lower probability of borrowing money, but had no association with selling assets or hardship financing. (Figure 25)

Figure 22: Financial coping mechanisms over time by insurance status

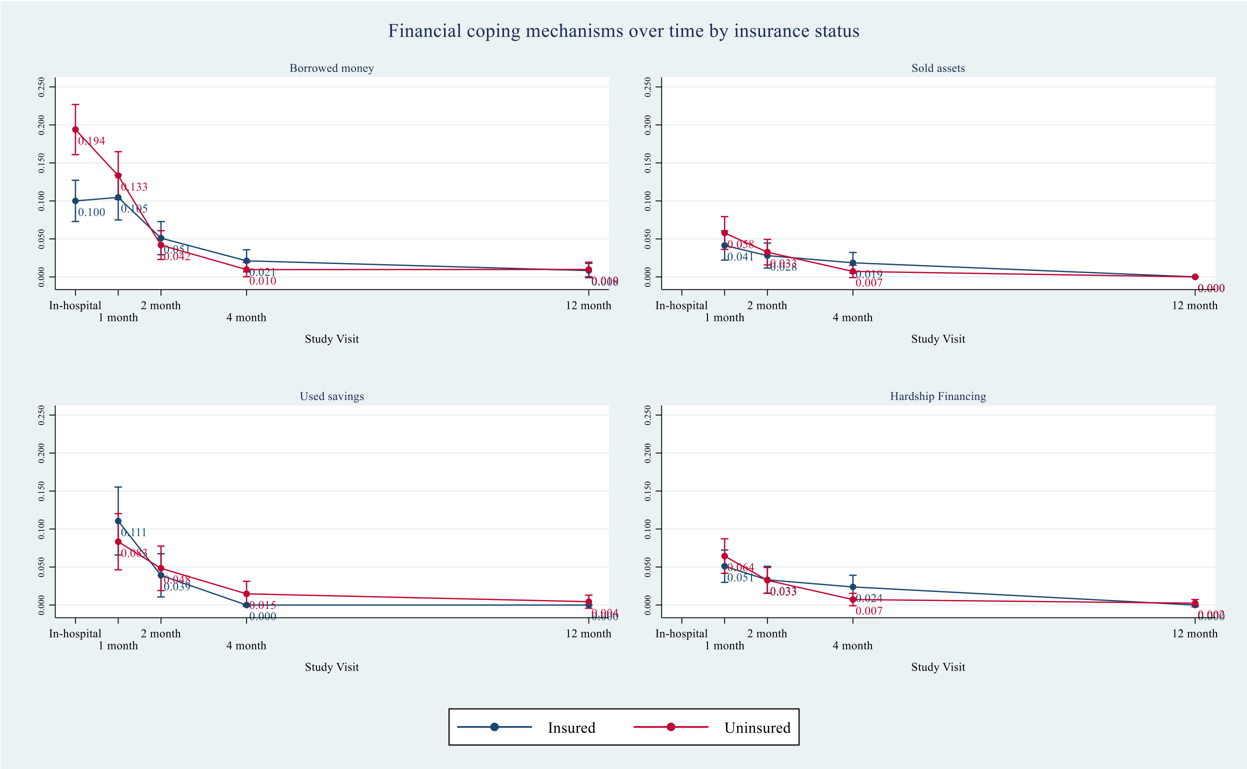


Figure 23: Financial coping mechanisms over time by urban or rural residence

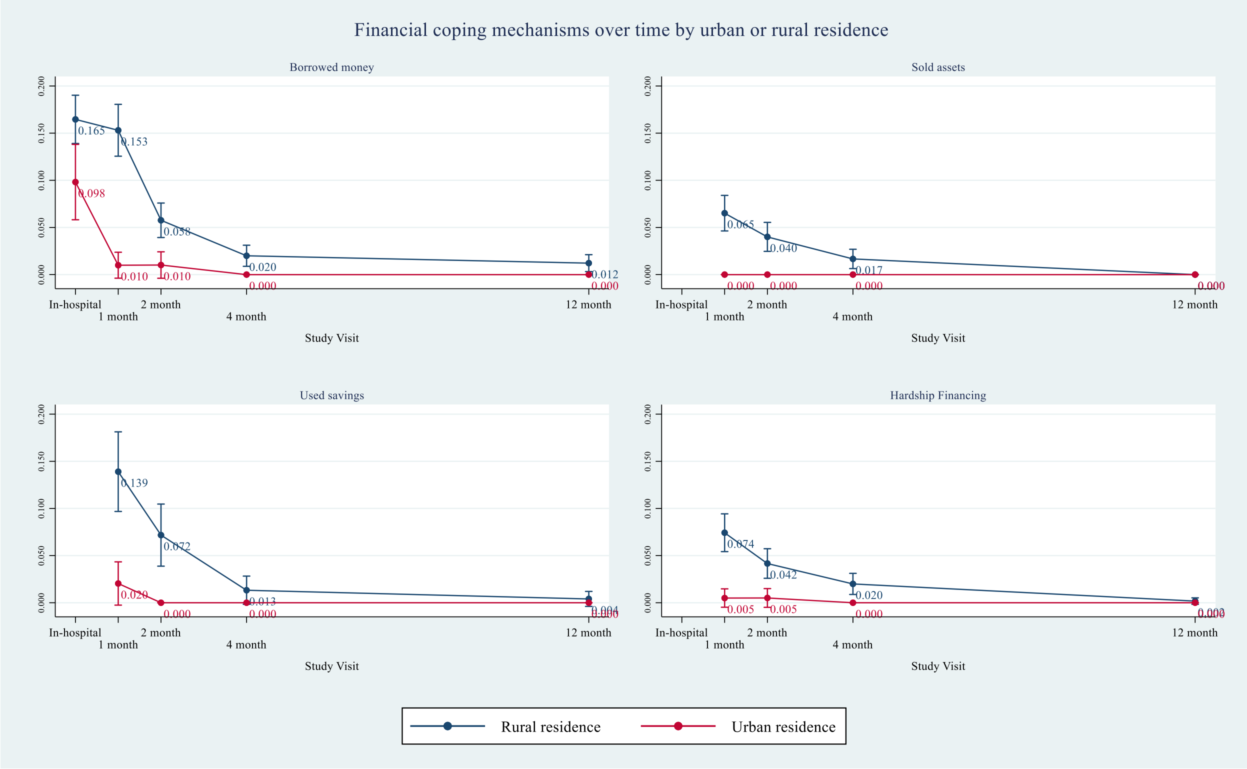


Figure 24: Financial coping mechanisms over time by patient visit to a doctor or hospital, or use of rehabilitation services

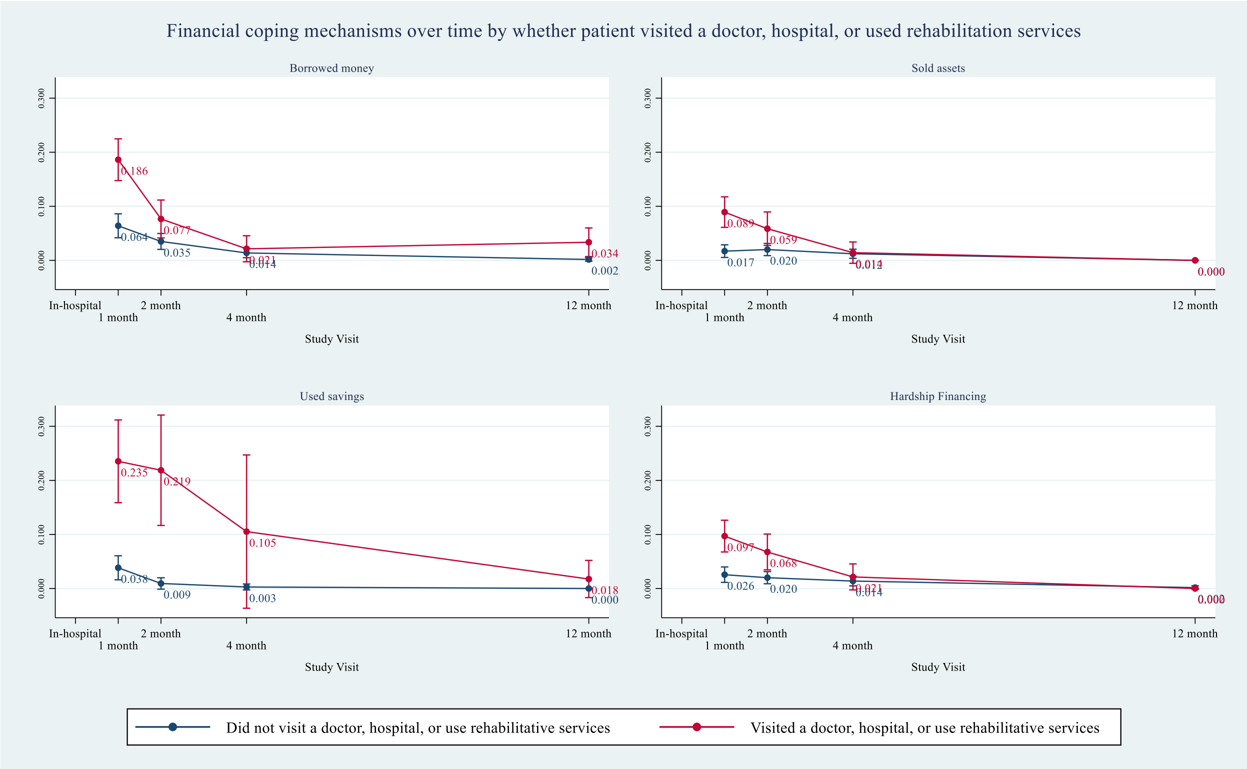
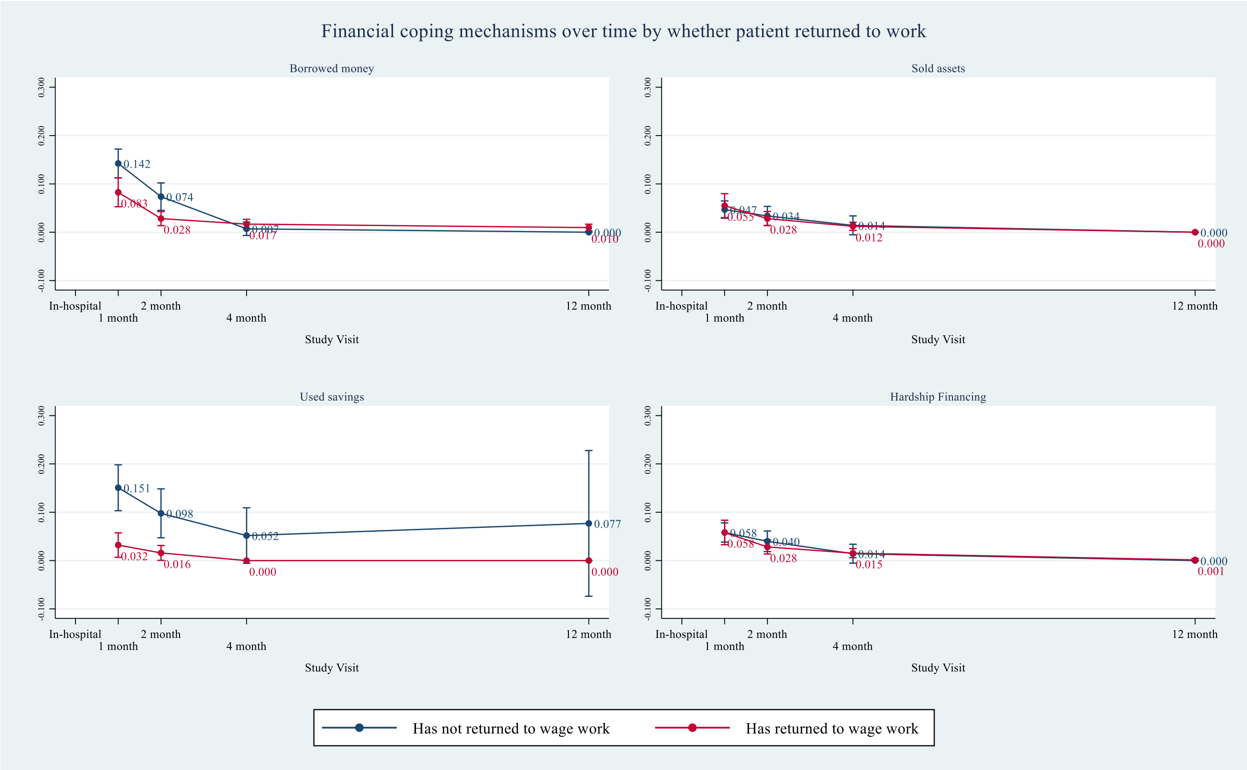


Figure 25: Financial coping mechanisms over time by whether patient had returned to work yet



d. Associations with borrowing money over time

The two models for borrowing, during hospitalization and following hospital discharge, reflected the findings of the graphical and descriptive analysis. Following hospital discharge, the odds of borrowing decreased over time, after controlling for residence, patient functional impairment, whether the patient's household had any savings, direct medical out-of-pocket costs as a proportion of post-injury income, and indirect costs as a proportion of average pre-injury income. (Table 11) Patients had 46.9% lower odds of borrowing at two months after discharged, compared to one month after discharge (aOR = 0.531; $p<0.001$), and a 70.5% reduction in odds of borrowing at four months compared to one month after discharge (aOR = 0.295; $p<0.001$). However, there was no further reduction in the odds of borrowing between four and twelve months following discharge (aOR of 12 mo. vs 4 mo. = 1.004; $p=0.989$).

Also reflecting earlier analyses, rural residents had almost 5 times the odds of borrowing money as compared to urban residents (aOR = 4.999; $p=0.004$), after controlling for other variables in the model. Higher patient functional impairment was associated with borrowing money such that for every one-point increase in WHODAS scores, patients on average increased their odds of borrowing by 2.2% ($p<0.001$). Higher levels of functional impairment were associated accessing health care, particularly formal health care, which in turn was associated with higher levels of out-of-pocket costs as indicated by the descriptive analysis. However, incurring out-of-pocket costs was associated with borrowing money in a curious fashion, with patients who incurred increasingly greater costs as a percentage of post-injury income having higher and then lower odds of borrowing money. Patients who incurred expenses of 10-29% had 1.9 times the odds as compared to those who spend less than 10% (aOR = 1.909; $p=0.007$). However, patients who incurred costs of 30% or greater had 44% lower odds of borrowing as compared to those with costs between 10-29% (aOR of ≥30% vs 10-29% = 0.556; $p = 0.015$).

Table 11: Adjusted and marginalized odds ratios for borrowing money: Post-hospital discharge time points

VARIABLES	aOR	p-value
Residence		
Urban	ref	
Rural	4.999	0.004
WHODAS	1.022	<0.001
Household has savings		
No	ref	
Yes	0.132	<0.001
Direct medical OOP costs (% of post-injury income)		
<10%	ref	
10-29%	1.909	0.007
≥30%	1.062	0.759
Indirect costs (% of pre-injury income)		
<10%	Ref	
10-29%	1.345	0.268
≥30%	1.906	0.002
Time		
1 month post-discharge	Ref	
2 months post-discharge	0.531	<0.001
4 months post-discharge	0.295	<0.001
12 months post-discharge	0.296	<0.001
Constant	0.015	<0.001
Observations	3,208	
Number of participants	859	
SD of random intercept (sigma)	3.786	
Intra-cluster correlation coefficient (rho)	0.813	
Quadrature points	70	

The relationship with income losses showed a more direct relationship with borrowing money, with patients who lost between 10-29% of their preinjury household income as a result of the injury having a non-significant 35% increase in the odds of borrowing from those who lost less than 10% (aOR = 1.345; p=0.268), but with patients who lost 30% or more having 1.9 times the odds as those who lost the least (aOR = 1.906; p=0.002). Further looking at how financial resources affected borrowing, patients who had any savings had an 87% reduction in the odds of borrowing as compared to households which did not have any savings (aOR=0.132; p<0.001). The effect of spending those savings could not be estimated, as one only one household which had savings did not spend them but borrowed money. Each variable discussed above was tested for interaction with time following hospital discharge, but no statistically significant interactions were found.

Table 12: Adjusted odds ratios for borrowing money: Prior to hospital discharge, single time point

	Using Visual Analogue Scale	
Variables	Marginalized aOR	p-value
Insurance		
Insured	ref	
Uninsured	1.893	0.013
Injury Severity Score	1.089	0.001
Child dependency ratio		
≤1	ref	
>1	1.897	0.056
Household has savings		
No	ref	
Yes	0.271	0.017
Direct medical costs: % of monthly post-injury HH income		
<10%	ref	
10-29%	0.635	0.343
≥30%	3.569	0.001
Pre-injury daily per capita income		
More than I$5.50	ref	
I$3.21 to 5.50	2.150	0.001
I$1.91 to 3.20	2.611	0.036
I$1.90 or less	4.222	0.009
Constant	0.025	<0.001
Observations	803	
Number of participants	803	

There were several notable differences in what variables were associated with borrowing money during hospitalization as compared to during the year following hospital discharge. Neither rural residence nor household income following the injury were associated with the odds of borrowing money during hospitalization; while the descriptive analysis showed that rural residence was associated with borrowing prior to hospital discharge, this association did not persist after including patient pre-injury income and insurance status in the model. Post-injury income was not associated with borrowing money in-hospital after controlling for pre-injury income, likely due to the much smaller indirect costs patients incurred during their hospitalization as compared to following discharge. Patient insurance status was significantly associated with borrowing prior to discharge, after controlling for injury severity score, child dependency ratio, whether the household had savings, pre-injury household income category, and direct medical costs. The relationship between direct medical costs and the odds of borrowing showed a that patients spending between 10-29% of household monthly income had no statistically significant difference with those who spent less than 10% (aOR=0.635; p=0.343), but that patients who spent 30% or more of household income on out-of-pocket direct medical costs having 3.6 times the odds of borrowing money as compared to those who spent less than 10% (aOR = 3.569, p=0.001), and 5.6 times the odds of borrowing money as those who spent between 10-29% (aOR = 5.625; p<0.001), after controlling for the other variables in the model. Lacking insurance increased the odds of borrowing almost 1.9 times as compared to those with any form of insurance, even after controlling for all the other variables in the model, including household income prior to injury and direct medical costs. Having any savings lowered the odds of borrowing by over 70% prior to hospital discharge, and by close to 90% following hospital discharge. A higher household child dependency ratio was associated with borrowing while the patient was in hospital, but not after the patient returned back home. While WHODAS scores were not collected during hospitalization, Visual Analog Scores were collected; however, these were not associated with borrowing prior to hospital discharge.

e. Associations with dissaving over time

Unlike other risk factors, patients were first asked whether they had any savings before being asked whether they had spent savings to cope with the injury, and modeling of factors associated with dissaving over time was conducted only with those households which reported they had savings to spend. By twelve months following hospital discharge, a greater proportion of patients reported having any savings as compared to one month following hospital discharge, but fewer respondents reported having any savings to spend if they had used savings in the previous time period. (Table 13 and Figure 26) Urban patients had over six times the odds of having any savings over time as compared to rural residents. The odds of having savings did not differ significantly at two (aOR=0.953; p=0.409) and four months (aOR=0.926; p=0.234) post discharge as compared to the first month following discharge, but at twelve months post discharge, patients' households had 1.3 times the odds of having savings as compared to one month following discharge (aOR=1.342, p<0.001).

Figure 26: Proportion of households which had savings by whether had used savings in the previous time period

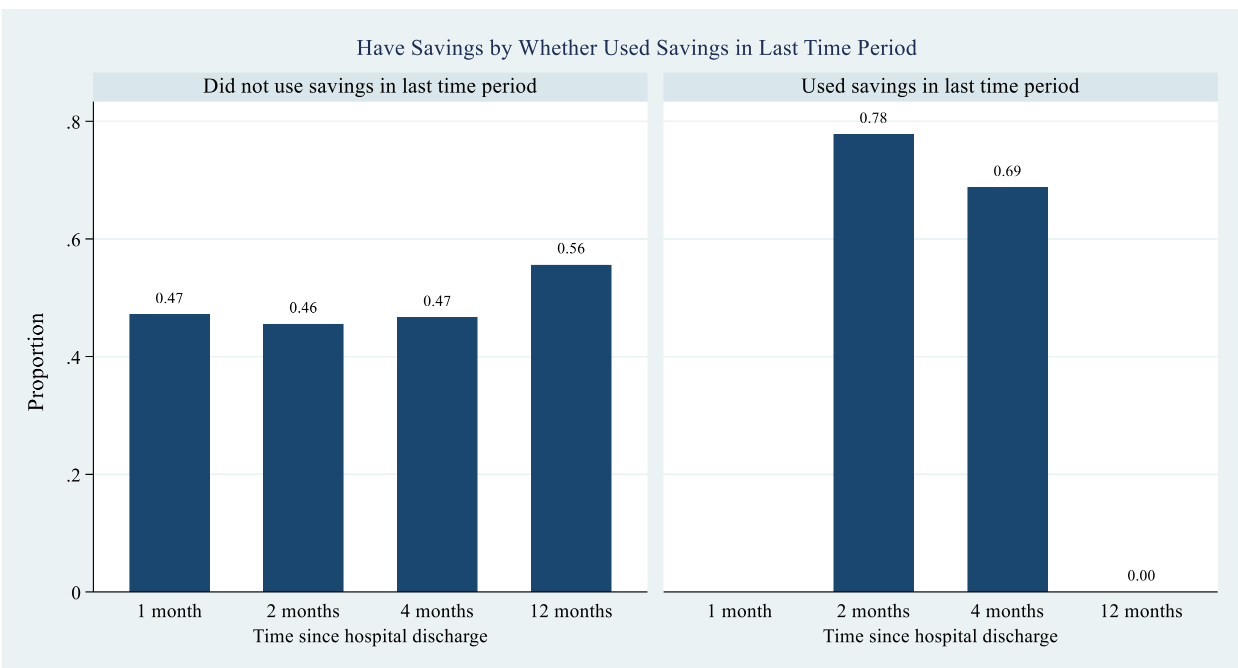


Table 13: Adjusted and marginalized odds ratios for dissaving and for having any savings

	Spent Savings		Have Any Savings	
VARIABLES	aOR marginalized	p-value	aOR marginalized	p-value
Residence				
Urban	ref		6.200	<0.001
Rural	7.314	0.019	ref	
Type of medical care since last follow-up				
No medical care	ref		ref	
Informal health care/pharmaceuticals only	0.809	0.653	0.845	0.042
Health care included doctor/hospital/rehabilitative services	4.601	0.010	0.829	0.008
Indirect costs: % of monthly pre-injury HH income				
<10%	ref		ref	
10-29%	7.947	0.016	1.048	0.696
>=30%	2.078	0.086	1.120	0.157
Time				
1 month post-discharge	ref		ref	
2 months post-discharge	0.548	0.047	0.953	0.409
4 months post-discharge	0.196	0.018	0.926	0.234
12 months post-discharge	0.169	0.025	1.342	<0.001
Constant	0.006	0.006	0.633	<0.001
Observations	1,582		3,215	
Number of patients	503		859	
SD of random intercept (sigma)	6.003		6.776	
Intra-cluster correlation coefficient (rho)	0.916		0.933	
Quadrature points	145		145	

There were very few factors which were independently associated with spending savings among those who reported to have savings, including time since hospital discharge, patient residence, the type of medical care utilized, if any, and the amount of indirect costs. Higher levels of functional impairment, as measured by WHODAS, and direct medical costs were associated with higher odds of dissaving only through the use of type of medical care utilized, and so were not included in the final model. While higher household daily per capita income prior to the injury was associated with the household having savings, living standards were not associated with dissaving among those households with savings to spend. As with borrowing money, spending savings was most likely soon after hospital discharge, with the odds of spending savings decreasing over time, after controlling for residence, health care utilization, and indirect costs. Compared to one month following discharge, rural patients had 45.2% reduction in odds of dissaving at two months (p=0.047). At four months, the odds of dissaving had reduced by another 65%, as compared to two months (aOR of 4 mo. vs 2 mo. = 0.357; p=0.059). The odds of dissaving at 12 months post-discharge, however, was lower but not significantly different from the odds of dissaving at four months after leaving hospital (aOR of 12 mo. vs 4 mo. = 0.863; p=0.835).

Rural patients whose households had savings had over 7 times the odds of spending those savings to cope with the injury as compared to urban patients whose households had savings (aOR=7.314; p=0.019). Patients who used only informal health care providers or pharmaceuticals did not have significantly different odds of borrowing money over the year following discharge compared to patients who did not use any medical care following hospital discharge, after controlling for the other variables in the model (aOR=0.809; p=0.653). Patients whose health care utilization included accessing a doctor, hospital, or rehabilitative services (whether or not in addition to the purchase of drugs or informal health care) had almost five times the odds of borrowing money as compared to patients who did not use any medical care (aOR=4.601; p=0.010). Patients who used formal medical care had close to six times the odds of borrowing money as compared to patients who only used informal medical care or purchased pharmaceuticals, after controlling for residence, indirect costs, and time since discharge (aOR=5.687; p=0.007).

As with borrowing, those patients whose households experienced income losses equivalent to 10-29% of their pre-injury household monthly income had close to eight times the odds of dissaving, compared to those whose household income losses were less than 10% (aOR=7.947; p=0.016), with those whose losses were 30% or greater having a little over twice the odds of dissaving as compared to those with indirect costs were less than 10%, though this was only marginally significant (aOR=2.078; p=0.086). The odds of dissaving for those in the highest category of income losses was significantly lower compared to those in the middle-income group (aOR of ≥30% vs 10-29%=0.261; p=0.038).

Inter-individual heterogeneity accounted for approximately 92% of the total variance in dissaving observed across patients (rho = 0.916). There were no models tested with alternate variables or parameterizations in either the rural or whole sample which explained more than approximately 10% of the total variation, or in which the standard deviation of the random intercept was lower than 6.0. In each of the final models, each covariate was tested for interaction with time and found to be non-significant.

f. Associations with selling assets over time

As with borrowing and dissaving, following hospital discharge, asset sale was a coping mechanism used predominantly by rural households, so much so that modeling patient residence with other covariates was not possible. Also similar to other financial coping mechanisms discussed, asset sale was most common one month after discharge, decreasing in prevalence over the year following hospital discharge such that no households, either urban or rural, sold assets after four months post-discharge. Compared to the first month after hospital discharge, rural patients had 17.0% lower odds of selling assets in the second month, after controlling for household direct medical costs, income category, and whether the household had any savings during the current period, though this was not significant (aOR=0.830; p=0.327). (Table 14) Between the second and fourth month post-discharge, the odds of selling assets decreased by 42.4% among rural residents, compared to the period between the first and second months after leaving hospital (aOR or 4 mo. vs. 2 mo. = 0.576; p=0.032) As no households sold assets following the fourth month following hospital discharge, further comparisons over time cannot be made.

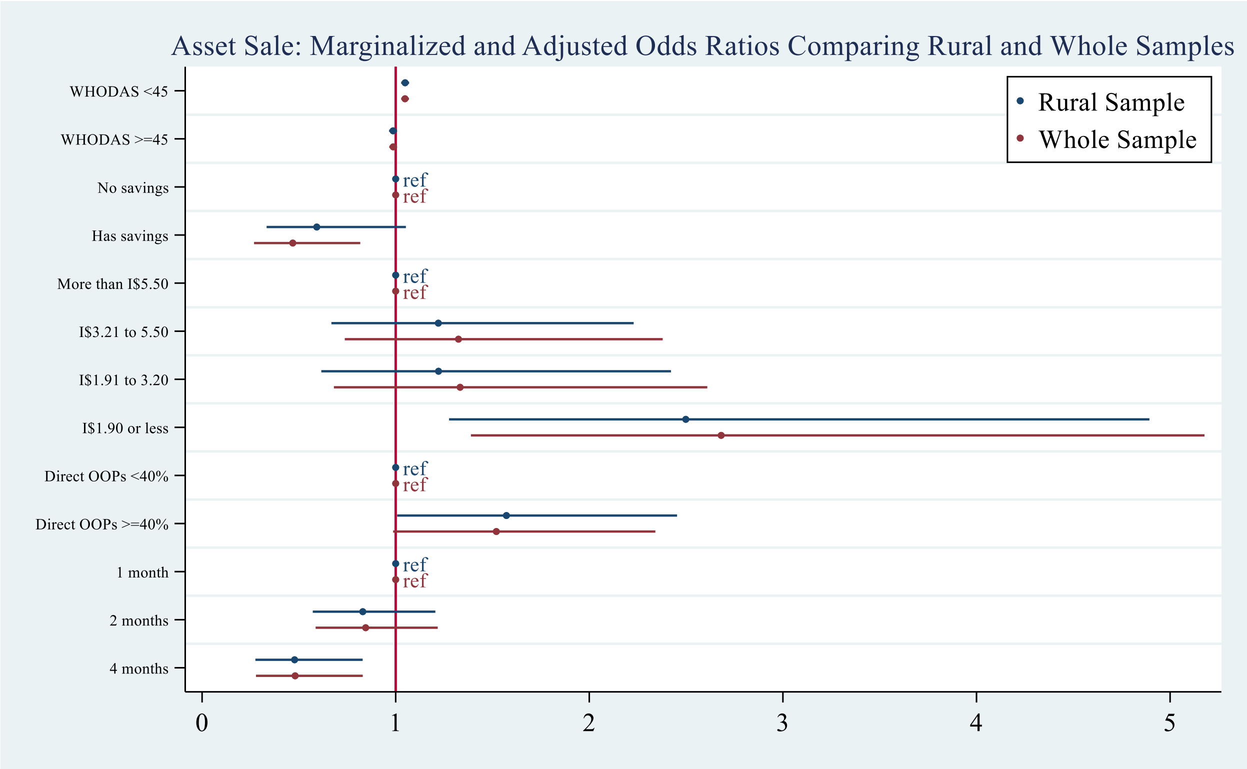
Table 14: Adjusted and marginalized odds ratios for selling assets: Whole sample vs rural residents only

	Rural sample		Whole sample	
VARIABLES	aOR marginalized	p-value	aOR marginalized	p-value
WHODAS				
0-45	1.049	<0.001	1.048	<0.001
46-100	0.986	0.203	0.987	0.212
Household has savings				
No	ref		ref	
Yes	0.592	0.074	0.468	0.008
Post-injury daily per capita income				
More than I$5.50	ref		ref	
I$3.21 to 5.50	1.220	0.517	1.324	0.347
I$1.91 to 3.20	1.221	0.567	1.333	0.402
I$1.90 or less	2.498	0.008	2.681	0.003
Direct medical costs: % of monthly post-injury HH income				
<40%	ref		ref	
≥40%	1.572	0.046	1.520	0.058
Time				
1 month post-discharge	ref		ref	
2 months post-discharge	0.830	0.327	0.845	0.366
4 months post-discharge	0.478	0.009	0.481	0.009
12 months post-discharge	Omitted		Omitted	
Constant	0.012	<0.001	0.011	<0.001
Observations	1,863		2,454	
Number of patients	659		860	
SD of random intercept (sigma)	3.780		3.820	
Intra-cluster correlation coefficient (rho)	0.813		0.816	
Quadrature points	100		100	

The patient's functional impairment was related to the household's choice to sell assets in a non-linear fashion. At lower levels of functional impairment, from a WHODAS score of 0 to 45, every one-point increase in WHODAS was associated with a 4.9% increase in the odds of asset sale (p<0.001). However, further increases in WHODAS scores, from 46 to the maximum of 100, led to a non-statistically significant 1.4% decrease in odds of asset sale for every point increase (p=0.203).

The proportion of monthly income spent on direct medical costs was associated with selling assets, with patients who spent less than 40% of their income have equivalent odds of selling assets, but with patients who spent 40% or more have over 1.5 times the odds of selling assets as compared to those with lower OOPs (aOR = 1.572; p=0.046). The household's financial status also had a significant impact on the decision to sell assets, with households who had any savings having approximately 40% lower odds of asset sale as compared to those who did not have any savings, though this was only marginally significant (aOR = 0.592; p=0.074). As with borrowing, the effect of spending savings on the odds of asset sale could not be estimated, as no household which had savings chose to sell assets and not spend savings. The amount of income lost due to the injury without crossing the threshold of a poverty line did not have a significant relationship with the odds of borrowing. However, there as a significant impact on the odds of borrowing for patients whose households were below the international poverty line of I$1.90 a day per person. There were no statistically significant differences in the odds of asset sale among households which earned above I$5.50, between I$3.21-5.50, and between I$1.91-3.20. However, patients from household living at or below the international poverty line had almost 2.5 times the odds of selling assets as compared to households earning above I$5.50 a day person and a little over twice the odds as households earning between I$1.91 to 3.20 (aOR=2.046; p=0.025) and between I$3.21 to 5.50 (aOR=2.047; p=0.012). In constructing a logistic longitudinal mixed model for the outcome of selling assets, the household's daily per capita income prior to injury was not found to be related with the odds of selling assets following hospital discharge, except as pre-injury income was related to post-injury income through indirect costs. Patients whose households fell below I$1.90 per person did not have different odds of asset sale from those households which had been below this threshold prior to the injury. The model explained approximately 19% of the variation in asset sale observed in the sample over the year of follow up, with the remaining 81% explained by inter-individual variation (rho = 0.813).

Figure 27: Asset sale: Marginalized and adjusted odds ratios comparing rural and whole sample



As asset sale was a financial coping mechanism used exclusively by rural households, the same model constructed within the rural sample was also performed with the entire sample, to compare whether relationships changed between these two analytical samples. The relationships observed and described above within the rural sample were fairly consistent, both in terms of magnitude and statistical significance, when the same model was run with the entire sample. (Figure 27) The odds of selling assets was higher among lower income groups in the whole sample, reflecting the relatively lower incomes of rural residents; and the odds of asset sale was even higher among those without savings as compared to those with savings in the whole sample as compared to the rural sample, reflecting the lower levels of savings among rural residents. Finally, while the relationships between OOPs exceeding 40% post-injury income and asset sale were equivalent in the rural and whole samples, this relationship was only marginally significant in the whole sample.

g. Associations with hardship financing

As with all other financing coping mechanisms mentioned, hardship financing was utilized mostly by rural households and was most common soon after hospital discharge, with odds decreasing over the following year. Between one and two months following hospitalization, the odds of using hardship financing decreased by 31.4% (aOR=0.686; p=0.050); between two and four months, the odds further decreased by 40.0% (aOR of 4 mo. vs. 2 mo. = 0.600; p=0.047); and between four and twelve months, the odds again decreased by approximately 60% (aOR=0.406; p=0.138), after controlling for residence, child dependency ratio, patient functional impairment, and household daily per capita income. (Table 15) Rural households had close to six times the odds of using hardship financing as compared to urban households (aOR=5.940; p=0.012).

The relationship between functional impairment, measured by WHODAS, and the hardship financing followed a similar pattern to that observed with the outcome of asset sale, with higher levels of functional impairment associated with higher odds of hardship financing up to a point: for every one point increase in WHODAS between scores of 0-45, the odds of hardship financing increased by 5.5% (p<0.001), but thereafter increases in WHODAS were associated with a nonsignificant decrease in odds (aOR= 0.983; p=0.112).

Households with higher numbers of children relative to adults was significantly associated with the odds of hardship financing, with those households with child dependency ratios greater than one having close to three times the odds as compared to households with ratios of one or lower (aOR=2.964; p=0.030) Other elements of household structure, such as household size or living alone, were not associated with hardship financing; neither was the household’s financial dependence on the patient prior to the injury associated with hardship financing.

Table 15: Adjusted and marginalized odds ratios for hardship financing

VARIABLES	aOR marginalized	p-value
Residence		
Urban	Ref	
Rural	5.940	0.012
Child dependency ratio		
≤1	ref	
>1	2.964	0.030
WHODAS*		
0-45	1.055	<0.001
46-100	0.983	0.112
Household has savings		
No	ref	
Yes	0.633	0.089
Post-injury daily per capita income		
More than I$5.50	ref	
I$3.21 to 5.50	1.089	0.759
I$1.91 to 3.20	1.323	0.392
I$1.90 or less	2.145	0.016
Time		
1 month post-discharge	ref	
2 months post-discharge	0.686	0.050
4 months post-discharge	0.412	0.001
12 months post-discharge	0.167	0.003
Constant	0.002	<0.001
Observations	3,207	
Number of patient	865	
SD of random intercept (sigma)	3.111	
Intra-cluster correlation coefficient (rho)	0.746	
Quadrature points	100	

* Per point increase in WHODAS score with a linear spline at WHODAS = 45.

Hardship financing was not associated with indirect costs or changes in income, but was associated with the level of income. Households which had been living at a certain income category prior to the injury did not behave differently from households which first experienced that income category following the injury. For example, households whose members had been living at or below I$1.90 a day prior to the injury did not have different odds of hardship financing compared to households whose members' living standards fell to I$1.90 a day or less.

However, while hardship financing did not show differences due to a change or relative changes in income, the odds of hardship financing did show a gradient with the level of post-injury household income. Compared to households with incomes greater than I$5.50 a day per person, those with incomes between I$3.21-5.50 had an 8.9% increase in odds (p=0.759); those with incomes between I$1.91-3.20 had a 32.3% increase in odds (p=0.392); and those with incomes less than I$1.90 a day per person had 114.5% increase in odds (p=0.016) of using hardship financing. Patients whose households had incomes of I$1.90 or less per day per person following the patient's discharge from hospital had close to twice the odds of using hardship financing as compared to households living on I$3.21-5.50 (aOR of ≤I$1.90 vs I$3.21-5.50 = 1.970; p=0.015). There were no statistically significant differences in the odds of hardship financing among other categories. Finally, households which had savings had 36.7% lower odds of using hardship financing as compared to households without any savings. There were no households which used had savings and hardship financing but not dissaving, making estimating the relationship between dissaving and asset sale not possible. Relationships among various financing coping mechanisms over time are explore in Aim 3.

The model for hardship financing explained 25.4% of the variability, with individual variation explaining the remaining 74.6% (rho=0.746). The sample showed large inter-individual variability, with the random intercept having a standard deviation slightly over 3 (sigma = 3.111).

Discussion

Following a moderate to severe injury which required inpatient hospitalization, both insured and uninsured patients in the HEALS cohort in Vietnam experienced very large out-of-pocket direct costs, both in absolute terms and relative to income, as well as serious income losses, by both the patient and other members of the household. These losses, as well as factors such as the patient's rural residence, household child dependency ratio, and functional impairment, led more than 30% of households to borrow money, spend savings, sell assets, or engage in hardship financing, which has the potential to affect income or consumption in the next time period. However, on average, the use of these financial coping mechanisms faded over time, with households able to rebuild at least some savings by the year following hospital discharge.

There was no evidence that households were making decisions about employing various coping mechanisms differentially by the demographics of the patient, such as sex, age, or marital status, or the patient's productive role in the household, such as their occupation or status as a breadwinner for the household. The positionality of the patient within the household was not found to be relevant in using FCM or the choice of FCM, whether or not the patient was insured; there was no evidence that positionality mattered for uninsured patients whose direct health care costs were less protected, as has been found in other contexts. Financial coping among this hospital-based cohort was primary driven by financial need, reflected in the proportion of pre-injury income lost due to the injury, by both patient and household members, and by continued functional impairment, measured by WHODAS and reflected in direct OOPs and health care utilization.

a. The HEALS Cohort and the History of Health Insurance Reform in Vietnam

The socioeconomic and demographic patterns observed in the HEALS cohort, both overall and by insurance status, reflect the history of incremental health insurance expansion in Vietnam as well as typical patterns of health care utilization within the country. Prior to the 2014 Health Insurance Law, formal sector workers were required to have health insurance. Individuals over 60 and those living below or near the poverty line were also required to have health insurance, with their insurance premiums and copays were heavily if not fully subsidized. However, there was no penalty for not having health insurance, and for those individuals outside of the formal sector, there was also no practical way to enforce the insurance requirement. (Somanathan et al., 2014; Thuong, Huy, Tai, & Kien, 2020) Given the positive association between income and formality of occupation, these policies have created an association between being uninsured and being middle-income, a "missing middle," patterns which were observed in the HEALS cohort.

While the under-representation of higher income groups in the HEALS cohort may be in part due to the socioeconomic gradient of injury incidence in Vietnam (as exists elsewhere), it is likely also due to a preference for private health care providers, only some of which are contracted to receive health insurance reimbursements. (Lieberman & Wagstaff, 2009; X. T. Nguyen, Hoang, Nguyen, Byass, & Lindholm, 2005; Somanathan et al., 2014; Thanh et al., 2006) Those who can afford to pay out-of-pocket for a perceived higher-quality provider may opt to do so, despite the actual quality of trauma care at Ninh Bình General Hospital.

The differences in referral pattern between those with and without insured reflects more general patterns of health care utilization and the gatekeeping role of Commune Health Centers (CHCs) in Vietnam. Among those who have insurance, higher copayments are required if they access a provincial hospital, such as Ninh Bình, without a referral from their assigned commune health center, although this practice is common due a perception of low quality of care at the primary level. (Barroy, Jarawan, & Bales, 2014; Lieberman & Wagstaff, 2009; Somanathan et al., 2014; Thuong et al., 2020) Referrals are likely to be less common among the uninsured, since for those without insurance, payments are same whether or not a patient bypasses the CHC. It is also possible that some referrals are from private providers, accessed by the insured, who advise their patients to seek care at the Ninh Bình, given that it is the largest and best equipped trauma center in Vietnam. (T. M. O. Tran et al., 2009)

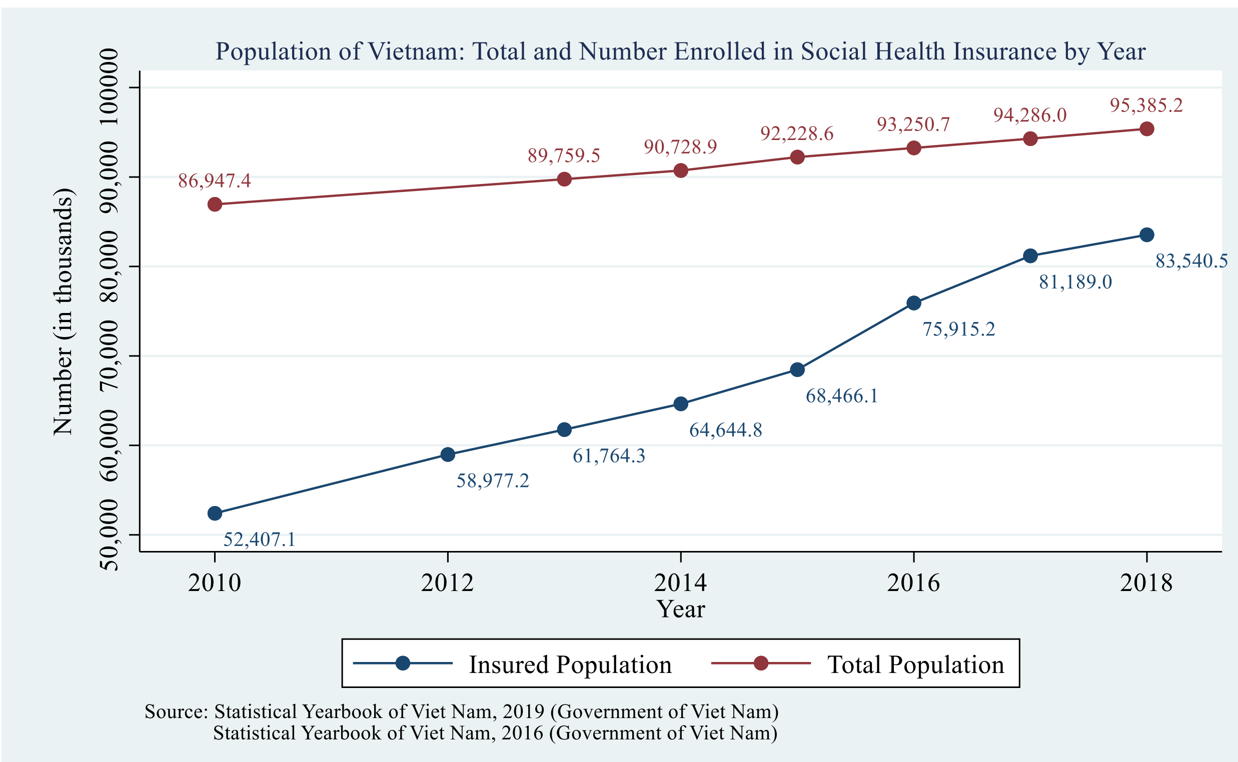
The higher pre-injury WHODAS scores observed among the insured, even after controlling for other factors, may demonstrate some adverse selection into insurance by those with poorer health or greater health needs. Health insurance prior to 2015 was not compulsory for all citizens; this, combined with incomplete enrollment among those for whom it was compulsory and the open nature of the voluntary insurance system, both permitted and incentivized participation in social health insurance by those with greater real or perceived health care needs. (Barroy et al., 2014; Somanathan, Dao, & Tien, 2013; Somanathan et al., 2014; Thuong et al., 2020) There is evidence of adverse selection prior to the merging of the compulsory and voluntary health insurance schemes, such as a greater intensity of health service utilization among those who voluntarily purchased health insurance versus those who were required to be enrolled. (Le, Blizzard, Si, Giang, & Neil, 2020; Somanathan et al., 2014; Thuong et al., 2020) Patients may not be the only agents promoting such adverse selection; this may also have been due in part to the nature of health care purchasing prior to the 2014 health insurance reform law, which went into effect at the beginning of 2015. Hospital were paid through a combination of global budgets based on historical usage and fee-for-service mechanisms, both of which have been documented to induce providers and social service administrators to enroll in health insurance those with greater health needs, in order to promote health service utilization and reimbursement levels. (Somanathan et al., 2014)

b. Temporal Trends and Seasonality

In this longitudinal study, time was defined according to a time origin, the date of admission into hospital of each participant in a rolling cohort. The use of a rolling cohort gives several advantages, as it disconnects trends in time since injury, since hospital admission, or since hospital discharge from normal background trends observed over calendar time. First, the rolling cohort gives an advantage against seasonal trends in income among individuals working in agriculture and in close connection to those working in agriculture in Vietnam, as it disconnects the time since the patient's injury from the normal increases and decreases in income due to harvests in Vietnam. (de Brauw, 2012; Narloch, 2016) However, if seasonality and time since hospital admission coincided systematically, (due to there being an association between discharge date and occupation, or discharge date and average pre-injury income), then changes in income over time which we observe may be confounded by normal background variability rather than the distance in time from hospital discharge. However, a visual analysis of scatterplots of deviance residuals from a multivariable logistic regression of formal employment, and deviance residuals from a multivariable logistic regression of patient occupation as a farmer, both plotted against calendar date of hospital discharge, indicate that there was no temporal trend in hospital admission in the HEALS cohort by individuals working in informal occupations or as farmers, who may be expected to experience greater income volatility over time than those in formal occupations. (Collins et al., 2009; Haughton & Khandker, 2009; Hussmanns, 1993; Morduch, 1995; Sipahimalani-Rao, 2006) While changes in income may be related to calendar time, there was no evidence that such changes in income are linked to time since the injury, as patients did not show temporal trends in hospital discharge by average income, using the same procedure. Therefore, while it may be that changes in income observed over time are due to more than the indirect costs incurred as a result of the injury, and such trends may be tied to calendar time for each individual, there is no evidence that these secular trends have a systematic relationship with time since hospital discharge. Changes in average reported household daily per capita income over time since date of hospital discharge are not confounded by seasonal variation in income tied to occupations in agriculture or formality of occupation.

Recent work illuminating the financial lives of individuals living at or near the international poverty line has illustrated the complex networks of financial transactions that are used in order to promote income and consumption smoothing. (Collins et al., 2009) Individuals living on lower incomes prior to the injury therefore may be expected to have larger baseline propensities to engage in borrowing, selling assets, dissaving, and hardship financing than those living at higher incomes. However, there was no evidence of temporal trends in hospital admission by patients' pre-injury income. Therefore, while there may be baseline variability in patients' propensity to engage in financial coping mechanisms, as predicted by informality of occupation or low levels of income, this variability is not tied to calendar time and therefore not to time measured in reference to the time origin for the study, hospital discharge.

Figure 28: Population of Vietnam: Total and number enrolled in social health insurance by year



There also was no evidence of progressive implementation of the Health Insurance Law of 2014, which went into effect on January 1, 2015. (National Assembly of the Socialist Republic of Vietnam, 2014)

While the Health Insurance Law of 2014 made purchasing health insurance compulsory for all citizens, it did not have penalties for those who failed to purchase health insurance. Enforcing this mandate for informal sector workers is challenging, as their incomes do not flow through formal channels, precluding automatic enrollment and deductions for premiums. (Dao, 2020)

The relationships that we observe between demographics and insurance status during hospitalization are therefore not influenced by date of admission, and the relationships we observe between direct costs and financial coping mechanisms over time are also not influenced by temporal trends in insurance status. While the proportion of the population of Vietnam which is enrolled in social health insurance had been increasing steadily since 2010, there did not appear to be a jump in enrollments during 2015 (Figure 28). (General Statistics Office of Vietnam, 2017, 2020) While the Health Insurance Law of 2014 went into effect in 2015, it did not appear to cause a marked increase in enrollment by the end of the year in 2015. Rather, that increased appeared to happen during 2016.

c. Frequency and Factors Associated with Different Financing Coping Mechanisms

i. Time

The factor with the strongest and most consistent association with the use of borrowing, dissaving, asset sale, and hardship financing was time, the distance in time from the patient's discharge from hospital. Patients and their households were the most likely to use any of these financial coping mechanisms during hospitalization, though factors associated with in-hospital financial coping could not be modeled separately due to available data. Following discharge, patients had progressively smaller odds of utilization of each financial coping mechanism as they moved away from hospital discharge, controlling for other factors including rural residence, functional impairment, child dependency, direct medical costs, indirect costs, or household living standards following hospital discharge.

Time may have operated to reduce the use of financial coping due to patient recovery and return to work, reducing the need to incur costs associated with medical care, reducing the need for other household member to change roles in order to provide informal care within the household, and reducing indirect cost. Patients showed improvements in functional impairment, reductions in indirect costs, and reductions in health care utilization and out-of-pocket direct medical costs over time; and by twelve months, were more likely to have savings than soon after hospital discharge. By definition for this hospital-based cohort, health care utilization was 100% of the sample prior to hospital discharge, with increasingly smaller proportions of the sample accessing any health services, either formal or informal, over the course of the year following discharge. Fewer uninsured than insured patients accessed health care services following discharge, meaning that among those who did access health care services, more of their costs were covered by insurance. Additionally, over time patients reported lower average functional impairment and increasingly returned to their main occupation or paid labor, which reduced indirect costs, either through the patient returning to paid labor or other household members returning to paid labor as they no longer needed to provide informal care to the patient. This suggests that, on average, patients recovered from their injuries over time, increasingly returning to work or daily activities, though with patients who had insurance accessing health care services more often to aid with their recovery.

However, despite controlling for such factors, time was still associated with reductions in the use of financial coping mechanisms. One reason might the timing and predictability of needed expenditures and incurred income losses. By its nature, an injury is an unexpected and sudden negative health event, making it unlikely that households would plan for the out-of-pocket costs of an injury, except in the general way they may plan for realized risks. The study inclusion criteria ensured that patients would be admitted for sudden, unexpected, and at least moderately severe injuries, as only patients whose injuries were severe enough to spend at least 24 hours in the hospital were invited to participate in the cohort, and study exclusion criteria did not admit as participants those individuals who entered the hospital for a planned procedure related to an earlier injury. If borrowing money, selling assets, and dissaving are less preferable options to using current income, but ones which can be leveraged on an emergency basis, this may propel households to use these options earlier on. Borrowing and asset sale may be the only alternatives for households which have liquidity constraints. As time went on, households which were still experiencing higher direct and indirect costs may have been able to utilize other coping mechanisms which cannot be leveraged immediately and were not captured by this study, such as increasing labor supply by other members of the household, physical capital investment reduction, and receiving remittances.

Alternatively, households may also have been able to fund continued direct and indirect costs in later time periods through the funds raised from financial coping mechanisms performed in earlier periods, such as borrowing money and selling assets, particularly if those assets were 'lumpy', by their nature to be bought and sold in large discrete amounts.

A further possibility is that patients may no longer have had assets to sell or borrowing partners from whom to obtain loans. While the available data does not provide information about whether patients had further assets to sell or whether they wished to, yet were unable to obtain loans, fewer patients over time reported that they had any savings to use among those who had used savings in the last time period. This indicates that some households which used savings completely depleted those savings completely over time, without accounting for households which may have partially, but not completely, depleted their savings in previous time periods. A similar reduction in the availability of assets to sell and lenders from which to borrow may have occurred among those who sold assets or borrowed in previous time periods.

ii. Insurance Status, Health Care Utilization, and Direct Medical Costs

Direct OOPs were associated with borrowing before and after discharge, asset sale following discharge, and through the type of medical care used, spending savings. However, while insurance status was associated with borrowing money prior to hospital discharge, it was not associated with any financial coping mechanism following hospital discharge, and no socioeconomic or demographic variables modified had a significant interaction with insurance status. This may be due to an association between having insurance and seeking medical care, within the context of the breadth and depth of insurance in Vietnam. As discussed above, prior to 2015, health insurance was voluntary for part of the population, with open enrollment, and even for those who were required to have health insurance, enrollment was not fully implemented. This created an environment of adverse selection where those with greater real or perceived health care needs were more likely to enroll in health insurance and use health care. (Barroy et al., 2014; Le et al., 2020; Somanathan et al., 2013, 2014; Thuong et al., 2020) This is seen in the HEALS cohort, as those who enrolled in health insurance had higher functional impairment than those who did not, after controlling for demographics targeted for enrollment in health insurance in Vietnam, including older age and lower income. In an environment of open enrollment and voluntary insurance, in policy or implementation, patients who are insured may have or anticipate having higher health care needs, or may have greater health-seeking behavior as compared to those without insurance. This has been found, both in Vietnam and other contexts, to influence both the decision to obtain insurance as well as the decision to seek health care. (Ali, Cookson, & Dusheiko, 2017; Dao, 2020) Indeed, authors in Vietnam and in other contexts have found that, due to increased utilization by those with health insurance, that *having* insurance can paradoxically be associated with an increase in OOPs due to higher health-seeking behavior as compared to those who do not currently have health insurance, while *gaining* insurance is associated with a reduction in OOPs. (Ekman, 2007; Sepehri & Vu, 2019; Thuong et al., 2020) While insurance was not associated with greater OOPs, insurance did not appear to significant lower OOPs on average within the HEALS cohort, where the insured had lower direct medical out-of-costs per visit and per patient, but greater health care utilization, particularly formal health care. Whether having insurance and the resulting expectation of lower direct out-of-pocket cost removes a financial access barrier to obtaining health care; or, whether those who have insurance already have worse health or a greater propensity to seek health care than those who did not have insurance, in the current health insurance policy environment in Vietnam, the result is the same: following discharge, the amount of direct medical out-of-pocket costs incurred between insured and uninsured patients were not significantly different.

iii. Rurality

After time, the next most important factor associated with using each financial coping mechanism examined was rurality, reflecting findings from studies in other low- and middle-income contexts. (Leive & Xu, 2008) Rural patients comprised the majority of the cohort recruited (79% in-hospital) and were also the overwhelming majority of households which employed financial coping mechanisms at each time point – including every households which sold assets.

Rural and urban households had several differences prior to the injury, including levels of education, occupation, daily per capita household income, and whether they had any savings prior to the injury. Urban households showed an overall profile of having a higher socioeconomic status, with more patients working in the formal sector, coming from households with higher income levels, and having higher levels of education among urban as compared to rural patients. Each of these factors may make urban households more financially resilient to health shocks in comparison to rural households. However, level of education, occupation and pre-injury income were not associated with any financial coping mechanism following hospital discharge, except as they were related to post-injury income, and did not affect the relationships between rurality and each financial coping mechanism of interest. However, having savings was related to the decision to borrow money, sell assets, or use hardship financing after considering other factors, or had an effect on the relationships between other variables in the models. Having savings may either indicate that households were able to rely on savings rather than resort to other coping mechanisms, may be a proxy for having sufficient household income to be able to cover out-of-pocket direct medical and non-medical costs, and to sustain a standard of consumption despite indirect costs. Among households which had savings, there were no households which chose to sell assets or engage in hardship financing and not use savings. Only one household with any savings chose to borrow money and not spend savings.

However, after controlling for having any savings, and post-injury income or indirect costs, rurality was still highly related to each financial coping mechanism. One possibility is the increase in direct non-medical costs incurred by living in a rural area, which has been found in other contexts. (Hu et al., 2015) Direct non-medical costs have been found to be substantial in Vietnam, amounting to 15% of direct costs related to a hospitalization for injury, and costing almost half of indirect costs experienced due to a health condition over the course of a year. (Kieu, Trinh, Pham, Nguyen, & Ng, 2020; H. Nguyen et al., 2013) Direct non-medical costs were measured at baseline, but not afterward, however, so this hypothesis cannot be tested with the data used for analysis following discharge.

A second possibility is that extent and solidity of informal mutual insurance networks is greater in rural areas as compared to urban areas, presenting greater opportunities for borrowing to rural households as compared to urban households. The majority of borrowing was not borrowing with interest, but rather took the form of participation in mutual insurance or an informal risk-sharing network, whereas the majority of asset sale took the form of selling productive assets. Such mutual insurance networks depend on the solidification of ties over a period of time, to develop systems for monitoring and enforcing the mutuality of the informal insurance arrangements, both in Vietnam and in other low- and middle-income countries. (Collins et al., 2009; Dao, 2020; Dercon, 2005; Fafchamps, 1999) As Vietnam has a rapidly urbanizing population, it may be that such ties are weaker in urban areas as compared to rural ones. (Phan & Coxhead, 2016) However, this would not explain the association between rural residence and asset sale or dissaving. A third possibility is the liquidity constraints of rural households, in Vietnam as elsewhere, due to involvement in agriculture and lower incomes as compared to urban households. For a similar amount of income, households involved in agriculture require a greater outlay for inputs into agriculture. (De Brauw et al., 2020) The income variable, even with consumption subtracted, may fail to capture actual amount of available income for other expenditure. Liquidity constraints are evident among rural households, which are much less likely to have any savings at each time point. Further, the lower proportion of rural households with any savings does not capture any differential in the amount of savings that may exist between rural and urban households with any savings; the survey does not capture how much savings households with any savings may have. These liquidity constraints are further supported by the choice of assets rural households sold; the majority of households which sold assets sold productive assets such as farm animals, machinery, and land use rights, and were much less likely to do so if they had any savings.

iv. Indirect Costs and Household Daily Per Capita Income

Indirect costs in this study were measured as the losses earned income as a result of the injury by both the patient and his or her household members. However, a human capital approach to measurement of indirect costs typically should include both paid and unpaid labor or the productivity that contributes to the welfare of the patient but is not remunerated in the marketplace. (Liljas, 1998; WHO, 2009) This study cannot cost the losses of unpaid labor by the patient or by household members who provide substitute labor for the patient or increase unpaid labor through providing informal care. However, as indirect costs are assessed not as component of total cost of injury in an economic evaluation, but rather are assessed as possible drivers of patient and household behavior in financially coping with costs, the focus on losses of wage labor is appropriate. Still, these wage labor losses may therefore be considered a minimum for productivity losses.

Indirect costs were, on average, highest for households in the month following hospital discharge. The proportion of pre-injury income lost due to the injury was directly related to borrowing and dissaving over the year following hospital discharge; however, relative income losses were not related to either asset sale or hardship financing. Increasing the odds of asset sale and hardship financing appeared to require the household to be below a particular threshold of living standards. These two financial coping mechanisms may require an increase in absolute poverty rather than only a loss of relative standard of living. The majority of patients whose households sold assets sold productive assets rather selling assets that may be thought of as illiquid savings, while the majority of borrowing was not borrowing with interest, but rather likely represented participation in an informal insurance network. Thus, asset sale was mostly hardship financing, while borrowing was mostly not hardship financing. A relative loss of a standard of living was insufficient to propel hardship financing; it seemed to require actual impoverishment.

For each outcome explored, there was no difference in odds of using a financial coping mechanism between those *were* below a poverty line and those who *fell* below poverty line following the injury; those who fell below a certain income threshold made similar choices to those who had been living below that income threshold. For dissaving, households which experienced larger income losses but which still had savings may have had a preference for either allowing consumption to vary or to use other financial coping mechanisms rather than to deplete their cushion of savings. (G. T. H. Nguyen, White, & Ma, 2008; V. Q. Tran, 2015; Zimmerman & Carter, 2003)

d. Strengths and Limitations

This analysis had several limitations related to measurement. First, hardship financing was not measured prior to hospital discharge, while dissaving and asset sale were measured together during hospitalization. This limited our ability to determine how associations between demographics, income or income losses, household expenditures and household structure may have affected these coping mechanisms prior to hospital discharge, as different from how they were associated with these factors following hospital discharge, as we were able to do for borrowing. Although this did not affect the validity of the current analyses, it did limit the questions which could be addressed.

A second measurement limitation was that, although patients were asked about their direct health care costs and insurance reimbursement at all time points, patients' insurance status was captured only once, at baseline. We were not able to determine whether any patients who were previously uninsured acquired insurance following hospital discharge. Although there were no patients who were uninsured at baseline who subsequently reported any insurance reimbursement for health care costs, this does not allow us to distinguish between patients who remained uninsured and patients who became insured but did not use health care or use their newly acquired insurance for health care costs. This may have led to misclassification of patients by insurance status following hospital discharge. However, other studies have found that patients in Vietnam who acquire insurance also increase their utilization due to their protection against high out-of-pocket costs; it seems unlikely that patients who were uninsured at baseline would acquire insurance following an injury and then not use it to access health care or to lower direct out-of-pocket costs. (Thuong et al., 2020) This is in and of itself interesting, as in other contexts the experience of a health shock has been shown to increase risk aversion, which, if that occurred following the experience of a moderate to severe injury in the current cohort, did not seem to translate into take-up of insurance. (Decker & Schmitz, 2016) Further research is needed to understand what interventions are needed to promote take-up of insurance in Vietnam, as there is no enforcement mechanism for the requirement that citizens have health insurance.

A third measurement limitation is the extent and the bias in missingness of the food consumption measurement. This limits our ability to understand whether food consumption was an alternate coping mechanism that may lower the concurrent or future odds of borrowing, dissaving, asset sale, or hardship financing, or may have been an outcome of previous financial coping. If a reduction in food consumption was driven by indirect costs, a drop in income category, or expenditure on direct medical costs leaving less income for consumption, an association between reduction in food consumption and financial coping may have instead been carried by those variables. This does not invalidate those estimates, but rather makes the estimates of associations between those variables and financial coping a measure of the total effect rather than an estimate only of the direct effect.

A fourth measurement limitation is our inability to cost non-wage labor contributed by the patient to the household, or by other members of the household who may have needed to change roles in order to provide informal care to the patient or take up the patient's wage or non-wage labor. This makes the measurement of indirect costs a minimum for total productivity losses in the household.

A final limitation is that the measurement of patients' functional limitation prior to injury was captured retrospectively. Patients self-reported their functional limitations prior to the injury using the WHODAS instrument during their hospitalization – following the injury. While this retrospective measurement was necessary as this was a hospital-based cohort, it is possible that the patient's experience of injury could have colored their self-evaluation of their own functional limitations prior to the injury. For example, patients may have as a whole had a rosier picture of their own health prior to the injury, when comparing their current state of health to that prior to the injury, leading to WHODAS scores prior to injury being biased upward. It is also possible that other factors associated with WHODAS scores prior to injury may have influenced their report, leading to differential measurement bias. However, it is not possible to test whether or to what extent pre-injury WHODAS scores suffered from measurement bias.

This study had several strengths related to design. First, the inclusion criteria for the study, that a patient had to have been injured severely enough to be admitted for a minimum of 24 hours, and that the patient could not be in the hospital for a procedure related to a previous injury, were intended to restrict the cohort to patients with less serious injuries who may have forgone or significantly delayed medical care. This use of injuries, restricted to moderate to severe injuries, allows us to define a health shock meaningfully as a sudden, unexpected, and severe negative change in health, which allows us to set a time origin for the use of financial coping mechanisms in the year following hospital discharge. Second, the use of a rolling cohort allows us to evaluate and reject the presence of temporal trends in income or occupation in the admission of patients into the cohort, and prevents the time of year in which patients were admitted from confounding associations between changes in income and financial coping. Third, the measurement of indirect costs using the entire household allows us to understand the full scope of the effect of the injury on the entire household, and a more comprehensive measure of how the financial effect on the household system may have influenced the choice of whether to use and which financial coping mechanisms to use. Finally, the longitudinal design allows us to evaluate the impact of an injury past the point of hospitalization into the year following discharge, to understand the extent of the reach of that injury in time in affecting the finances of the household and the health of the patient.

References

Alam, K., & Mahal, A. (2014). Economic impacts of health shocks on households in low and middle income countries: a review of the literature. *Globalization and Health*, *10*(1), 21. https://doi.org/10.1186/1744-8603-10-21

Ali, S., Cookson, R., & Dusheiko, M. (2017). Addressing care-seeking as well as insurance-seeking selection biases in estimating the impact of health insurance on out-of-pocket expenditure. *Social Science and Medicine*, *177*, 127–140. https://doi.org/10.1016/j.socscimed.2016.11.005

Allison, P. D. (2002). *Missing data*. Thousand Oaks, Calif: Sage Publications. Retrieved from https://catalyst.library.jhu.edu/catalog/bib_2664389

Amponsah, S. (2016). The Incidence of Health Shocks, Formal Health Insurance, and Informal Coping Mechanisms. *Perspectives on Global Development and Technology*, *15*(6), 665–695. https://doi.org/10.1163/15691497-12341412

Baron, R. M., & Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research : Conceptual , Strategic , and Statistical Considerations, (6), 1173–1182.

Barroy, H., Jarawan, E., & Bales, S. (2014). *Vietnam - Universal health coverage for inclusive and sustainable development : country summary report*. Retrieved from http://documents.worldbank.org/curated/en/827041468329937967/Vietnam-Universal-health-coverage-for-inclusive-and-sustainable-development-country-summary-report

Berman, P., Ahuja, R., & Bhandari, L. (2010). The Impoverishing Effect of Healthcare Payments in India: New Methodology and Findings. *Economic and Political Weekly*, *XLV*(16), 65–71. https://doi.org/10.2307/25664359

Binnendijk, E., Koren, R., & Dror, D. M. (2012). *Hardship financing of healthcare among rural poor in*

Orissa, India. *BMC Health Services Research* (Vol. 12). https://doi.org/10.1186/1472-6963-12-23

Carlsson, A. M. (1983). Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain*, *16*(1), 87–101. https://doi.org/10.1016/0304-3959(83)90088-X

Collins, D., Morduch, J., Rutherford, S., & Ruthven, O. (2009). *Portfolios of the Poor: How the World's Poor Live on $2 a Day*. Princeton: Princeton University Press. Retrieved from https://catalyst.library.jhu.edu/catalog/bib_3617045

Dao, A. (2020). What it means to say "I Don't have any money to buy health insurance" in rural Vietnam: How anticipatory activities shape health insurance enrollment. *Social Science and Medicine*, *266*. https://doi.org/10.1016/j.socscimed.2020.113335

de Brauw, A. (2012). Seasonal Migration and Agriculture in Vietnam. *SSRN Electronic Journal*, (202). https://doi.org/10.2139/ssrn.1039561

De Brauw, A., Herskowitz, S., Ambler, K., Le, N., Truong, H., Thu, T., … Toth, R. (2020). *Agriculture Value Chain Finance in Viet Nam*. Washington, DC.

Decker, S., & Schmitz, H. (2016). Health shocks and risk aversion. *Journal of Health Economics*, *50*(Supplement C), 156–170. https://doi.org/https://doi.org/10.1016/j.jhealeco.2016.09.006

Demombynes, G., & Vu, L. V. (2015). *Demystifying Poverty Measurement in Vietnam* . *Vienam Development Economics Discussion Paper* . Washington, DC: World Bank .

Department of International and Social Affairs Statistical Office,. (1982). *Provisional Guidelines on Standard International Age Classifications*. New York.

Dercon, S. (2005). Risk, Insurance, and Poverty: a Review. In S. Dercon (Ed.), *Insurance against Poverty* (pp. 9–37). New York : Oxford University Press .

Dercon, S., & Krishnan, P. (2000). In Sickness and in Health : Risk Sharing within Households in Rural Ethiopia. *Journal of Political Economy*, *108*(4), 688–727.

Drummond, M., Sculpher, M. J., Claxton, K., Stoddart, G. L., & Torrance, G. W. (2015). Cost Analysis. In *Methods for the economic evaluation of health care programmes* (4th ed., pp. 219–266). Oxford: Oxford University Press.

Duflo, E., & Udry, C. (2004). Intrahousehold Resource Allocation in Côte D'Ivoire: Social Norms, Separate Accounts and Consumption Choices. *NBER Working Papers*, *1542*, 33–36. https://doi.org/10.1017/CBO9781107415324.004

Ekman, B. (2007). Catastrophic health payments and health insurance: Some counterintuitive evidence from one low-income country. *Health Policy*, *83*, 304–313. https://doi.org/10.1016/j.healthpol.2007.02.004

Fafchamps, M. (1999). *Rural Poverty, Risk and Development*. Oxford. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.95.7536&rep=rep1&type=pdf

Filmer, D., & Pritchett, L. H. (2001). Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India. *Demography*, *38*(1), 115–132.

Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2011a). *Applied longitudinal analysis*. *Applied longitudinal analysis* (2nd ed). Hoboken: Wiley. Retrieved from https://catalyst.library.jhu.edu/catalog/bib_4329556

Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2011b). Missing Data and Dropout: Multiple Imputation and Weighting Methods. In *Applied Longitudinal Analysis* (2nd ed., pp. 965–1030). Hoboken: Wiley.

Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2011c). Missing Data and Dropout: Overview of Concepts and Methods. In *Applied Longitudinal Analysis* (2nd ed., pp. 916–964). Hoboken: Wiley.

Flores, G., Krishnakumar, J., O'Donnell, O., & Van Doorslaer, E. (2008). Coping with Health-Care Costs: Implications for the Measurement of Catastrophic Expenditures and Poverty. *Health Economics*, *17*, 1393–1412. https://doi.org/10.1002/hec.1338

General Statistics Office. (2016). *Vietnam Household Living Standards Survey 2016*. Hanoi. Retrieved from http://www.gso.gov.vn/default_en.aspx?tabid=515&idmid=5&ItemID=18977

General Statistics Office of Vietnam,. (2017). *Statistical Yearbook of Vietnam, 2016*. Hanoi, Vietnam.

General Statistics Office of Vietnam,. (2020). *Statistical Yearbook of Vietnam 2019*. Hanoi, Vietnam.

Goldstein, M. (1999). Chop time, no friends: Intrahousehold and individual insurance mechanisms in Southern Ghana. *University of California at Berkeley, Department of Agricultural and Resource Economics*, 1–59. Retrieved from http://aida.econ.yale.edu/~cru2/pdf/insurancev2.pdf

Haddad, L., Hoddinott, J., & Alderman, H. (1997). *Intrahousehold Resource Allocation in Developing Countries: Methods, Models, and Policy*. *IFPRI*. Baltimore and London: Johns Hopkins University Press. https://doi.org/10.1016/S0306-9192(98)00011-6

Haughton, J., & Khandker, S. (2009). Measuring Poverty. In *Handbook on Poverty and Inequality* (pp. 9–37). Washington, DC: World Bank Group. https://doi.org/10.1596/978-0-8213-7613-3

Hedeker, D., du Toit, S. H. C., Demirtas, H., & Gibbons, R. D. (2018). A Note on Marginalization of Regression Parameters from Mixed Models of Binary Outcomes. *Biometrics*, *74*(1), 354–361. https://doi.org/10.1016/j.physbeh.2017.03.040

Hu, H., Sawhney, M., Shi, L., Duan, S., Yu, Y., Wu, Z., … Dong, H. (2015). A Systematic Review of the Direct Economic Burden of Type 2 Diabetes in China. *Diabetes Ther*, *6*, 7–16. https://doi.org/10.1007/s13300-015-0096-0

Hung, Y. W., He, H., Mehmood, A., Botchey, I., Saidi, H., Hyder, A. A., & Bachani, A. M. (2017). Exploring injury severity measures and in-hospital mortality: A multi-hospital study in Kenya. *Injury*, *48*(10), 2112–2118. https://doi.org/10.1016/j.injury.2017.07.001

Hussmanns, R. (1993). *Defining and measuring informal employment*. Geneva.

International Comparison Program. (2018). PPP conversion factor, private consumption (LCU per international $) . Retrieved June 17, 2020, from https://data.worldbank.org/indicator/PA.NUS.PRVT.PP

International Labour Organization (ILO). (1993). *Resolutions Concerning Statistics of Employment in the Informal Sector, Adopted by the 15th International Conference of Labour Statisticians*. New York.

Jakobsen, J. C., Gluud, C., Wetterslev, J., & Winkel, P. (2017). When and how should multiple imputation be used for handling missing data in randomised clinical trials - A practical guide with flowcharts. *BMC Medical Research Methodology*, *17*(1), 162–172. https://doi.org/10.1186/s12874-017-0442-1

Jolliffe, D. M., & Prydz, E. B. (2016). *Estimating International Poverty Lines from Comparable National Thresholds.* Washington, D.C. Retrieved from http://documents.worldbank.org/curated/en/837051468184454513/Estimating-international-poverty-lines-from-comparable-national-thresholds

Kieu, T. T. M., Trinh, H. N., Pham, H. T. K., Nguyen, T. B., & Ng, J. Y. S. (2020). Direct non-medical and indirect costs of diabetes and its associated complications in Vietnam: An estimation using national health insurance claims from a cross-sectional survey. *BMJ Open*, *10*(3). https://doi.org/10.1136/bmjopen-2019-032303

Kruk, M. Eo. in four households in forty developing countries resort to “hardship financing” to pay for health care, Goldmann, E., & Galea, S. (2009). Borrowing And Selling To Pay For Health Care In Low-

And Middle-Income Countries. *Health Affairs*, *28*(4). https://doi.org/10.1377/hlthaff.28.4.1056

Le, Q. N., Blizzard, L., Si, L., Giang, L. T., & Neil, A. L. (2020). The evolution of social health insurance in Vietnam and its role towards achieving universal health coverage. *Health Policy OPEN*, *1*, 100011. https://doi.org/10.1016/j.hpopen.2020.100011

Leive, A., & Xu, K. (2008). Coping with out-of-pocket health payments: Empirical evidence from 15 African countries. *Bulletin of the World Health Organization*, *86*(11), 849–856. https://doi.org/10.2471/BLT.07.049403

Lieberman, S., & Wagstaff, A. (2009). *Health financing and delivery in Vietnam: looking forward*. Washington, DC. Retrieved from http://documents.worldbank.org/curated/en/295021468124767254/Health-financing-and-delivery-in-Vietnam-looking-forward

Liljas, B. (1998). How to calculate indirect costs in economic evaluations. *PharmacoEconomics*, *13*(1 PART I), 1–7. https://doi.org/10.2165/00019053-199813050-00009

Madley-dowd, P., Hughes, R., Tilling, K., & Heron, J. (2019). The proportion of missing data should not be used to guide decisions on multiple imputation. *Journal of Clinical Epidemiology*, *110*, 63–73. https://doi.org/10.1016/j.jclinepi.2019.02.016

Morduch, J. (1994). Poverty and Vulnerability. *The American Economic Review*, *84*(2), 221–225. https://doi.org/10.2307/2117833

Morduch, J. (1995). Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives*, *9*, 103–114.

Narloch, U. (2016). *The Varying Income Effects of Weather Variation: Initial Insights from Rural Vietnam* (Policy Research Working Papers). Washington, DC: The World Bank.

https://doi.org/10.1596/1813-9450-7764

National Assembly of the Socialist Republic of Vietnam. Vietnamese Law on Health Insurance of 2014 (2014). Government of Vietnam; Hanoi, Vietnam.

Nguyen, G. T. H., White, B., & Ma, C. (2008). When Faced with Income and Asset Shocks, Do Poor Rural Households in Vietnam Smooth Food Consumption or Assets? *The Journal of Development Studies*, *55*(9). https://doi.org/10.1080/00220388.2018.1528350

Nguyen, H., Ivers, R. Q., Jan, S., Martiniuk, A. L. C., Li, Q., & Pham, C. (2013). The economic burden of road traffic injuries: evidence from a provincial general hospital in Vietnam. *Injury Prevention*, *19*, 79–84. https://doi.org/10.1136/injuryprev-2011-040293

Nguyen, X. T., Hoang, M. H., Nguyen, T. K. C., Byass, P., & Lindholm, L. (2005). Does poverty lead to non-fatal unintentional injuries in rural Vietnam? *International Journal of Injury Control and Safety Promotion*, *12*(1), 31–37. https://doi.org/10.1080/17457300512331342207

O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2008). Measurement of Living Standards. In *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation* (pp. 69–82). Washington, D.C. Retrieved from http://web.worldbank.org/archive/website01411/WEB/IMAGES/HEALTHEQ.PDF

Phan, D. N., & Coxhead, I. (2016). Rural-Urban Migration and Remittances in Vietnam: Evidence from Migrant Tracer Data. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2751939

PovcalNet. (n.d.). CPI--Consumer Price Index. Base year 2011. Retrieved June 17, 2020, from http://iresearch.worldbank.org/PovcalNet/data.aspx

Rabe-Hesketh, S., & Skrondal, A. (2008). Dichomous or Binary Responses. In *Multilevel and Longitudinal Modeling using Stata2* (2nd ed, pp. 501–574). College Station, TX: Stata Press Publication.

Royston, P., & White, I. R. (2011). Multiple Imputation by Chained Equations (MICE): Implementation in Stata. *Journal of Statistical Software*, *45*(4), 1–20. Retrieved from http://www.jstatsoft.org/

Segui-Gomez, M., & Lopez-Valdes, F. J. (2012). Injury Severity Scaling. In G. Li & S. Baker (Eds.), *Injury Research: Theories, Methods, and Approaches* (pp. 281–296). New York: Springer.

Sepehri, A., & Vu, P. H. (2019). Severe injuries and household catastrophic health expenditure in Vietnam: findings from the Household Living Standard Survey 2014. *Public Health*, *174*(204), 145–153. https://doi.org/10.1016/j.puhe.2019.06.006

Sipahimalani-Rao, V. (2006). *Income Volatility and Social Protection in Developing Asia*. Manila. Retrieved from www.adb.org/economics

Somanathan, A., Dao, H. L., & Tien, T. Van. (2013). *Integrating the Poor into Universal Health Coverage in Vietnam*. World Bank, Washington DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/13315

Somanathan, A., Tandon, A., Dao, H. L., Hurt, K. L., & Fuenzalida-Puelma, H. L. (2014). *Moving towards Universal Health Coverage of Social Health Insurance in Vietnam: Assessment and Options.Directions in Development.* Washington, D.C.: The World Bank Group. https://doi.org/10.1596/978-1-4648-0261-4

StataCorp. (2017). Stata Statistical Software: Release 15. College Station, TX: StataCorp LP.

Strauss, J., & Thomas, D. (1995). Human Resources: Empirical Modeling of Household And Family Decisions. *Handbook of Development Economics*, *III*.

Thanh, N. X., Hang, H. M., Chuc, N. T. K., Rudholm, N., Emmelin, A., & Lindholm, L. (2006). Does "the injury poverty trap" exist?: A longitudinal study in Bavi, Vietnam. *Health Policy*, *78*(2), 249–257. https://doi.org/https://doi.org/10.1016/j.healthpol.2005.10.003

The World Bank. (2017). Moving toward UHC : Vietnam - national initiatives, key challenges, and the role of collaborative activities. Washington, D.C.: World Bank Group. Retrieved from http://documents.worldbank.org/curated/en/464111513160157867/Moving-toward-UHC-Vietnam-national-initiatives-key-challenges-and-the-role-of-collaborative-activities

Thuong, N. T. T., Huy, T. Q., Tai, D. A., & Kien, T. N. (2020). Impact of Health Insurance on Health Care Utilisation and Out-of-Pocket Health Expenditure in Vietnam. *BioMed Research International*, *2020*. https://doi.org/10.1155/2020/9065287

Tran, T. M. O., Tran, V. T., Duong, H. L., Khuong, A. T., Nguyen, K. P., Le, Q. C., … Helfenbein, S. (2009). *Assessing Provincial Health Systems in Vietnam: Lessons from Two Provinces*. Bethesda, MD. Retrieved from https://www.hfgproject.org/wp-content/uploads/2015/02/Assessing-Provincial-Health-Systems-in-Vietnam-Lessons-from-Two-Provinces.pdf

Tran, V. Q. (2015). Household's coping strategies and recoveries from shocks in Vietnam. *Quarterly Review of Economics and Finance*, *56*, 15–29. https://doi.org/10.1016/j.qref.2014.06.006

Üstün, T., Kostanjsek, N., Chatterji, S., & Rehm, J. (Eds.). (2010). *Measuring Health and Disability: Manual for WHO Disability Assessment Schedule (WHODAS 2.0 WHO Library Cataloguing-in-Publication Data Measuring Health and Disability: Manual for WHO Disability Assessment Schedule (WHODAS 2.0)* . Malta: World Health Organization.

Von Hippel, P. T. (n.d.). How Many Imputations Do You Need? A Two-stage Calculation Using a Quadratic Rule. *Sociological Methods & Research*, *2020*(3), 699–718. https://doi.org/10.1177/0049124117747303

White, H., & Masset, E. (2003). The importance of household size and composition in constructing poverty profiles: An illustration from Vietnam. *Development and Change*, *34*(1), 105–126.

https://doi.org/10.1111/1467-7660.00298

White, I. R., Daniel, R., & Royston, P. (2010). Avoiding bias due to perfect prediction in multiple imputation of incomplete categorical variables. *Computational Statistics and Data Analysis*, *54*(10), 2267–2275. https://doi.org/10.1016/j.csda.2010.04.005

White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine*, *30*(4), 377–399. https://doi.org/10.1002/sim.4067

WHO. (2009). *Guide to Identifying the Economic Consequences of Disease and Injury*. Geneva. https://doi.org/10.1073/pnas.1400475111

WHO. (2015). *Tracking Universal Health Coverage: First Global Monitoring Report*. Geneva. Retrieved from http://www.who.int/healthinfo/universal_health_coverage/report/2015/en/

World Bank Group. (2019). *Poverty & Equity Brief: Vietnam*. Washington, DC. Retrieved from https://databank.worldbank.org/data/download/poverty/33EF03BB-9722-4AE2-ABC7-AA2972D68AFE/FM2019/Global_POVEQ_VNM.pdf

World Bank Group. (2020). *Poverty & Equity Brief: East Asia and Pacific*. Washington, DC. Retrieved from https://databank.worldbank.org/data/download/poverty/33EF03BB-9722-4AE2-ABC7-AA2972D68AFE/Global_POVEQ_EAP.pdf

Young, R., & Johnson, D. R. (2015). Handling Missing Values in Longitudinal Panel Data With Multiple Imputation. *Journal of Marriage and Family*, *77*(1), 277–294. https://doi.org/10.1111/jomf.12144

Zimmerman, F. J., & Carter, M. R. (2003). Asset smoothing, consumption smoothing and the reproduction of inequality under risk and subsistence constraints. *Journal of Development Economics*, *71*, 233–260. https://doi.org/10.1016/S0304-3878(03)00028-2

Paper 2: Discharge Against Medical Advice in a Passive Purchasing Environment: Estimating the Effects on Direct Costs, Health Care Utilization, Patient Health, and Household Indirect Costs

Introduction

The goals of health financing for universal health coverage are to enable the use of effective health services by all people without requiring those who use health services to incur financial hardship. (Kutzin 2013) Health services covered should include not only curative and rehabilitative services, but also health promotion and prevention services as well. Part of effective coverage is that patients receive services appropriate to need at a quality that is sufficient to promote, protect, and restore health and well-being. Protection from financial hardship means that when patients utilize health services that they should not face either impoverishment or a disruption in living standards as a result of directly paying for health services, or paying other costs in an effort to access health services. These two goals are joined together, rather than place in tension. Patients should not have to choose between accessing effective coverage and avoiding financial hardship. When patients choose to access health care which causes financial hardship, they may cope with such costs through potentially maladaptive coping mechanisms such as borrowing money with interest, selling productive assets, or liquidating a personal or familial safety net. However, patients may also choose to cope with health care costs which may cause financial hardship by forgoing health care and its associated costs. Universal health coverage therefore both embodies and is integral to the goals of overall health systems, which are to make all types of effective health care available and accessible to all persons; to ensure equitable utilization of services across a population; and arrange equitable distribution of the financial burden of funding health care services.

Financial accessibility involves ensuring against cost acting as a barrier to accessing all needed services. Cost may serve as a barrier when individuals who utilize health services face financial hardship. This financial protection encompasses protection against burdensome payments for health care as well as the costs spent accessing health care. Cost may also service as a barrier when individuals forgo needed health care due to inability to pay. Forgoing medical care following an injury can take several forms.

First, individuals who are injured may delay care, or not seek medical care at all; may seek medical care at a lower level of intensity than appropriate to need; may refuse certain types of care; may leave care against medical advice; may forgo follow-up care; or any combination of the above. This study focuses on trauma and injury patients who leave hospital against medical advice (LAMA) following admission, also called discharge against medical advice (DAMA). Hospital discharge planning is a key component of care coordination, and how discharge occurs is almost as important as when it occurs. Discharge should take place when the patient may leave hospital without significant risk to the patient's health, well-being, recovery, or stability; and should involve the arrangement and coordination of appropriate follow-up care, with the discharge plan clearly communicated to the patient. (Alfandre 2018; Ciapponi et al. 2017; Gonçalves-Bradley et al. 2016) Discharge against medical advice describes the patient making the decision to leave hospitalization at a time before it is recommended by the health care provider, and when the health care provider recognizes the patient's competence and right to autonomy and self-determination to make decisions about their own care. (Alfandre 2018; Gonçalves-Bradley et al. 2016)

Ensuring equitable utilization of services requires covering gaps in population, service, and financial coverage. If such gaps remain, individuals may forgo needed health services in order avoid associated direct medical and non-medical costs as a form of financial coping. This form of financial coping may have serious consequences for the physical health of the patient, but also the financial health of the patient and household. If avoiding medical care prolongs a period of temporary disability, it may increase indirect costs, if the patient is not able to return fully to work, or if others in the household have to forgo income in order to provide informal care for the patient or to substitute for the patient's role in the household. The choice between using health services and avoiding direct health care costs may also be the choice between incurring direct costs and incurring additional indirect costs as well as prolonging a period of disability. Any of these options may potentially lead to negative financial or health consequences in the mid- to long-term.

There may be patient-, doctor-, and/or hospital-related factors affecting the risk of a patient leaving against medical advice. Patient factors which increase the risk of LAMA include having lower income and lower levels of education; being uninsured or, in the United States, having public insurance such as Medicaid; younger age; being male; having a mental health, substance use, and/or alcohol use disorder; and having financial or familial obligations. (Ashrafi et al. 2017; Baptist et al. 2007; Gautam et al. 2018; Hasan et al. 2019; Ibrahim, Kwoh, and Krishnan 2007; Jasperse et al. 2020; Mohseni et al. 2015; Nagarajan et al. 2018; Onukwugha et al. 2012; Ramakrishnan et al. 2018; Spooner et al. 2017; Tawk, Freels, and Mullner 2013) However, these factors are not consistent in their relationship with discharge type; both the risk factors and the prevalence of LAMA vary by the patient's health condition, hospital type, and the country or regional context.

The potential consequences of LAMA include increased and otherwise unnecessary contact with health care providers through quick hospital readmission, increased morbidity and even increased mortality for some patients. (Hasan et al. 2019; Hwang et al. 2003; Olufajo et al. 2016; Ramakrishnan et al. 2018; Southern, Nahvi, and Arnsten 2012) This may even lead to higher direct medical and nonmedical costs for some patients; if the patient left hospital against medical advice to avoid financial hardship, the risk taken would have effectively backfire. (Alfandre 2009)

The final and perhaps most fundamental goal of universal health coverage is to ensure that effective health services are available for all persons, regardless of demographic group membership or ability to pay. Ensuring universality of coverage requires generating sufficient revenue to fund health services through increasing fiscal space, efficiently organizing expenditures, and ensuring an equitable distribution of the financial burden of funding health services in a society. Each of these various goals is integral to the success of all the others: sufficient revenue is required to produce the full range of comprehensive health services of sufficient quality, while efficiently organizing expenditures can increase the supply of health care appropriate to need while providing financial protection to patients.

Marshalling, efficiently organizing, and equitably distributing the revenue burden sustainably promotes an adequate supply of quality health care services, while financial protection promotes accessibility and equitable utilization.

This study has several aims. The first is to understand what characteristics of the patient, the injury, and the household may influence the decision to forgo needed medical care, focusing here on leaving hospital early against medical advice. Second, this study examines whether and to what extent LAMA was a component of managing health care costs associated with a hospitalization. This study estimates the direct medical cost savings that patients and households gained through leaving hospital early, and how many days early did these patients leave. Finally, this study aims to understand what health and financial consequences the decision to LAMA may have had for the patient and household in the year following hospital discharge: whether forgoing medical care had consequences for patients' levels of impairment or functionality in the year following injury, or led to increased total household indirect costs.

Methods

a. Variable definitions

Variable definitions for covariates were maintained for all analyses as described in Paper 1.

i. Forgoing needed medical care: Independent variable definition

Prior to leaving hospital, all study participants were considered to require medical attention, by reason of having been admitted to the hospital for a minimum period of 24 hours, per study inclusion criteria. Propensity score matching was used to define a sample of patients similar on need for medical care, using both patient and injury-related factors, as described further below.

Forgoing medical care was defined as leaving hospital against medical advice, compared to the referent condition of being discharged from hospital. While in the literature, the concept of forgoing medical care sometimes includes patients who are unable to access needed care, this narrower definition is used to explore the concept as a coping strategy. Both types of hospital discharge were reported to interviewers from medical records or medical staff. Patients who were transferred to another health care provider were not included in the analysis sample, as their ultimate discharge type did not appear in the dataset.

ii. Impact of forgoing needed medical care: Outcome definitions

Four consequences of forgoing medical care were considered: the direct medical costs that patients avoided; the amount of medical care patients avoided; the patients self-reported levels of functionality and impairment; and indirect costs to the patient and their household members.

The direct medical costs that patients avoided was defined as the difference between the total hospital bill patients who left against medical advice incurred and what a similarly injured set of patients who were discharged incurred. The amount of medical care that was avoided was evaluated during hospitalization as the reduction in length of stay by patients who left hospital against medical advice, against similarly injured patients who were discharged. In evaluating whether forgoing medical care had an impact on patients' levels of impairment or functionality, the World Health Organization Disability Assessment Schedule (WHODAS) was used to define functionality on a continuous scale, as described in paper 1.

Finally, to understand whether forgoing medical care had an impact on household income losses over follow-up, indirect costs were defined as the income losses by patients and household members which those income earners attributed to the injury, as described in paper 1. This definition was used as patients were asked for their average monthly household income prior to the injury, but after the injury were asked for their household income in the month prior to the survey. Income reported in the month prior to the survey therefore may be subject to seasonal variation, or other variability, which cannot necessarily be attributed to the injury. Such confounding by time can be avoided through using a direct measure of income losses which income earners themselves attribute to the injury; these losses may be due to the patient being unable to return to work, or other household members losing income in order to provide informal care to the patient, or substitute for the patient's role in the household. These reported indirect costs are assumed to be reported as net losses incurred by household members, as the questions intend.

b. Data analysis

Four analyses were conducted to explore the relationships among insurance status, forgoing health care, direct medical costs, indirect costs, and health status after leaving hospital. First, the relationship between LAMA and insurance status, among other factors, was explored through multivariable logistic regression. Second, propensity score matching on variables associated with health care need was used to understand how LAMA impacted length of stay and total hospital charges. Third, a difference-in-differences strategy was used to understand the impact of forgoing medical care and insurance status on self-reported impairment, measured by differences in WHODAS scores from prior to injury, using the propensity score matched sample. Finally, longitudinal mixed modeling was used to estimate the impact of forgoing medical care on indirect costs over the year following discharge, again using the propensity score matched sample.

i. Associations with leaving against medical advice

A multivariable logistic regression was used to evaluate what factors may be associated with LAMA as compared to being discharged, including patient demographics and pre-injury disability status, household economic status, injury-related factors, and insurance status. Missing values were imputed using multiple imputation by chained equations, as described in paper 1. Imputed datasets were used for regression analyses, while descriptive analyses used the original data, only.

ii. Consequences of forgoing medical care on direct medical costs and lengths of stay in-hospital

Several analyses were done to understand the potential impacts of having left hospital against medical advice on direct medical costs and lengths of stay, as compared to patients who were discharged. As there were differences in distributions of the variables that were associated with required intensity of health services, propensity score matching was used to avoid extrapolating through regression. To estimate a counterfactual cost for patients who left against medical advice had they been discharged, patients who left hospital against medical advice were matched against those who were discharged from hospital using 1:1 nearest-neighbor propensity score matching without replacement. Propensity scores are the probability that the patient selected the independent variable of interest, in this case LAMA, conditional on covariates. When analyses are restricted to the set of pairs matched by propensity scores, then selection into the independent variable is ignorable with respect to observed covariates when estimating the relationship of the independent variable with dependent variables. (Rubin 1973, 1979) In this case, the independent variable was whether or not the patient left against medical advice, and the dependent variables are the total hospital charges and the patient's length of stay.

Propensity scores for LAMA versus being discharged were estimated using logistic regression, including in the model variables which are associated with the intensity of needed in-hospital health services, including patient factors (age category, sex, and pre-injury impairment measured by WHODAS), and injury-related factors (the injury cause and intent, the number of injuries, estimated Injury Severity Score, Glasgow Coma Scale at arrival, and the patient referral process and hospital admitting department). The aim was to create groups which differed in their discharge type from hospital, but were similar on all observed injury and patient factors affecting needed in-hospital health care usage, and who therefore should have had similar medical care, reflected in similar hospital charges and lengths of stay, had they all been properly discharged.

In order to be able to assess whether insurance status, which is not related to the intensity of needed in-hospital health services, may have modified the relationships between LAMA and direct costs or lengths of stay, propensity scores were estimated separately within the insured and uninsured groups. In theory, while correctly specified propensity score models estimated using the entire sample should not differ within subgroups, in practice, this may require large sample sizes, with subgroups needing to exceed 1000 observations each. (Rassen et al. 2012) However, the in-hospital sample for the HEALS cohort was just 1,022 individuals, so subgroup samples cannot meet this threshold. In practice, in order to assess whether the factors that affect patients' decisions to leave against medical advice differ by insurance status, separate estimation of propensity scores within each subgroup has had the best performance in making causal inferences. (Green and Stuart 2014)

Balance on covariates between those who did and did not leave against medical advice was assessed by comparing the standardized mean difference, also called the standardized bias, for each variable before and after the matching process. The standardized mean difference is the difference in means of each variable in units of whole sample standard deviation, which should be lower than before the matching, and overall below approximately 0.1, although opinions differ about whether up to 0.25 is reasonable. (Stuart, Lee, and Leacy 2013) As propensity score matching usually involves restricting the analytical sample to patients with similar propensity scores, other comparisons of balance between levels of the independent variable which involve hypothesis tests may indicate no significant difference due to the reduction in sample size and therefore statistical power rather than actual balance. (Imai, King, and Stuart 2008; Stuart et al. 2013) This reduction in sample is particularly acute when estimating propensity scores separately by subgroup, in order to later assess effect modification of the main relationships of interest by subgroup membership.

Multivariable linear regression was then used to evaluated the estimated impact of having left against medical advice on total hospital bill, testing interactions with patient insurance status, and controlling for all the covariates used to estimate the propensity score. Patients who left hospital against medical advice left early by variable numbers of days. To understand what other factors may be associated with this variability, a second multivariable regression with the same parameterization as above was used to evaluated the estimated impact of LAMA and covariates on length of stay. Standard errors were bootstrapped, using 100 replications.

The approach of combining propensity score methods with regression adjustment using bootstrapped standard errors contributes to robustness of the estimates for the impact of LAMA on hospital bills and on length of stay, even in the face of imperfect matching on propensity scores, while accounting for the uncertainty in the propensity score model and estimates of differences in hospital bill and lengths of stay. (Austin and Small 2014; Imbens 2004; T. Nguyen et al. 2017; Pan and Bai 2015; Rubin 1973, 1979; Rubin and Thomas 2000)

Several moderately different regressions to estimate propensity scores were tested to assess the sensitivity of the estimated difference in hospital bills and lengths of stay to propensity score construction. Each procedure for estimating propensity scores incorporated information about injury type, location, severity, as well as patient pre-injury health information, using different variable choices or parameterizations. Matches were chosen separately by insurance status, as with the original procedure. Balance of the constructed propensity scores between those who did and did not leave against medical advice was explore through comparisons of standardized mean differences and graphical analysis using the same procedure as above. Parameterizations for the propensity score model that did not achieve balance on observed variables were discarded. The same regression models for length of stay and total hospital charges were performed, controlling for the variables which were used to construct the propensity scores and bootstrapping the standard errors using 100 replications. The coefficients and 95% confidence intervals were then plotted for easier comparison.

It should be noted that due to the use of propensity scores and the reduction in sample for this analysis to the matched pairs, the estimands are of the average treatment effect on the treated (ATT), i.e. the average effect of LAMA on outcomes among those who did leave against medical advice. (Imbens 2004) Additionally, of note is that while the number and type of medical interventions which occurred in-hospital would naturally be the most associated with patient cost – in fact, would comprise that medical cost – these variables were not used as part of the model for estimating propensity scores. If avoiding such interventions and their associated cost was a cause of patients LAMA, this would make their absence a result of LAMA. Therefore, these variables, or more precisely their absence, may be considered a consequence of an underlying propensity to avoid direct medical costs, of which leaving against medical advice is the most extreme manifestation, and should not be not used in models to estimate propensity scores. (Greenland 2003; Imbens 2004) Further, variables that were not thought to contribute to needed medical care were not included in the model to estimate propensity scores, as the model was intended to create groups equal on medical need but which made different decisions about receipt of medical care. Variables which take into account economic considerations which may prompt efforts to reduce direct medical costs, such as insurance status, pre-injury poverty, and occupation, were instead tested in the regression adjustment to separately assess their contribution to a reduction in bills and length of stay.

iii. Consequences of forgoing medical care on health status and indirect costs over time

1. Reported impairment and functionality from prior to injury using difference-in-differences

In order to understand how leaving hospital against medical advice may have impacted the patient's recovery over the year following discharge, a linear longitudinal mixed model was constructed for the difference between the patient's WHODAS score at each follow-up and their WHODAS score prior to their injury. This analysis was restricted to the sample of patients matched by propensity scores, controlling for the variables used to estimate the propensity score as described above.

This difference-in-differences approach compares the changes in WHODAS scores from pre-injury between patients who left against medical advice with changes in WHODAS scores among those who were discharged, rather than comparing the values themselves in order to avoid making assumptions about pre-injury levels of functional impairment between those who did and did not leave against medical advice. However, patients who differ by hospital discharge type also differed in their experience of injury – type, number, cause, and severity. Restricting the analysis to the propensity score matched sample and using doubly robust regression analysis as described above allows for comparison of patients who differ in their hospital discharge type but not on any measurement of injury experience, without making assumptions about pre-injury functional impairment.

<u>To construct this model, let</u>:

i = the *i*th patient, from 1 to 1,022

j = the time of measurement, with j=0 indicated prior to injury, and j= 1, 2, 4, and 12 indicating the number of months post-discharge.

t = a variable which takes on a value of 1 at time j and a value of 0 at other measurement times

Y_{ij} = continuous WHODAS score at time j for the *i*th patient

LAMA = 1 if the patient left against medical advice, and 0 if was discharged

X_{ij} = vectors of covariates

A difference-in-differences model may be estimated using:

$$\mathrm{E}\left[\mathrm{Y}_{ij} - \mathrm{Y}_{i0}\right] = \beta_0 + \beta_1 \cdot LAMA_i + \beta_2 \cdot \mathrm{t}_{\mathrm{j=2}} + \beta_3 \cdot \mathrm{t}_{\mathrm{j=4}} + \beta_4 \cdot \mathrm{t}_{\mathrm{j=12}} + \beta_5 \cdot LAMA_i \cdot \mathrm{t}_{\mathrm{j=2}} + \beta_6 \cdot LAMA_i \cdot \mathrm{t}_{\mathrm{j=4}} + \beta_7 \cdot LAMA_i \cdot \mathrm{t}_{\mathrm{j=12}} + \beta_8 \cdot X_{ij}$$

Where the difference in WHODAS scores from pre-injury at time j between those who did and did not given by the sum of β_1 and the appropriate interaction term for time j:

$$\beta_1 + \beta \cdot \mathrm{t_j} = \mathrm{E}\left[\mathrm{Y}_{ij} - \mathrm{Y}_{i0} \mid LAMA = 1\right] - \mathrm{E}\left[\mathrm{Y}_{ij} - \mathrm{Y}_{i0} \mid LAMA = 0\right]$$
$$= \left(\mathrm{E}\left[\mathrm{Y}_{ij} \mid LAMA = 1\right] - \mathrm{E}\left[\mathrm{Y}_{ij} \mid LAMA = 0\right]\right) - \left(\mathrm{E}[\mathrm{Y}_{i0} \mid LAMA = 1] - \mathrm{E}[\mathrm{Y}_{i0} \mid LAMA = 0]\right)$$

With the difference in WHODAS scores from pre-injury at time j=1 month post-discharge between those who did and did not leave against medical advice given by β_1.

2. *Indirect costs: Linear longitudinal mixed model*

Additional linear longitudinal mixed models were developed to understand any impact of LAMA on indirect costs over the period of follow-up. Indirect costs were defined as discussed in paper 1: the total losses reported by the patient and household members which were attributable to the injury. In addition to total household indirect costs, patient indirect costs and household member-only indirect costs were also modeled, to compare differences in how the injury financially affected the patient versus household members.

As mentioned, since patients were asked their average monthly income prior to the injury at baseline, and during follow-ups were asked for their household income in the month prior to the interview, a difference-in-differences was not used for indirect costs, as differences between pre- and post-injury household income may be affected by underlying trends in income, such as seasonality.

As discussed in paper 1, mixed models with a random intercept are appropriate in order to account for the unbalanced nature of the dataset in both design and implementation, as there are both missing observations and unequally spaced observations over time. A marginal model, as opposed to a conditional model, would be likely to provide biased estimates. Unlike with a binary outcome, with a continuous outcome such as cost, the average of each of the subject-specific regression coefficients is not different from the population-wide regression coefficients. This is because with a continuous outcome, the regression coefficients are a conditional average on covariates for each subject; averaging over all subjects provides a population-wide conditional average, since the average of a set of averages is still an average. Therefore, no marginalization procedure, as is needed for binary outcomes, is required.

Results

a. Associations with leaving against medical advice

i. Demographics, injury cause, injury severity, and hospital discharge type: Descriptive analyses

Overall, 21.88% (219/1001) of the total sample was known to have left against medical advice. There were 21 patients who were transferred or whose disposition was otherwise not known who could therefore not be classified as either having been discharged by a medical provider or having been discharged against medical advice.

Patients who left against medical advice had significantly lower injury severity scores than patients who were discharged by almost a full point (p=0.003), but did not differ by injury cause and intentionality (p=0.88), or in their pre-injury WHODAS scores (p=0.584). (Table 16) Looking at demographics, there were no significant differences by sex, pre-injury occupation, highest level of education completed, or rural/urban residency between patients who did and did not leave against medical advice; however, patients who left against medical advice were slightly younger than patients who were discharged (p=0.012), and were more likely to be single rather than married, or previously married (p<0.001). Patients who left against medical advice lived in households with higher child dependency ratios (0.54 versus 0.44, p=0.016), but did not show higher financial responsibility for their households prior to the injury (p=0.900), or have households of difference sizes (p = 0.234). Finally, those patients whose households prior to the injury were above the middle income country poverty threshold of I$3.20 per person per day, but not above the high income country poverty threshold of I$5.50, seemed to be slightly more likely to leave against medical advice; however, this difference was not statistically significant (p=0.176).

Table 16: Patient demographics, pre-injury household socioeconomic status, and injury factors by hospital discharge type

Variables	Left against medical advice mean (sd) n (%)	Discharged mean (sd) n (%)	p-value
N	219	782	
Injury severity score	3.62 (3.28)	4.52 (4.64)	0.003
Injury cause and intentionality			
Road traffic	133 (60.73%)	475 (60.74%)	0.877
Fall	32 (14.61%)	127 (16.24%)	
Burn	3 (1.37%)	11 (1.41%)	
Sharp object	13 (5.94%)	34 (4.35%)	
Animal / insect related	1 (0.46%)	6 (0.77%)	
Blunt object	7 (3.20%)	29 (3.71%)	
Electrocution	0 (0.00%)	4 (0.51%)	
Self-harm (Intentional)	6 (2.74%)	11 (1.41%)	
Assault (Intentional)	22 (10.05%)	78 (9.97%)	
Other, specify	2 (0.91%)	7 (0.90%)	
WHODAS score, pre-injury	2.22 (7.44)	1.89 (6.46)	0.584
Sex			
Male	158 (72.15%)	558 (71.36%)	0.819
Female	61 (27.85%)	224 (28.64%)	
Occupation			
Farmer	99 (45.21%)	359 (45.91%)	0.389
Gov. or semi-gov. employee	19 (8.68%)	71 (9.08%)	
Private employee	15 (6.85%)	31 (3.96%)	
Self-employed	58 (26.48%)	199 (25.45%)	
No wage labor	28 (12.79%)	122 (15.60%)	
Highest level of education			
Primary school or less	15 (6.85%)	64 (8.18%)	0.441
Secondary School	174 (79.45%)	588 (75.19%)	
More than secondary	30 (13.70%)	129 (16.50%)	
Missing	0 (0.00%)	1 (0.13%)	
Age category			
18 to 24	59 (26.94%)	167 (21.36%)	0.012
25 to 34	61 (27.85%)	165 (21.10%)	
35 to 44	36 (16.44%)	128 (16.37%)	
45 to 54	26 (11.87%)	118 (15.09%)	
55 to 64	16 (7.31%)	115 (14.71%)	
65 and up	21 (9.59%)	88 (11.25%)	
Missing	0 (0.00%)	1 (0.13%)	

Residence			
Rural	183 (83.56%)	607 (77.62%)	0.057
Urban	36 (16.44%)	175 (22.38%)	
Marital Status			
Single	86 (39.27%)	213 (27.24%)	<0.001
Married	133 (60.73%)	555 (70.97%)	
Other	0 (0.00%)	14 (1.79%)	
Child dependency ratio	0.54 (0.66)	0.44 (0.66)	0.016
Household size	3.81 (1.374)	3.93 (1.241)	0.234
Proportion of household income earned by patient, pre-injury			0.900
0%	23 (11.73%)	77 (10.86%)	
>0%, <25%	12 (6.12%)	36 (5.08%)	
>=25%, <50%	52 (26.53%)	181 (25.53%)	
>=50&, <75%	89 (45.41%)	328 (46.26%)	
>=75%, <=100%	20 (10.20%)	87 (12.27%)	
Daily per capita income, pre-injury			
More than I$5.50	98 (44.75%)	383 (48.98%)	0.176
I$3.21 to 5.50	98 (44.75%)	299 (38.24%)	
I$1.91 to 3.20	6 (2.74%)	42 (5.37%)	
I$1.90 or less	6 (2.74%)	22 (2.81%)	
Missing	11 (5.02%)	36 (4.60%)	

ii. Hospital admissions process, hospital discharge type, and insurance status: Descriptive analyses

Patient medical care prior to hospital admission and the process by which patients were admitted was related to LAMA. Among those patients who ultimately left against medical advice, a greater percentage had been self-referred than among patients who were discharged, at 87% vs 81% (p=0.038). (Table 17) Similarly, a higher percentage of patients who were discharged had received interventions prior to hospitalization compared to those who left against medical advice (26% versus 19%, p = 0.021). However, the admitting department did not appear to be significantly related to hospital discharge type (p=0.160). The strongest association with having left against medical advice in the bivariate analysis was with insurance status, with almost 69% of those who left against medical advice being uninsured, compared to less than 50% among those who were discharged being uninsured (p<0.001).

Table 17: Proportion of patients that left against medical advice by referral origin and admitting department

Variable	Left against medical advice n (%)	Discharged n (%)	p-value
N	219	782	
Source of referral			
Hospital/health care provider	28 (12.79%)	147 (18.80%)	0.038
Self-referred	191 (87.21%)	635 (81.20%)	
Any pre-hospital interventions			
No	169 (77.17%)	535 (68.41%)	0.021
Yes	41 (18.72%)	202 (25.83%)	
Unknown	9 (4.11%)	45 (5.75%)	
Admitting department			
Emergency department	191 (87.21%)	651 (83.25%)	0.156
Out-patient / Specialist clinic	28 (12.79%)	131 (16.75%)	
Insurance status			
Uninsured	151 (68.95%)	390 (49.87%)	<0.001
Insured	68 (31.05%)	392 (50.13%)	

iii. Insurance, costs, and hospital discharge type: Descriptive analyses

This association between being uninsured and LAMA was reflected in differences in total hospital charges, out-of-pocket costs, and average costs per day of hospitalization. As would be expected, out-of-pocket direct medical costs were significantly higher among uninsured patients as compared to patients with any form of health insurance (I$398.84 versus I$179.79; p<0.001). (Table 18) However, total hospital charges (i.e. the total bill incurred for health care services, not the amount paid out of pocket) were significantly and meaningfully higher among insured patients as compared to uninsured patients, with the insured incurring hospital bills of I$547.28 on average, compared to the average hospital bill among the uninsured of I$399.50 (p<0.001).

Table 18: Health care costs during hospitalization by insurance status

Variables	Insured mean (sd)	Uninsured mean (sd)	p-value	Total mean (sd)
Hospital charges (I$)				
Total (I$)	547.28 (694.34)	399.50 (589.30)	<0.001	467.46 (643.66)
Average per day in hospital (I$)	58.01 (55.28)	60.18 (41.21)	0.004	59.18 (48.18)
OOP direct medical costs				
Total (I$)	179.79 (293.77)	398.84 (589.35)	<0.001	298.10 (488.90)

There are several possible explanations: insured patients may have, on average, had greater medical need and therefore have appropriately utilized more health care; the uninsured may have utilized less medical than their needs, relative to the insured; the insured may have been provided or have utilized medical care in excess of their needs relative to the uninsured; or, combinations of the above. Injury severity scores were slightly higher among patients with insurance as compared to the uninsured (4.64 among insured patients vs. 4.21 among uninsured patients; p=0.027) (

Table 19). As ISS is a metric that does not comment on the patient’s vulnerability to an injury, but only assesses the injury itself, health care need may have been even higher among the insured, as those with insurance had significantly higher WHODAS scores prior to the injury, were significantly older and were more likely to be below both the middle income poverty line and the international extreme poverty line. (

Table 19) Each of these factors is associated with or, in the case of WHODAS, defines poorer health which is associated with less resilience to injury.

Length of stay in-hospital is often taken as an additional indicator of injury severity; and, uninsured patients had significantly shorter lengths of stay compared to the insured, staying three days fewer on average than insured patients. While insured patients may have had a greater need for medical care, descriptive analysis suggests that the difference in total hospital charges between insured and uninsured patients may be driven in part by patients who are uninsured disproportionately LAMA. Insured patients incurred charges I$147.78 greater than uninsured patients; however, among insured patients, patients who were discharged were charged I$324.80 more than those who left against medical advice, while among uninsured patients, those who were discharged were charged I$244.04 more than those who left against medical advice. (Table 20) The disproportionate number of uninsured patients who truncated their stays in hospital may be reflected in their larger average costs per day, with uninsured patients incurring I$60.18 per day on average versus I$58.01 for insured patients ($p=0.004$). Patients admitted to hospital for an injury may be expected to incur their most expensive health care services earlier on in their hospitalization, as the most intensive health care services would be provided first. Patients who left against medical advice would have left during the period when fewer costs were being incurred, effectively reducing the denominator more than they reduce the numerator by which an average cost per day would be calculated.

Table 19: Patient demographics and socioeconomic status, injury severity, and pre-injury levels of impairment by insurance status

Variables	Insured n (col %)	Uninsured n (col %)	p-value	Total n (col %)
Total	470	552	N/A	1022
Estimated Injury Severity Score	4.64 (4.01)	4.21 (4.86)	0.024	4.41 (4.49)
Length of stay (days)	9.31 (5.48)	6.43 (4.88)	<0.001	7.76 (5.36)
WHODAS score, pre-injury	3.91 (10.04)	0.88 (3.78)	<0.001	2.27 (7.50)
Age Category			<0.001	
18-24	77 (16.38%)	152 (27.54%)		229 (22.41%)
25-34	68 (14.47%)	160 (28.99%)		228 (22.31%)
35-44	69 (14.68%)	97 (17.57%)		166 (16.24%)
45-54	72 (15.32%)	76 (13.77%)		148 (14.48%)
55-64	83 (17.66%)	53 (9.60%)		136 (13.31%)
65+	101 (21.49%)	13 (2.36%)		114 (11.15%)
Missing	0 (0.00%)	1 (0.18%)		1 (0.10%)
Household daily per capita income, pre-injury			<0.001	
More than I$5.50	230 (48.94%)	262 (47.46%)		492 (48.14%)
I$3.21 to 5.50	159 (33.83%)	245 (44.38%)		404 (39.53%)
I$1.91 to 3.20	31 (6.60%)	18 (3.26%)		49 (4.79%)
I$1.90 or less	22 (4.68%)	6 (1.09%)		28 (2.74%)
Missing	28 (5.96%)	21 (3.80%)		49 (4.79%)

Table 20: Direct health care costs and length of stay by insurance status and hospital discharge type

	Left Against Medical Advice			Discharged			
	Insured mean (sd)	*Uninsured mean (sd)*	*p-value*	*Insured mean (sd)*	*Uninsured mean (sd)*	*p-value*	*Total mean (sd)*
Sample	68	151	N/A	392	390	N/A	1001
Hospital charges (I$)							
Total (I$)	264.39 (196.17)	211.64 (173.48)	0.022	589.19 (731.09)	455.68 (614.81)	<0.001	458.15 (617.72)
Average per day (I$)	51.15 (20.68)	60.47 (29.09)	0.051	57.87 (57.51)	58.78 (43.22)	0.048	58.16 (46.69)
OOP direct medical costs							
Total (I$)	144.12 (136.85)	221.40 (181.76)	<0.001	199.65 (334.22)	480.19 (654.77)	<0.001	308.46 (485.58)
Length of hospital stay (days)	5.29 (3.33)	3.68 (2.62)	<0.001	10.06 (5.50)	7.46 (5.04)	<0.001	7.76 (5.34)

iv. Associations with discharge against medical advice: multivariable logistic regression

In the multivariable logistic regression of LAMA, patients who were uninsured had approximately 2.10 times the odds of leaving hospital against medical advice, after controlling patient age, injury severity, and whether the patient received any pre-hospital care ($p<0.001$). (

Table 21) Patients who had received pre-hospital medical interventions had 34.0% lower odds of LAMA (p = 0.033). Patients with higher injury severity scores had lower odds of leaving hospital early; for every one-point increase in estimated Injury Severity Scores, patients had 6.0% lower odds of LAMA (p = 0.008).

The relationship between age and LAMA was non-linear; age was treated as continuous with splines at ages 22 and 70. For patients between 18 to 22 years old, age was not significantly related to LAMA. Patient between the ages of 23 and 70 saw a 1.7% reduction in the odds of LAMA for every year increase in age. Patients 71 years of age and older saw a 9.4% increase in the odds of LAMA for every year increase in age. Patient sex and occupation, rural or urban residency, household socioeconomic status prior to injury, patient contribution to total household income prior to injury, and household size were not found to be associated with discharge type in bivariate analysis and remained unassociated in regression analysis. Child dependency ratio and marital status were no longer associated with discharge against medical advice after accounting for age, and referral source was no longer associated with discharge against medical advice after accounting for insurance status.

Table 21: Multiple logistic regression of leaving hospital against medical advice

Variables	Adjusted Odds Ratio	p-value
Insurance Status		
Insured	ref	
Uninsured	2.101	<0.001
Any pre-hospital medical interventions		
No	ref	
Yes	0.660	0.033
Estimated Injury Severity Score	0.940	0.008
Age		
18-22 years	1.115	0.270
23-70 years	0.983	0.008
71+ years	1.094	0.001
Constant	0.030	0.096
Observations	991	

b. Cost savings from leaving hospital against medical advice

i. Propensity Score Matching

Propensity scores were estimated using a multivariable logistic regression model which disregarded parsimoniousness and statistical significance in favor of designing a model that maximized the amount of outcome variation within the sample that could explained. Propensity scores were estimated using pre-injury WHODAS score, age category, sex, Injury Severity Score, Glasgow Coma Scale at arrival, the number of injuries, injury cause and intentionality, patient referral source, and admitting department. Propensity score matching of patients who left against medical advice with patients who were discharged created 219 matched pairs. While every patient who left against medical advice was assigned a match, there were 8 patients who were discharged who were not considered for matching as their propensity scores could not be estimated using the above model due to the rarity of their injury types and their extremely high severity scores. For 217 pairs, the difference in estimated propensity scores between matched pairs was below 0.01, and for the remaining 2 pairs, the difference was below 0.07. (Figure 29) The availability of multiple potential matches by propensity score for each patient who left against medical advice indicated there was no need to use replacement to find adequate matches (Figure 30) The propensity scores showed reasonable balance across distributions of variables used to do the matching, with all variables showing a standardized mean difference of less than 0.15 and the majority less than 0.10. However, several variables showed a slight increase from before the matching, likely due to the number of variables used for matching. (Table 22)

Figure 29: Differences in propensity scores between matched observations by hospital discharge type

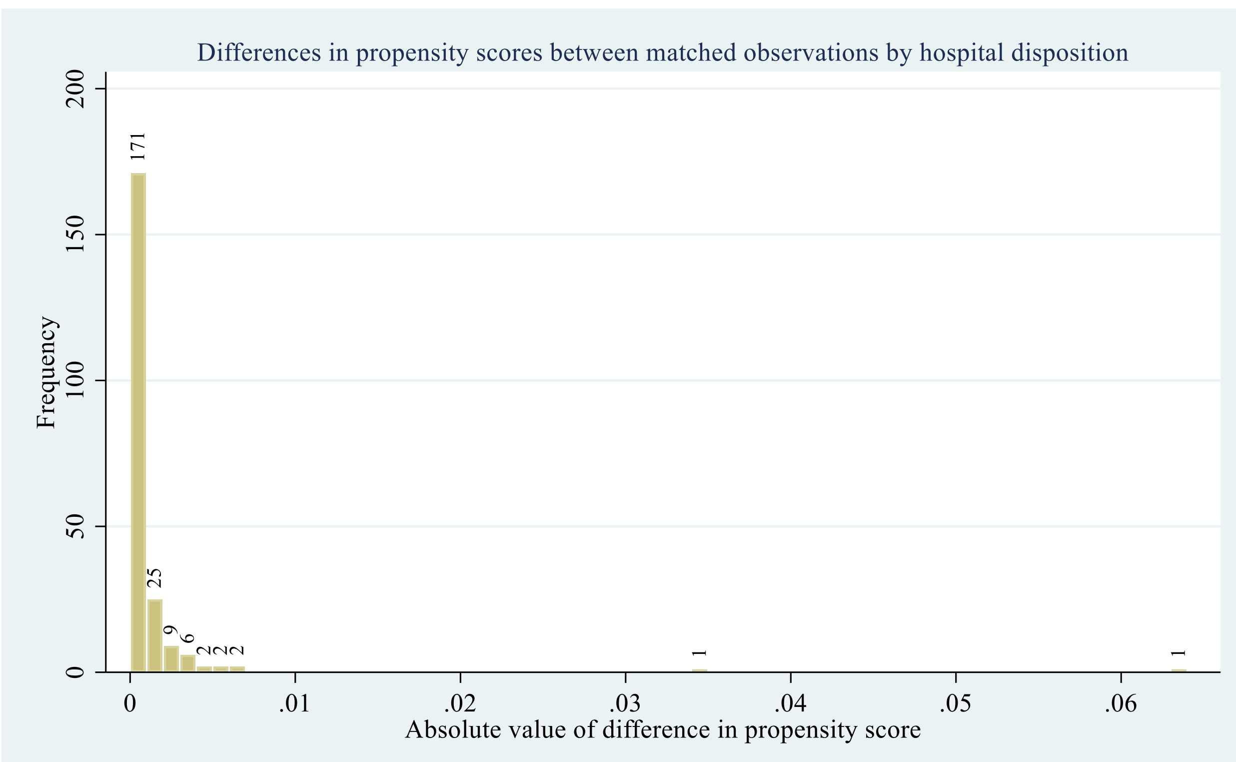


Figure 30: Propensity score distributions before and after matching

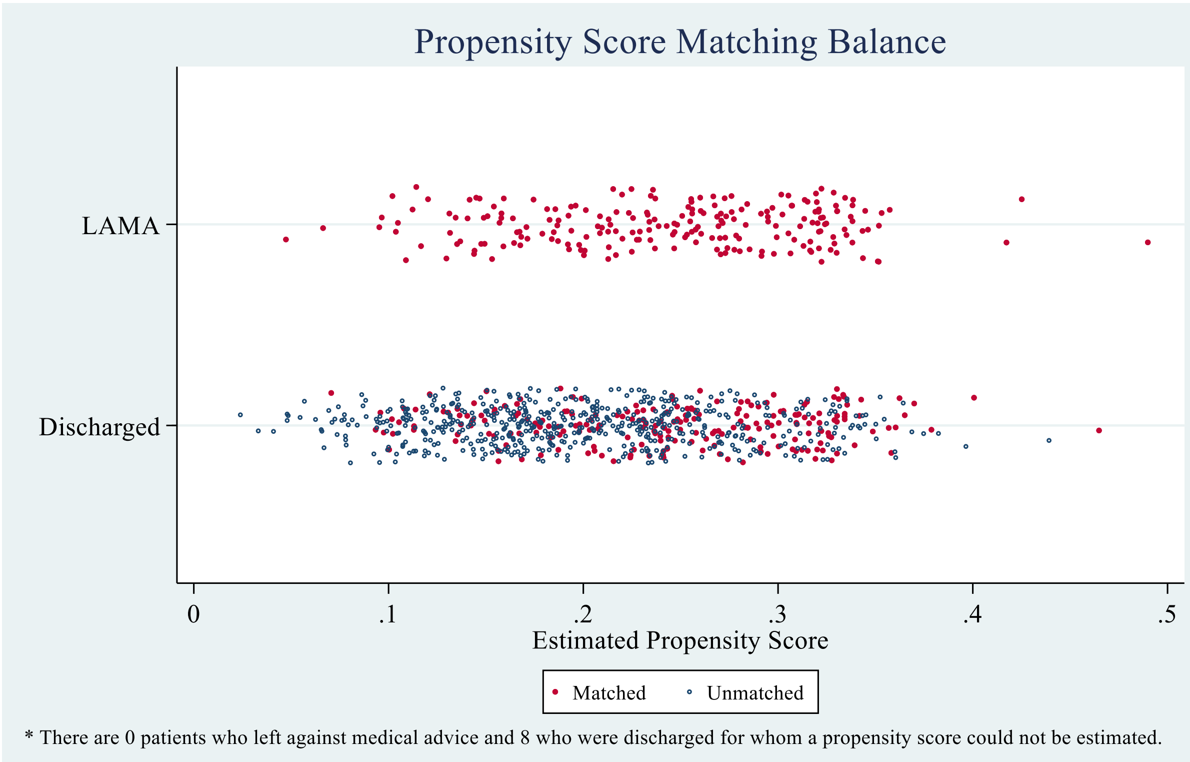


Table 22: Propensity score matching balance checks: Standardized mean difference (SMD) between those who did and did not leave against medical advice, before and after propensity score matching

Variable	SMD: Whole Sample	SMD: Matched Sample
Estimated propensity score	0.439	0.012
WHODAS, pre-injury	0.051	0.073*
Proportion female (vs male)	0.018	0.010
Age in completed years on date of injury		
Age 18 to 24	0.14	0.067
Age 25 to 34	0.159	0.043
Age 35 to 44	0.001	0.073*
Age 45 to 54	0.092	0.052
Age 55 to 64	0.216	0.027
Age 65 and up	0.057	0.029
Glasgow Coma Score at arrival	0.003	0.026*
Patient admitting department		
Emergency department	0.110	0.112*ǂ
Out-patient / Specialist clinic	0.110	0.112*ǂ
Patient referral source		
Referred from another hospital	0.158	0.016
Health center / GP	0.059	0.051
Self admission	0.164	0.048
Injury Severity Score	0.200	0.073
Number of different injuries		
1	0.152	0.117 ǂ
2	0.115	0.057
3	0.093	0.133*ǂ
Injury Cause		
Road traffic	0.003	0.075*
Fall	0.049	0.025
Burn	0.004	0.039*
Sharp object	0.074	0.066
Animal/insect related	0.036	0.000

Blunt object	0.029	0.000
Electrocution	-	-
Self-harm (Intentional)	0.103	0.036
Assault (Intentional)	0.001	0.062*
Other, specify	0.001	0.046*

* Post match standardized mean difference is larger than pre-match standardized mean difference.

ǂ Post match standardized mean difference is larger than 0.10.

ii. Savings in hospital charges from leaving hospital against medical advice: Doubly-robust regression within propensity score matched sample

A multivariable linear regression for total hospital charges was performed with the matched sample, controlling for the same variables used to predict the propensity score, with a significant interaction between LAMA and insurance status. Both insured and uninsured patients who left hospital against medical advice were charged less than their peers by insurance status who were discharged. Uninsured patients who left against medical advice were charged approximately I$153.90 less than uninsured patients who were discharged (p<0.001), with injuries similar in severity, cause, and number; who had similar hospital admission and referral processes; and with similar ages, sex, and pre-injury levels of functional impairment. (Table 23) By contrast, insured patients who left against medical advice were charged I$314.22 less than those who were discharged from hospital (p<0.001).

Average hospital charges were significantly different by insurance status among those who were discharged, but not among those who left against medical advice. (

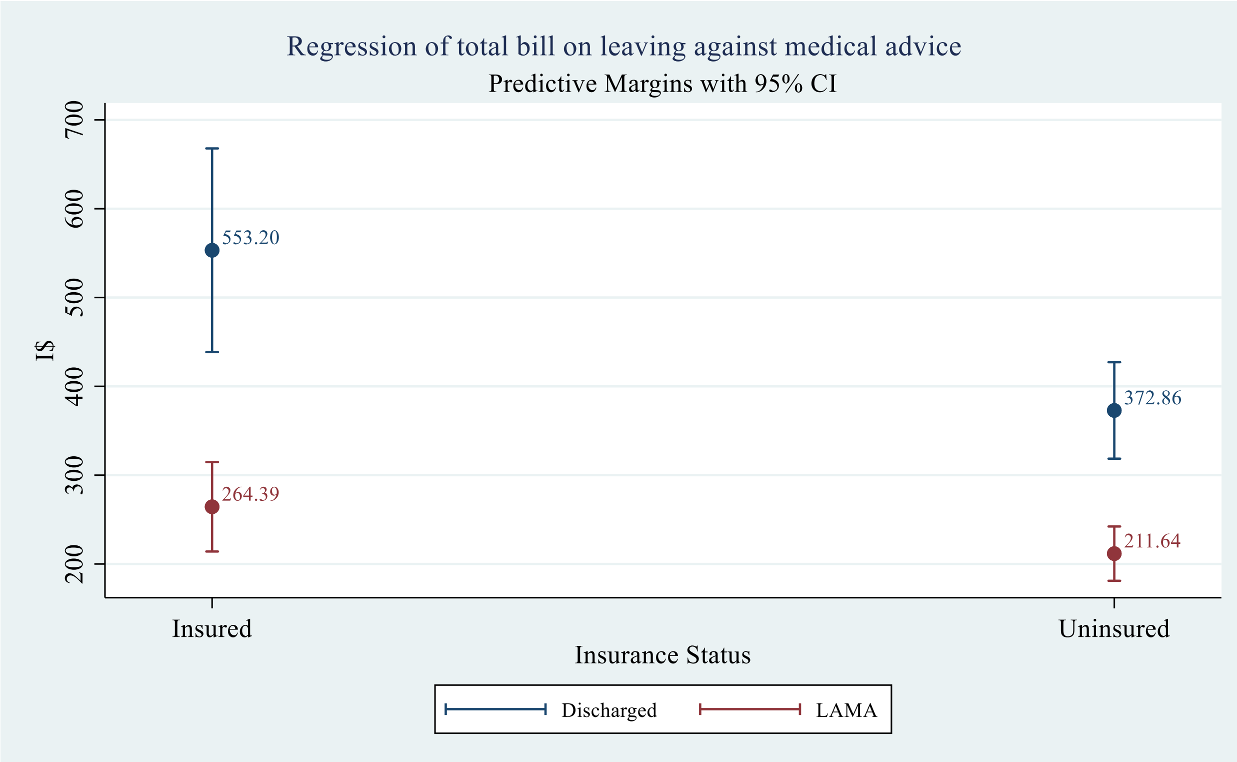
Figure 31) Looking at just those who were discharged, insured patients were charged I$140.80 more than uninsured patients (p=0.034). Among those who left against medical advice there were no significant or meaningful differences in hospital charges by insurance status, with uninsured patients who left against medical advice having charges that were approximately I$19.53 (p=0.598) more than insured patients who left against medical advice. Pre-injury income household income category, patient occupation, patient share of pre-injury household income, and various other demographics were tested and found to neither be significant nor to alter the relationships among LAMA, insurance status, and the bill.

Table 23: Differences in total bill by discharge type from hospital: Propensity score matching combined with regression adjustment (bootstrapped standard errors)

	Coefficient (I$)*	p-value
Insured		
Discharged	ref	
Left against medical advice	-314.22	<0.001
Uninsured		
Discharged	ref	
Left against medical advice	-153.90	<0.001
Observations	438	

* Variables used for propensity score matching were included in the regression but omitted from the table, as the matching process means that their coefficients are not meaningful. As the constant is not meaningful without the full set of covariates, it too was omitted.

Figure 31: Predictive margins and 95% confidence interval of total bill by insurance status and hospital discharge type from multivariable regression following propensity score matching



iii. Differences in length of stay due to leaving hospital against medical advice: Doubly-robust regression within propensity score matched sample

Among both the insured and the uninsured, lengths of stay were significantly shorter for patients who left against medical advice, though the number of days that patients left early varied by insurance status. A regression for length of stay within the propensity score matched sample adjusted by the variables used to predict the propensity score showed that insured patients who left against medical advice had lengths of stay which were 5.29 days shorter than those who were discharged (p<0.001), again with injuries similar in severity, cause, and number; who had similar hospital admission and referral processes; and with similar ages, sex, and pre-injury levels of functional impairment. (Table 24) Uninsured patients who left against medical advice left approximately 3.02 days earlier than their uninsured peers who were discharged (p<0.001).

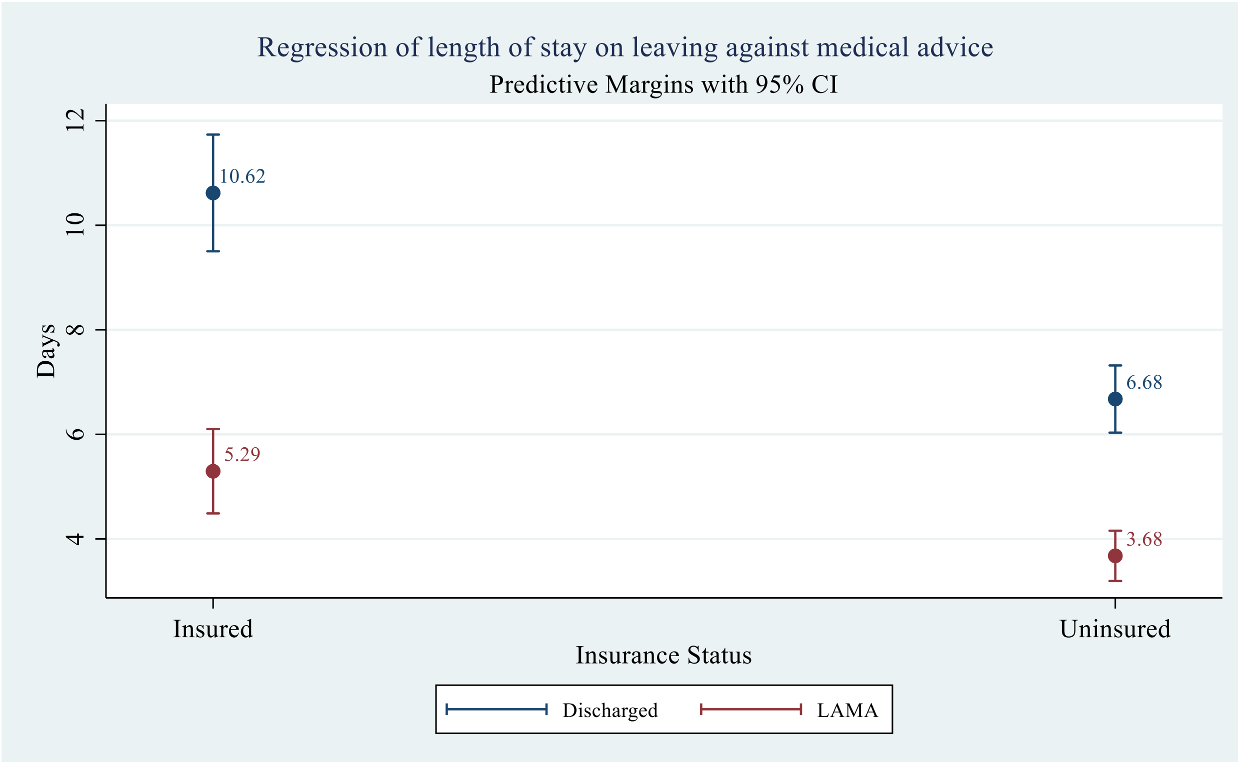
Among those who left against medical advice, lengths of stay were just under a day shorter among the uninsured, though this difference was only marginally significant (0.90 days shorter, p=0.061). Among those who were discharged, insured patients had lengths of stay which were 3.17 days longer than the uninsured (p<0.001). In other words, insured patients were prescribed additional medical care amounting to more than three days in hospital as compared to uninsured patients, despite having similar medical needs. On average, insured patients who were discharged spent almost eleven days in the hospital, while those who left against medical advice, spent a little more than six and a half. (Figure 32) Uninsured patients on average had lengths of stay which were only about half as long as their insured counterparts by discharge status.

Table 24: Differences in length of stay by discharge type from hospital: propensity score matching combined with regression adjustment

	Coefficient (days)*	p-value
Insured		
Discharged	ref	
Left against medical advice	-5.29	<0.001
Uninsured		
Discharged	ref	
Left against medical advice	-3.02	<0.001
Observations	438	

* Variables used for propensity score matching were included in the regression but omitted from the table, as the matching process means that their coefficients are not meaningful. As the constant is not meaningful without the full set of covariates, it too was omitted.

Figure 32: Predictive margins and 95% confidence interval of length of stay by insurance status and hospital discharge type from multivariable regression following propensity score matching



Four parameterizations for a propensity score model, incorporating information about injury type, location, severity, as well as patient pre-injury health information, were found to have balance on observed variables. Each regression model tested for interaction between hospital discharge type and insurance status, controlled for the variables were used to in the propensity score model, and was bootstrapped the standard errors using 100 replications. While the estimates did show some differences in the models for total hospital charges (Figure 33) and length of stay (Figure 34), since all confidence intervals overlapped, these differences were not deemed to invalidate the original propensity construction.

Figure 33: Sensitivity analysis: Impact of propensity score estimation procedure on multivariable regression of total bill

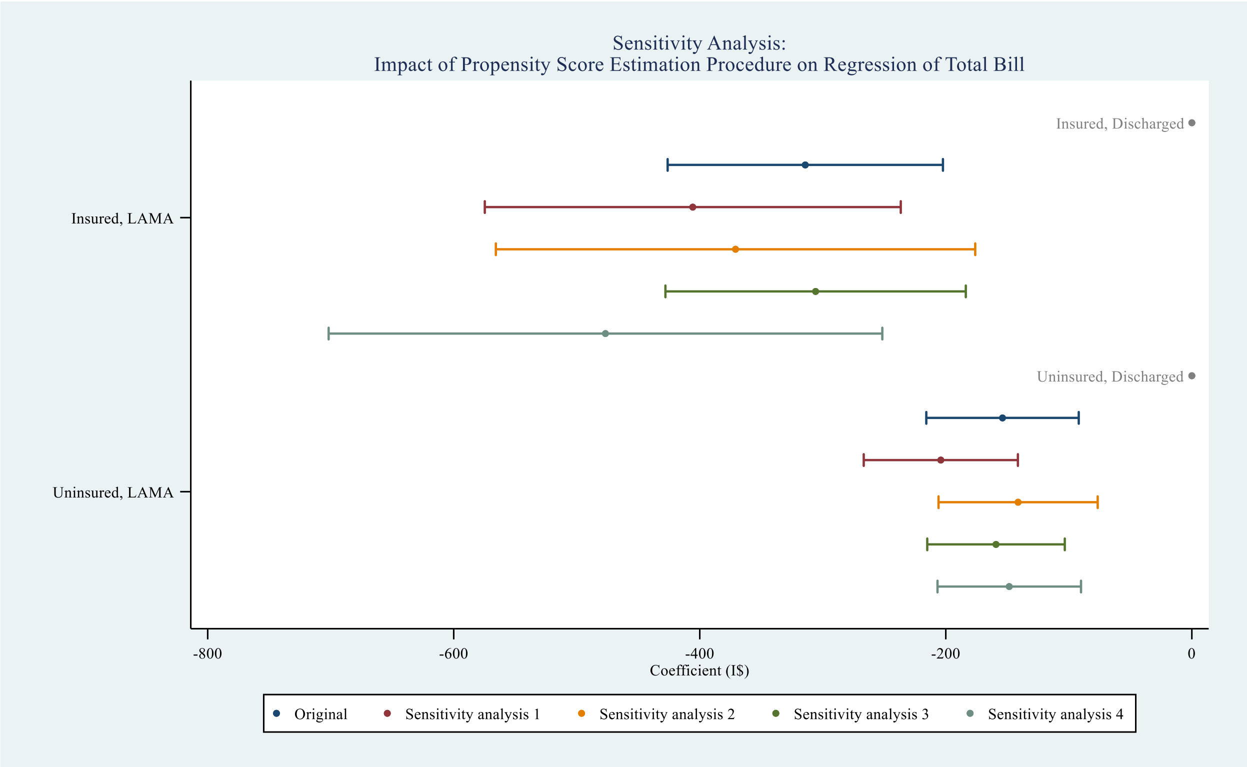
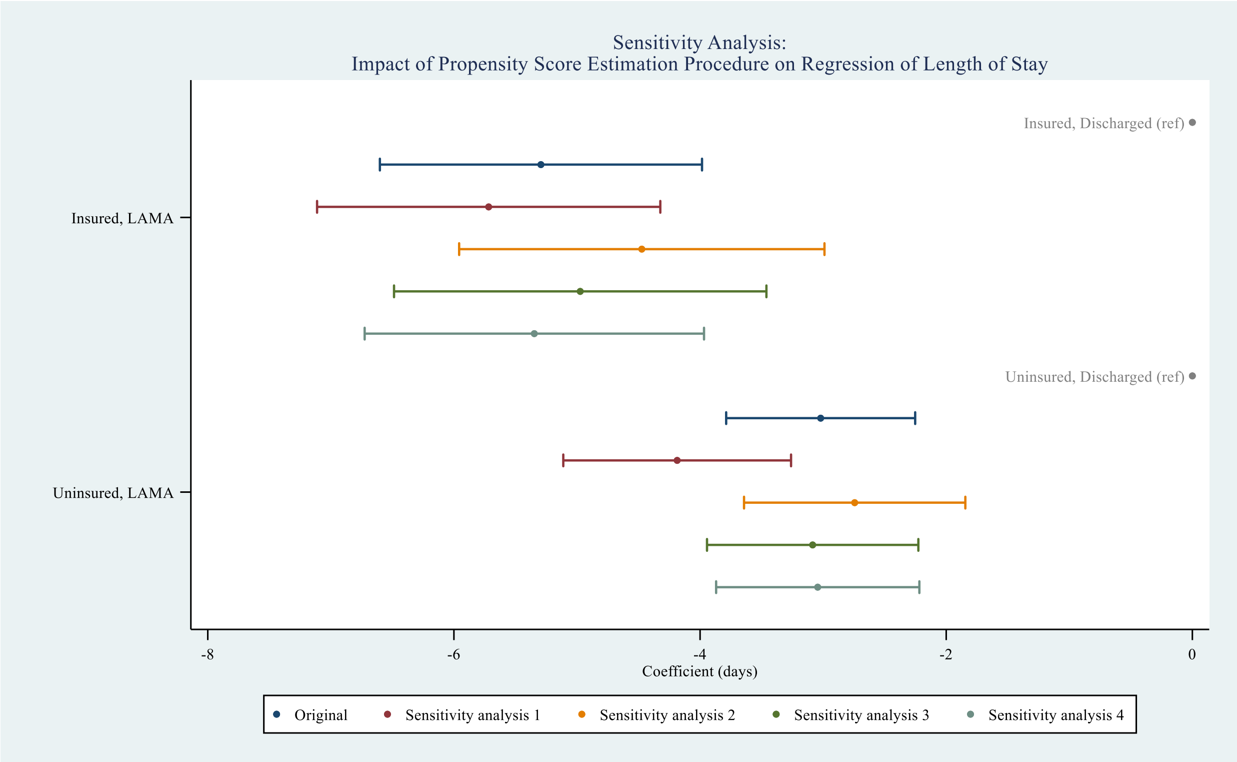


Figure 34: Sensitivity analysis: Impact of propensity score estimation procedure on multivariable regression of length of stay



c. Differences in post-discharge health care utilization by patient discharge and insurance status

Descriptive analysis was used to explore differences in health care usage following discharge by patients who had and had not left against medical advice within the propensity score matched sample. Insured patients who left hospital against medical advice were more likely to use medical care of any sort, including doctor visits, rehabilitative care, medical equipment, and pharmaceuticals, as compared to insured patients who were discharged during the year following hospitalization, while uninsured patients who were discharged were slightly more likely to use any medical care than uninsured patients who left against medical advice, though these differences were not significant (Figure 35) Both insured and uninsured patients who left hospital against medical advice were also more likely to visit a doctor between 1 and 12 months following discharge than their counterparts by insurance status who were discharged, though again, these differences were not significant. (Figure 36) Less than 5.5% of patients, regardless of discharge type, ever used rehabilitative care, though this figure varied over time. (Figure 37)

Figure 35: Use of any medical care since last follow up within matched sample, by hospital discharge type and insurance status, over time

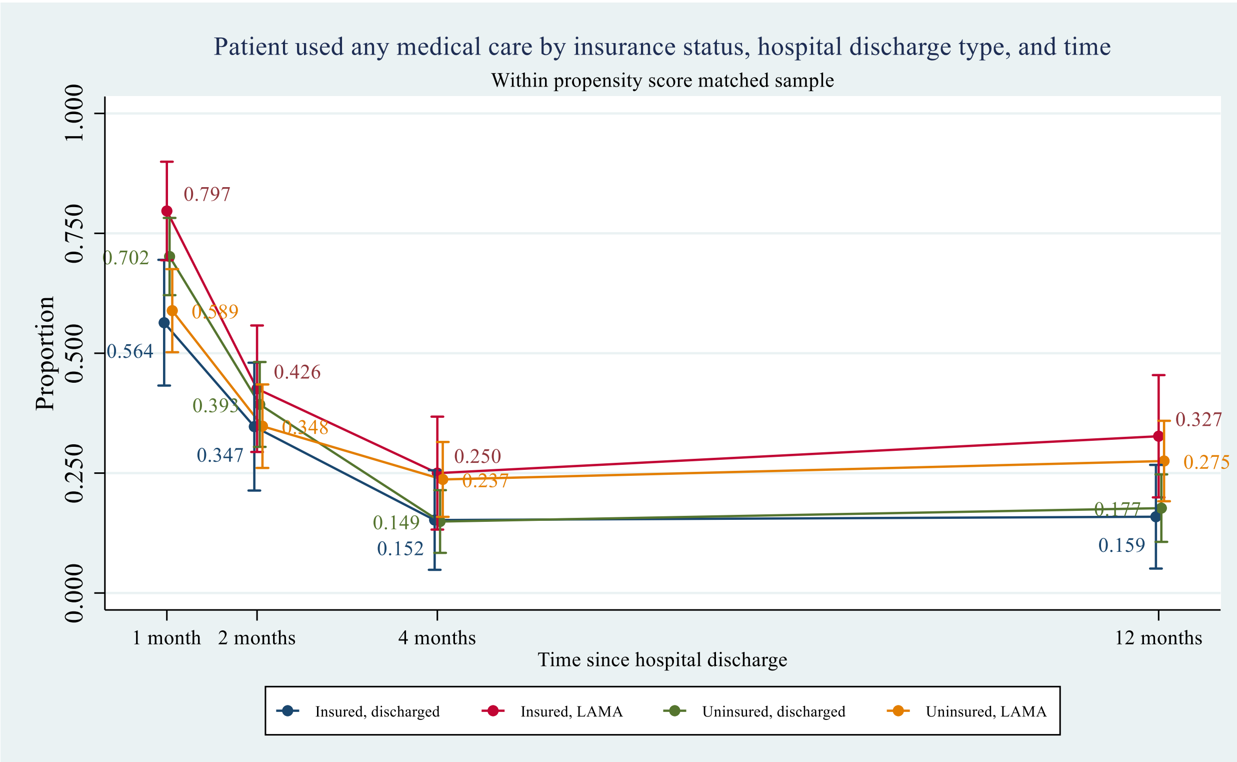


Figure 36: Visited a doctor since last follow up within matched sample, by hospital discharge type and insurance status, over time

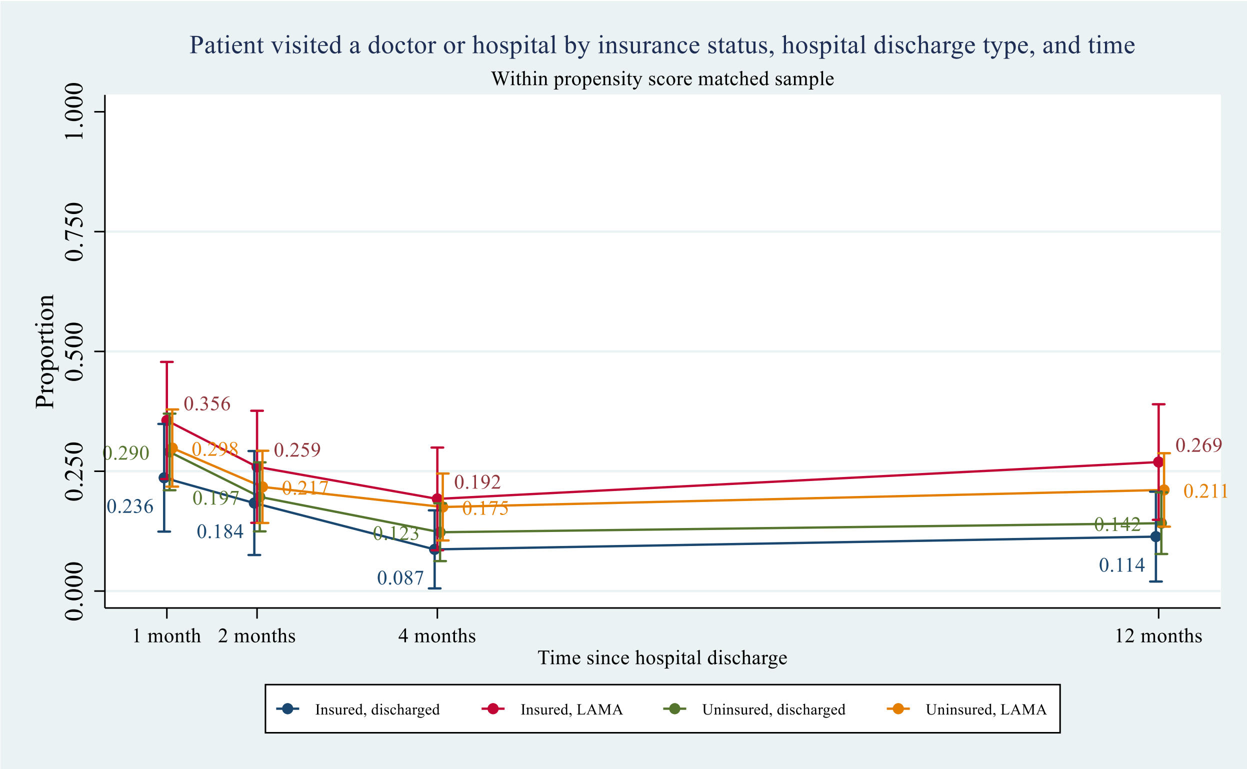
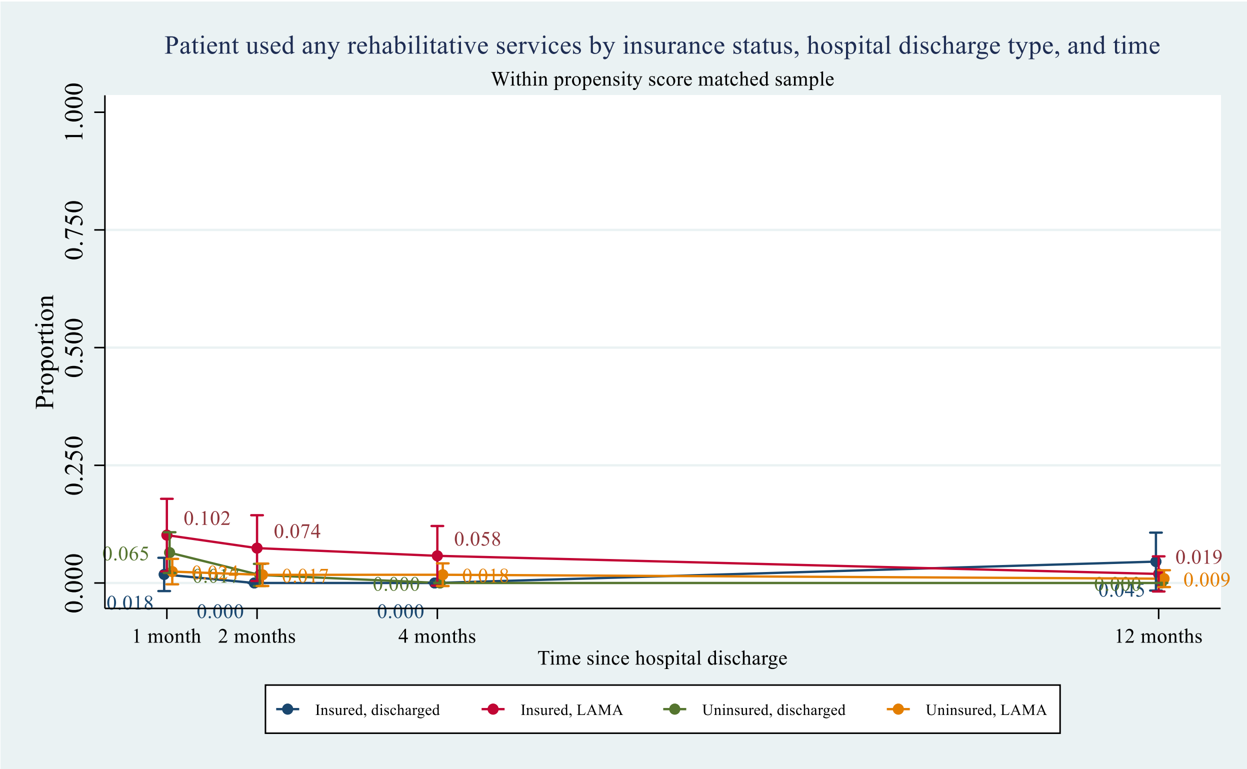


Figure 37: Use of rehabilitative care since last follow up within matched sample, by hospital discharge type and insurance status, over time

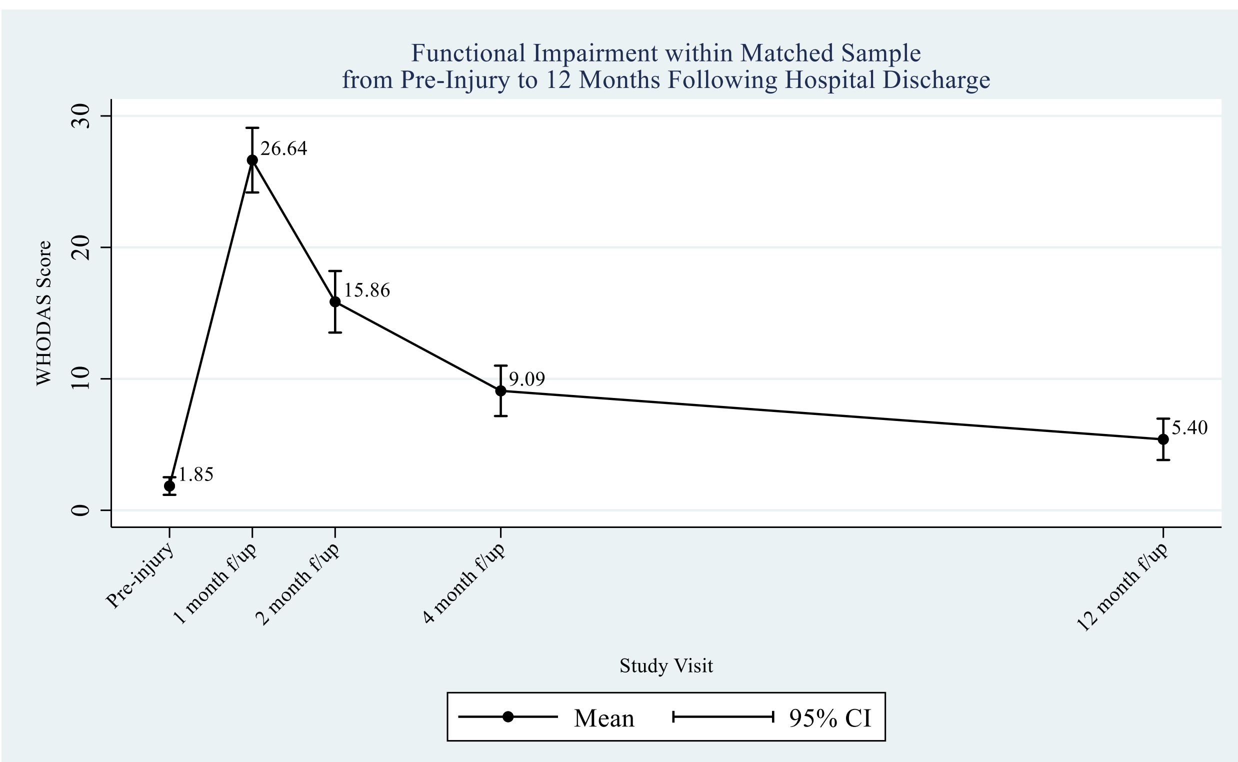


d. Post-discharge levels of impairment by insurance status and discharge type from hospital

Prior to injury, the average WHODAS score was 2.27 (sd = 7.49), with 82.49% of patients (843/1022) reported having no functional impairment, a WHODAS score of 0. Of those patients who reported any impairment, the average WHODAS score was 12.97 (sd = 13.53).

Among the patients matched by their propensity to leave hospital against medical advice, pre-injury WHODAS scores were slightly lower than the non-matched sample, at 1.85, as patients with higher WHODAS scores pre-injury had lower propensities to leave against medical advice, and were not matched. Patients reported a trajectory in functional impairment, as captured by WHODAS, characterized by a steep increase in impairment from before injury followed by diminishing improvement over time. (Figure 38)

Figure 38: WHODAS scores prior to injury and at 1, 2, 4, and 12 months following hospital discharge within propensity score matched sample



A longitudinal mixed model was developed to examine the effect of LAMA and insurance status on patients of patients to their pre-injury levels of functional impairment among patients with similar injury experiences. (Table 25) Negative coefficients signal a lower gap between post-injury WHODAS scores and pre-injury WHODAS scores, indicating relatively better recovery after injury, while positive coefficients show a higher gap between post- and pre-injury WHODAS scores, indicating worse recovery relative to the referent condition.

Table 25: Regression results from longitudinal mixed model of difference between pre-injury and post-injury WHODAS scores

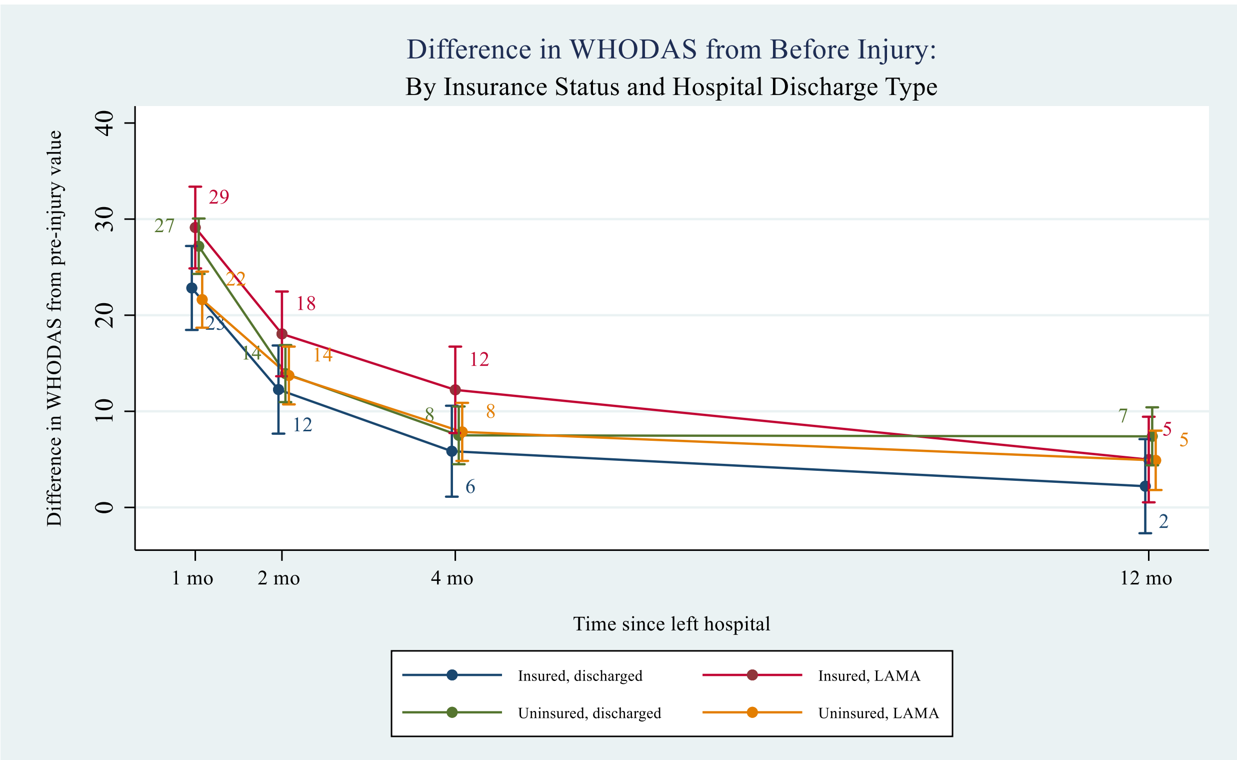
Variables	Coefficient	p-value
Hospital discharge type by insurance status over time		
1 month		
Insured, discharged	ref	
Insured, left against medical advice	4.301	0.173
Uninsured, Discharged	ref	
Uninsured, left against medical advice	-7.047	0.001
2 months		
Insured, discharged	ref	
Insured, left against medical advice	3.254	0.323
Uninsured, Discharged	ref	
Uninsured, left against medical advice	-1.967	0.367
4 months		
Insured, discharged	ref	
Insured, left against medical advice	3.780	0.264
Uninsured, Discharged	ref	
Uninsured, left against medical advice	1.155	0.600
12 months		
Insured, discharged	ref	
Insured, left against medical advice	0.469	0.892
Uninsured, Discharged	ref	
Uninsured, left against medical advice	-3.817	0.087
Pre-Injury Income classification		
More than I$3.20	ref	
<= I$3.20	4.264	0.022
Residence		
Rural	ref	
Urban	-7.381	<0.001
Constant	33.226	0.001
Observations	1,329	

Among those who were insured, patients who left against medical advice generally reported higher WHODAS scores post-injury compared to those who were discharged at each time point, but these differences were not significant. At one month post-discharge, insured patients who left against medical advice had WHODAS scores that were 4.301 higher than insured patients who were discharged (p=0.173). At two months post-discharge, this gap among the insured between those who did and did not leave against medical discharge was 3.254 (p=0.323), while at four months, it was 3.780 (p=0.264), and at 12 months it was 0.469 (p=0.892). Among uninsured patients, those who left against medical advice appeared to have better recovery trajectories, though this was only significant at one month post-discharge. Uninsured patients who left against medical advice reported WHODAS scores that were 7.047 lower than uninsured patients who were discharged (p=0.001) at one month post-discharge; 1.967 lower at two months (p=0.367), 1.15 lower at four months (p=0.600), and finally 3.817 lower at twelve months post-discharge (p=0.087), relative to uninsured patients who were discharged.

Among patients who left against medical advice, there were no significant differences in WHODAS scores by insurance status. Uninsured patients who left against medical advice reported WHODAS scores different from the insured who left against medical advice of -1.911 (p=0.484) at one month, 0.904 (p=0.749) at two months, 0.844 (p=0.768) at four months, and 4.860 (p=0.089) at six months. Among those who were discharged, uninsured patients reported higher WHODAS scores than insured patients who were discharged. Among discharged patients, those without insurance reported WHODAS scores 9.437 points higher at one month post-discharge than patients who had any form of insurance (p=0.001). Uninsured discharged patients had scores that were 6.125 higher at two months (p=0.033), 5.779 higher at four months (p=0.050), and 9.145 higher at twelve months (p=0.002) compared to insured discharged patients. All patients regardless of hospital discharge type or insurance status showed a recovery trajectory with larger improvements soon after discharge, with recovery slowing over time. (Figure 39)

The income category of the patient's household prior to the injury and whether the patient lived in a rural or urban area also appeared to influence WHODAS scores within the propensity score matched sample, though not the shape of the recovery trajectory over the year following hospital discharge. Patients from households which were below the middle-income country poverty line (I$3.20 per capita per day) prior to the injury had WHODAS scores which were 4.264 higher than those who were above this poverty line. Patients who lived in an urban area had WHODAS scores which were 7.381 lower than patients who lived in a rural area.

Figure 39: Difference in WHODAS scores from prior to injury by patient hospital discharge type and insurance status among matched sample: Predictive margins with 95% confidence intervals

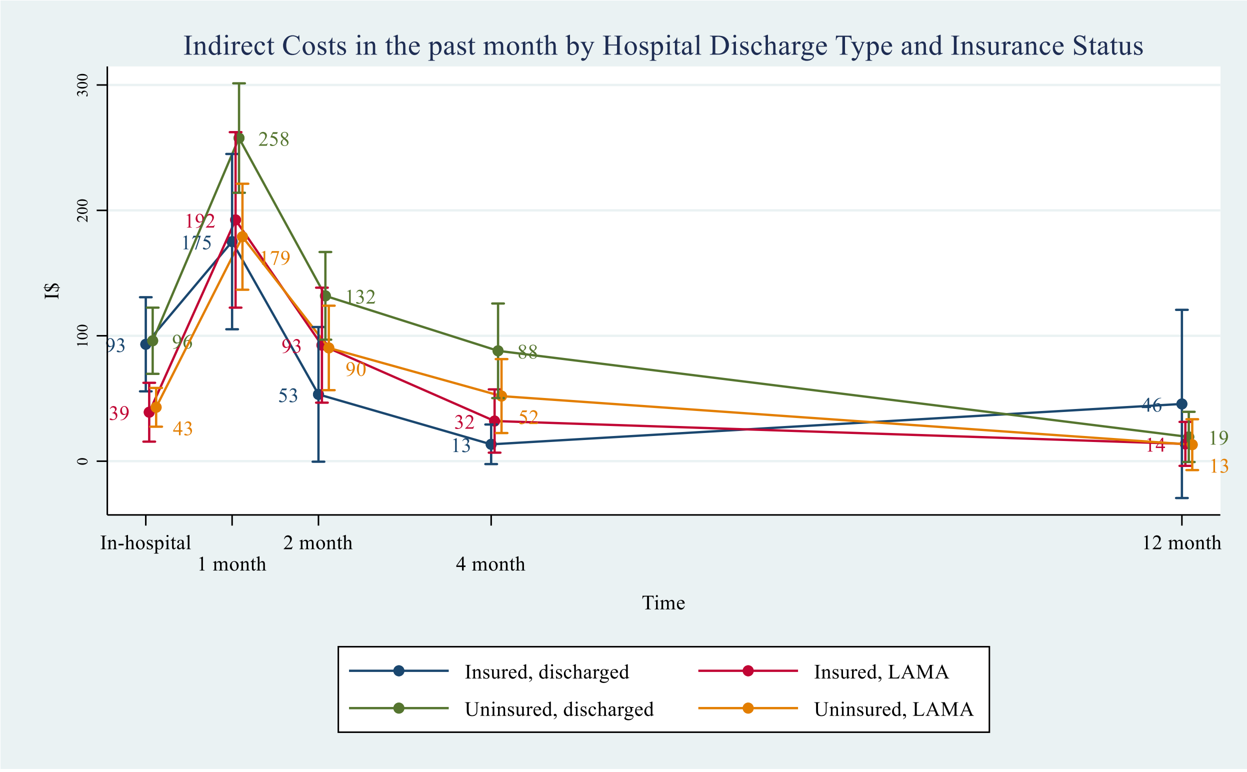


e. Indirect costs incurred by patient and household members by discharge type from hospital

Patients reported income lost by themselves and their household members attributable to their injury both prior to leaving hospital and at 1, 2, 4, and 12 months following hospital discharge. The trajectory for household indirect costs was similar to that of patient WHODAS scores: a sharp increase after hospital discharge followed by an increasingly slower decline. (Figure 40)

In a linear longitudinal mixed-effect regression using the propensity score-matched sample, the impact of LAMA on total household indirect costs, patient indirect costs, and household member indirect costs differed by insurance status, after controlling for household daily income per person, whether the household lived in a rural or urban area, and all of the variables that were used to predict the propensity score: the patient's pre-injury WHODAS score, sex, and age category; as well as the injury severity score, the number of injuries, the injury cause, the patient's Glasgow Coma Scale at arrival, the referral source, and admitting department.

Figure 40: Total household income losses attributed to the patient's injury by hospital discharge type, insurance status, and time



Among both the insured and the uninsured, total indirect costs were lower among those who left against medical advice compared to those who were discharged during hospitalization. (Figure 41) Among the insured, indirect costs were I$66.65 (p=0.028) lower along those who left against medical advice, while among the uninsured, indirect costs were I$51.90 (p=0.010) lower among those who left against medical advice, compared to their peers by insurance status who were discharged. (Table 26) The differences in total household indirect costs during hospitalization seems to be mostly driven by household members of patients who were discharged incurring higher indirect costs during hospitalization, though patients who were discharged also incurred higher indirect costs themselves, compared to patients who left against medical advice and their household members. (

Figure 42 and Figure 43) During hospitalization, household members of insured patients who left against medical advice had I$46.60 (p<0.001) lower indirect costs and household members of uninsured patients who left against medical advice had I$34.77 (p<0.001) lower indirect costs compared to household members of patients who were discharged by insurance status. Patients did not differ in their indirect costs during hospitalization by hospital discharge type, with insured patients who left against medical advice having a non-significant I$20.56 (p=0.429) lower indirect costs and uninsured patients who left against medical advice having a non-significant I$17.37 (p=0.315) lower indirect costs, compared to patients who were discharged of the same insurance status.

Table 26: Results from longitudinal linear mixed model: Total, patient, and other household member indirect costs over time by hospital discharge type among propensity score matched sample

VARIABLES	Total (I$)	p-value	Patient (I$)	p-value	Household (I$)	p-value
Discharge type by insurance status over time						
In-hospital						
Insured, discharged	ref		ref		ref	
Insured, left against medical advice	-66.65	0.028	-20.56	0.429	-46.60	<0.001
Uninsured, Discharged	ref		ref		ref	
Uninsured, left against medical advice	-51.90	0.010	-17.37	0.315	-34.77	<0.001
1 month						
Insured, discharged	ref		ref		ref	
Insured, left against medical advice	27.48	0.407	58.10	0.045	-19.96	0.138
Uninsured, Discharged	ref		ref		ref	
Uninsured, left against medical advice	-79.38	<0.001	-87.87	<0.001	4.47	0.620
2 months						
Insured, discharged	ref		ref		ref	
Insured, left against medical advice	35.86	0.300	39.10	0.189	-3.61	0.797
Uninsured, Discharged	ref		ref		ref	
Uninsured, left against medical advice	-45.98	0.045	-53.46	0.008	6.16	0.507
4 months						
Insured, discharged	ref		ref		ref	
Insured, left against medical advice	12.23	0.731	12.50	0.682	-0.64	0.964
Uninsured, Discharged	ref		ref		ref	
Uninsured, left against medical advice	-40.78	0.077	-40.45	0.043	-0.31	0.974
12 months						
Insured, discharged	ref		ref		ref	
Insured, left against medical advice	-39.57	0.273	-29.26	0.346	-10.77	0.463
Uninsured, Discharged	ref		ref		ref	
Uninsured, left against medical advice	-11.29	0.630	-10.90	0.590	-0.88	0.927
Pre-injury daily per-capita income category						
>I$3.20	ref		ref		ref	
<=I$3.20	6.828	0.687	13.36	0.359	-9.158	0.183

Residence						
Rural	ref		ref		ref	
Urban	-41.52	<0.001	-28.91	0.001	-15.32	<0.001
Constant	242.4	0.007	100.0	0.199	147.3	<0.001
Observations	1,760		1,725		1,760	
Patients	438		438		438	
Residual standard deviation	173.1		148.6		70.24	

Over the year following hospitalization, total household indirect costs did not differ by discharge type among those who were insured, but did among the uninsured. Total indirect costs among insured patients who left against medical advice were I$27.48 (p=0.407) higher at one month following discharge, I$35.86 (p=0.300) higher at two months following discharge, I$12.23 (p=0.731) higher at four months following discharge, and I$39.57 (p=0.273) lower at 12 months following discharge, compared to households where the patient was discharged. By contrast, among the uninsured, total household indirect costs among patients who left against medical advice continued to be lower over the first two months, with total household indirect costs I$79.38 (p<0.001) lower at one month, I$45.98 (p=0.045) lower at two months, I$40.78 (p=0.077) lower at four months, and I$11.29 (p=0.630) lower at twelve months compared to households where the patient was discharged. Unlike total indirect costs during hospitalization, the lower indirect costs following hospitalization among the uninsured who left against medical advice was driven by patients. Among uninsured patients who left against medical advice, patient indirect costs were I$87.87 (p<0.001) lower at one month, I$53.46 (p=0.008) lower at two months, I$40.45 (p=0.043) lower at four months, and I$10.90 (p=0.590) lower at twelve months, compared to uninsured patients who were discharged. Household members of uninsured patients did not report either meaningful or statistically significant differences in indirect costs after discharge by the patient's discharge type.

Figure 41: Predictive margins following linear mixed modeling: Total household lost income (patients and household members) attributed to injury by insurance status, hospital discharge type, and time

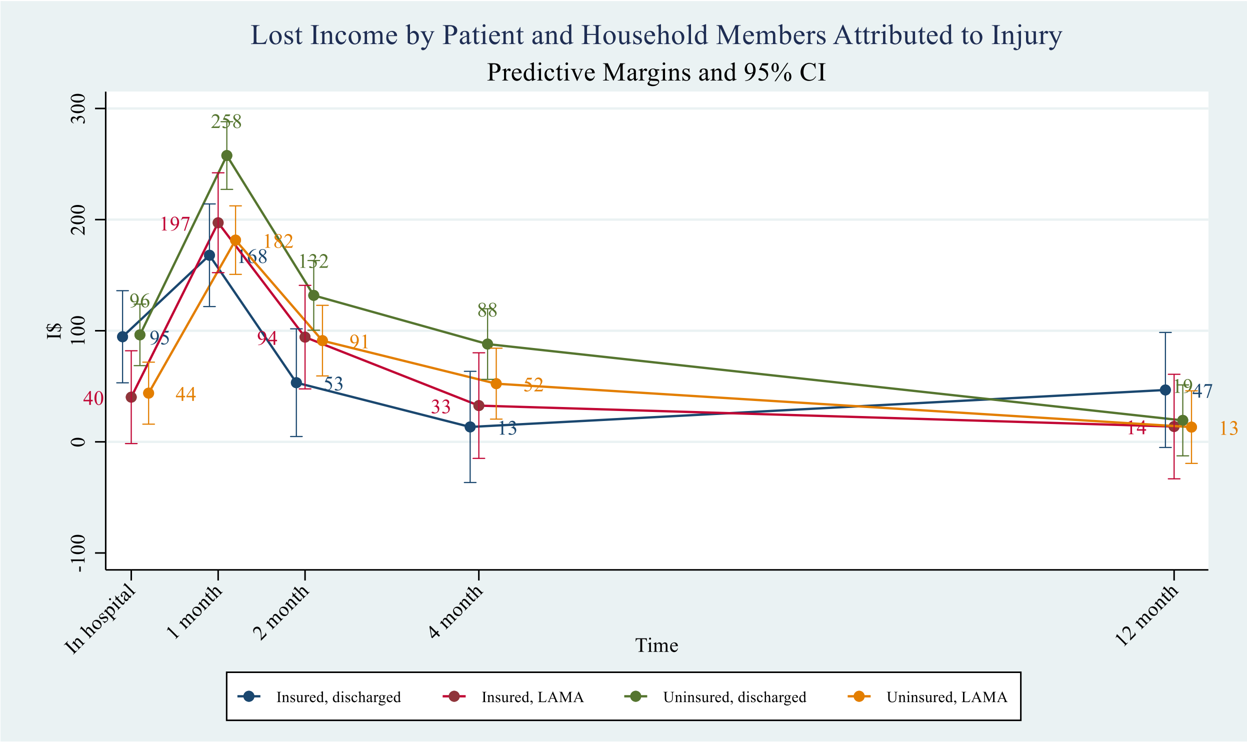


Figure 42: Predictive margins following linear mixed modeling: Lost income by patients attributed to injury by insurance status, hospital discharge type, and time

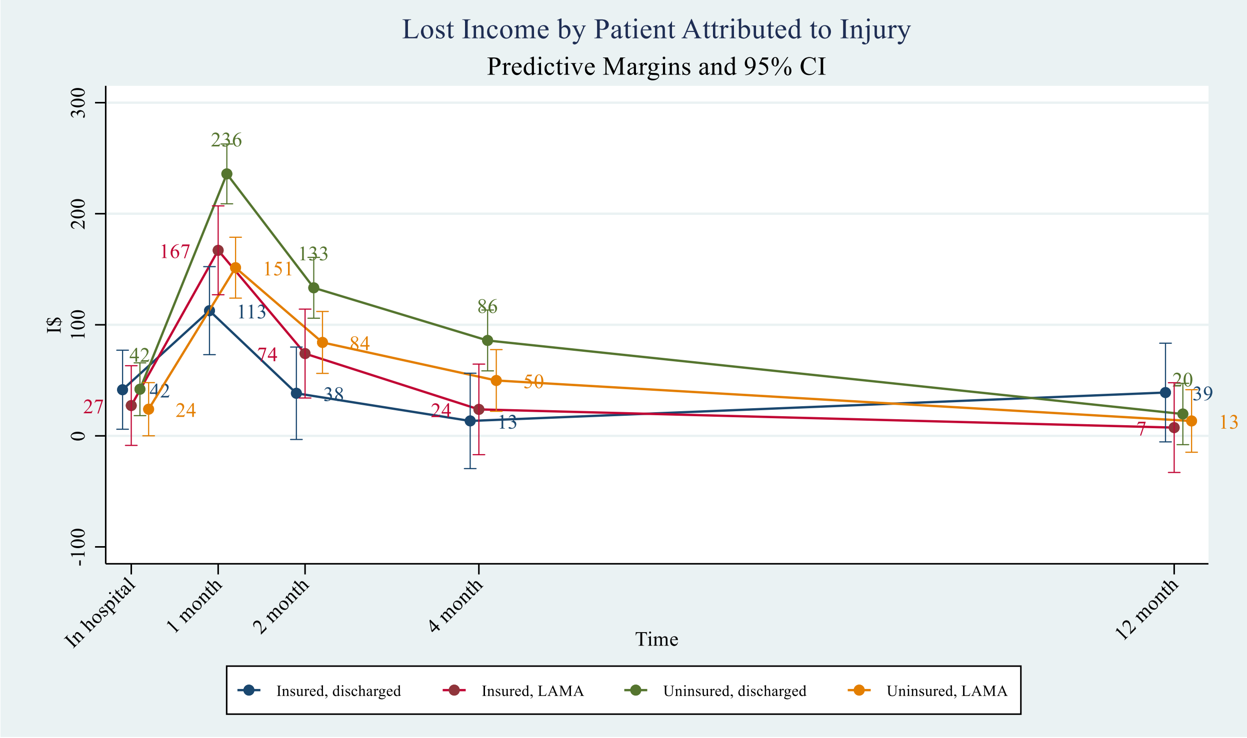
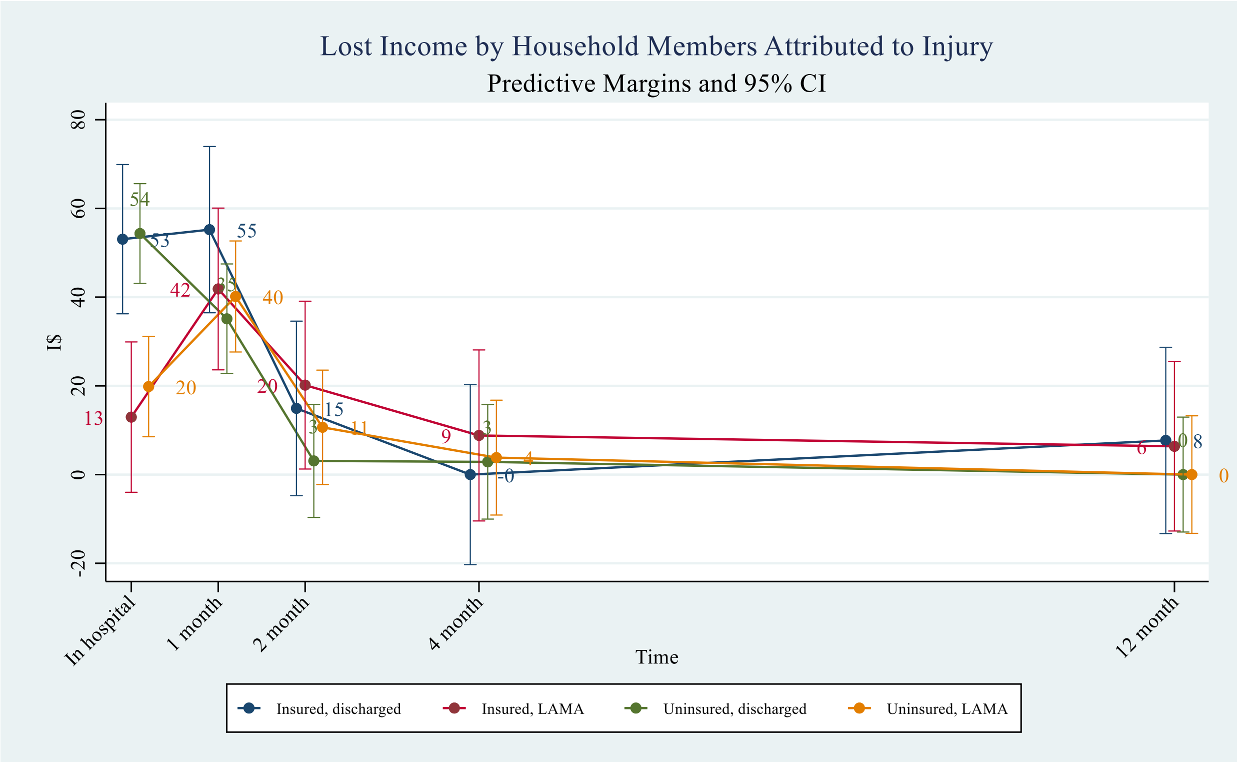


Figure 43: Predictive margins following linear mixed modeling: Lost income by household members attributed to injury by insurance status, hospital discharge type, and time



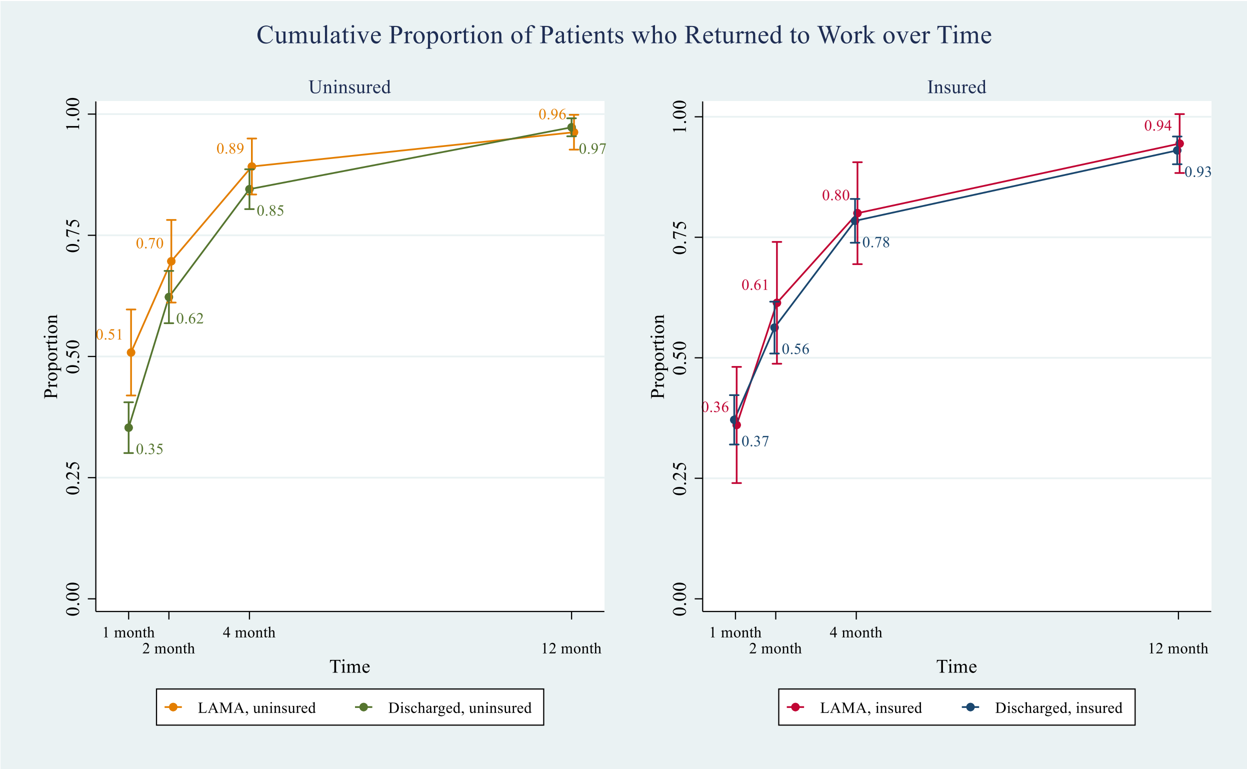
As discussed, patients who left hospital against medical advice spent significantly fewer days in hospital compared to those who were discharged and who were matched based on injury-related factors and factors related to patient resilience to an injury. During hospitalization, patients who differed by discharge type experienced equivalent income losses per day of hospitalization, with patients who left against medical advice reporting income losses of I$5.99 (sd = 21.02) per day, while patients who were discharged reported income losses of I$5.78 (sd=13.30) per day (SMD = 0.012). (Table 27) Household members of patients with different discharge types also reported equivalent losses per day of the patient's hospitalization, with household members of patients who left against medical advice reporting on average I$12.33 (sd=6.84) losses per day, while household members of patients who were discharged reporting on average I$17.66 (30.83) per day of hospitalization (SMD = 0.219). However, patients who were discharged had significantly more household members who reported any losses, with each discharged patient reporting 0.42 (sd=0.66) household members with any losses, and patients who left against medical advice reporting 0.27 (sd=0.55) household members with any losses (SMD = 0.254).

Table 27: Indirect costs during hospitalization: Overall, by patients, by household members, both total costs, and average costs per day of hospitalization

	Discharged mean (sd)	Left against medical advice mean (sd)	Standardized Mean Difference
Matched sample size	219	219	
Total Indirect costs during hospitalization			
Total in household (I$)	95.15 (162.76)	41.74 (97.31)	0.391
Household members (I$)	53.45 (122.80)	17.31 (47.20)	0.382
Patients (I$)	41.70 (79.49)	24.43 (63.63)	0.238
Indirect costs per day of hospitalization, per person			
Household members (I$)	17.66 (30.83)	12.33 (6.84)	0.219
Patients (I$)	5.78 (13.30)	5.99 (21.02)	0.012
Number of household members with any indirect costs per patient	0.42 (0.66)	0.27 (0.55)	0.254

Over the year following hospital discharge, there were no significant or meaningful differences in the cumulative proportion of patients who returned to work among those with insurance by their discharge status within the propensity score matched sample, matched by pre-injury health status, injury severity and cause, and hospital admissions process. (Figure 44) However, among uninsured patients, higher proportions of those who had left hospital against medical advice returned to work within the first month after leaving hospital, compared to uninsured patients who had been discharged. Over 50% of uninsured patients who left against medical advice returned to work within the first month after leaving hospital, compared to just over 35% of uninsured patients who were discharged.

Figure 44: Cumulative proportion of patients who returned to work over the year following hospital discharge, by discharge type, insurance status, and time



Discussion

a. Prevalence of discharge against medical advice

In this study, almost 22% of the cohort ultimately left hospital against medical advice. This percentage is much larger than other studies which estimated the prevalence of admitted patients who left against medical advice. Estimates of the percentage of patients who leave inpatient hospitalization against medical advice in high income countries (HICs) range between 1-2% of all discharges, while in low- and middle-income countries (LMICs), this prevalence is estimated to be twice or more that of HICs, between 3-15%. (Alfandre 2009; Ashrafi et al. 2017; Jimoh et al. 2015; Lee et al. 2016; Mahajan et al. 2019; Mohseni et al. 2015; Nasir and Babalola 2008; Ramakrishnan et al. 2018) Estimates specific to trauma patients are similar in high income countries, with the percentage of trauma and injury patients who leave against medical advice being below between 1-3% in HICs, but are estimated to be between 3-5% in LMICs. (Haines et al. 2020; Hashempour et al. 2019; Jasperse et al. 2020; Lee et al. 2016; Olufajo et al. 2016)

To our knowledge, this is the first estimate of the prevalence of trauma and injury patients LAMA in Vietnam. There are several possibilities for why the HEALS cohort exceeded the prevalence of discharges against medical advice found in other studies, including the patient population, the hospital characteristics, the survey inclusion criteria, and the country context. First, the HEALS cohort is restricted to a single population, trauma and injury patients. Multiple studies have found that the patient population can influence the prevalence of discharge against medical advice, (Alfandre 2009; Gonçalves-Bradley et al. 2016; Nagarajan et al. 2018) and that trauma patients may be more likely to leave against medical advice than patients admitted for other diagnoses, psychiatric and behavioral health patients excepted. (Lee et al. 2016; Nasir and Babalola 2008) Trauma patients may be more likely to leave against medical advice than patients with other diagnoses due to the high direct costs of medical care for trauma (Alfonso et al. 2017; H. Nguyen et al. 2017; Prinja et al. 2016; Wesson et al. 2013), as financial burden is a commonly cited reason for LAMA (Hasan et al. 2019; Jimoh et al. 2015; Mohseni et al. 2015; Nagarajan et al. 2018; Nasir and Babalola 2008; Onukwugha et al. 2012).

Second, the HEALS cohort was recruited from a single hospital in Ninh Bình Province in Vietnam. In high-income settings, hospital size, location, teaching, or non-profit status have all been found to be associated with the prevalence of LAMA, though this has not been studied in LMIC contexts. (Ibrahim et al. 2007; Spooner et al. 2017) It is possible that a feature of this particular hospital, such as size, location, or catchment area, may have presented a risk factor for patients to leave against medical advice; however, further research would be needed comparing the proportion of discharges against medical advice across different hospitals to be able to draw any conclusions. Third, the inclusion criteria for the study was for patients who spent a minimum of 24 hours in the hospital, and who were physically and mentally stable enough within the first two weeks of admission of hospital to be able to participate in the interview. As patients who were discharged had significantly worse injury severity scores on average as compared to patients who left against medical advice, patients who were physically and mentally unstable and not able to participate may have had more severe injuries and have been less likely to leave against medical advice. As the data on having left against medical advice comes from trauma patients who agreed to participate in the survey, rather than captured from hospital records as most quantitative studies of discharge against medical advice have done, this may have introduced a bias. (Haines et al. 2020; Jasperse et al. 2020; Jimoh et al. 2015; Lee et al. 2016; Mahajan et al. 2019; Olufajo et al. 2016; Spooner et al. 2017)

A final possibility is that discharge against medical advice from hospital was higher in Vietnam than in other low- or middle-income settings. There are two studies which reported the prevalence of LAMA in Vietnam, both of which provided among the highest estimates of the prevalence of LAMA among general discharge, or condition-specific discharges, in the literature. The first study found that 10.5% of all discharges which were admitted to a prospective cohort study stopped their in-hospital treatment early, including 6.0% who ended treatment early due to financial considerations. (Ho et al. 2019; Vuong 2015) This prospective cohort study included patients who were unable to participate in the study until four or five weeks after their admission. Another study in Vietnam among malaria patients found that fully one third left hospital against medical advice, again for financial reasons. (Morrow et al. 2009) This is explored further below.

The high proportion of patients LAMA may in part be a response by patients to an over-provision of medical services by providers in Vietnam. Among patients who were discharged, insured patients had significantly higher total charges and significantly longer lengths of stay as compared to uninsured patients, despite matching on factors related to medical need within subgroups defined by insurance status. This suggests that among patients who received all prescribed medical care and were discharged, insured patients were provided significantly more medical need than uninsured patients. One possibility is that providers may be sensitive to the fact that uninsured patients would have to pay for all care out-of-pocket, and may take a more conservative approach to their care relative to insured patients, whose medical bills would be paid for largely by insurance. Another possibility for this is over-provision of medical care to insured patients as a way to capture additional insurance reimbursement. This is somewhat supported by the fact that patients who left against medical advice reported only small and non-significantly higher WHODAS differentials in the year following hospital discharge, suggesting no meaningful difference in functional outcomes resulting from the choice to leave hospital against medical advice; and that the difference in length of stay by insurance status among the discharged was greater than three days, a differential that suggests against taking a conservative approach to care being the major explanation.

Vietnam has a well-known problem of over-provision of health care services, particularly in hospitals, which is attributable to the passive purchasing mechanisms which have been used to pay the cost of care at public provincial hospitals, such as Ninh Bình Hospital. (Lieberman and Wagstaff 2009; Somanathan et al. 2014; Teo et al. 2019; Thanh et al. 2014; Vian et al. 2012) Over-provision of care may represent an effort by providers to increase revenue; a lack of appropriate clinical judgment; or the two combined or blurred together. (Vian et al. 2012) When too much care is provided as a fundraising strategy, its success depends on the information asymmetry that exist between patients and providers, with providers having a better understanding of what care is appropriate and needed, and patients not having the information or judgment to independently assess their own need.

User fees for inpatient hospital care were first introduced in Vietnam in 1989 as part of the *Doi Moi* reforms, but a fee schedule for health care services was only set in 1995. (Dao et al. 2008; Lieberman and Wagstaff 2009) Between 1995, when the fee schedule for health services was first set, and 2015, provincial hospitals were paid through a combination of global budgets based on historical usage and fee-for-service payments. (Lieberman and Wagstaff 2009) Global budgets based on historical usage mean that state-provided subsidies to hospitals were based on health care usage at the hospital in the previous year, but are not required to be used for specific uses. Fee-for-service (FFS) payments are remuneration to health care providers which are paid based on the number of services provided. On both counts, health care providers are incentivized to provide more services in order to gain additional payment, either immediately in the case of FFS payments or in the next budget cycle, in the case of historical budgets. This was exacerbated in Vietnam by the fact that between 1995 and 2012, the fee schedule for basic services was not increased, not even to keep up with inflation, meaning that health care providers could not recover the cost of services provided; and in 2006, the fee schedule was updated only to include fees for new medicines and higher technology service. (Lieberman and Wagstaff 2009; Teo et al. 2019; Vian et al. 2012) Further, policies of decentralizing decision-making around staffing and service provision and devolving financial autonomy to public hospital were put in place in 2002 and further in 2006, which permitted joint ventures using private investment capital as well as profit sharing with hospital staff. (Sepehri 2014; Teo et al. 2019; Vietnam Ministry of Health et al. 2011) In response to these policies, it has become a common practice for health care providers to themselves put up the capital for the purchase of expensive equipment, such as MRI machines, over-utilize that equipment with patients, and redistribute to themselves the profits thus generated. (Teo et al. 2019; Thanh et al. 2014; Vian et al. 2012) This health care purchasing environment created an incentive for over-provision, while a policy of hospital autonomy both intensified the incentive and created the enabling environment for hospitals to respond to these incentives. (London 2013; Sepehri 2014; Somanathan et al. 2014; Vietnam Ministry of Health et al. 2011)

This combination of incentives within an enabling environment has led providers to over-provide services generally, and specifically to over-provide services which were newer and more expensive relative to the provision of more basic services, as a way to cover the costs of care. This was reflected in the costs of inpatient care at hospitals rising far faster than the number of patients admitted to hospitals during this period; excess hospital admissions for patients who could be treated as outpatients; excessive diagnostic tests and pharmaceutical prescribing; and excessive lengths of stay in hospital. (Lieberman and Wagstaff 2009; Teo et al. 2019; Thanh et al. 2014; Vian et al. 2012) Some of the newest forms of health services, which were added to the fee schedule after 2006, were for trauma care; prior to the 2012 and 2015 updates to the fee schedule, a higher proportion of the cost for the care of certain types of trauma and injury was recoverable than for other health conditions, such as childhood pneumonia. (Lieberman and Wagstaff 2009) It is possible that trauma and injury patients may have been particularly susceptible to overprovision of care.

This situation may have been further exacerbated by the Health Insurance Law of 2015, which came into effect on January 1, 2015, which removed all supply-side supports including the provision of global budgets and allowed for payment of services only through fees for services set by the fee schedule, which was now set at full cost recovery. However, the 2015 Health Insurance Law did not set conditions or controls on payments for services, nor did it provide guidelines for treatment; and the policy of financial autonomy for hospitals was maintained. As the supply of health care has been found to increase with the price, the increase in fees in 2012 and in 2015 to set the rates for services at full cost recovery may have increased the incentive to oversupply services, compounded by the simultaneous loss of all supply-side supports for curative care in 2015. (Clemens and Gottlieb 2014) This may also have had the unplanned negative consequence of increasing financial exposure for those patients who still remain uninsured, and therefore have to pay the higher fee schedule prices out-of-pocket. This may have contributed to the sudden and sustained increase in out-of-pocket costs as a proportion of total health expenditure which started in 2012. Between 2000 and 2011, the percentage of total health expenditure comprised of household out-of-pocket costs held steady at approximately 37%; however, beginning in 2012, the last year for which data is available, this percentage increased steadily to 45% in 2017, the last year for which data is available. (World Health Organization 2020) Further research, including qualitative interviews, would be needed to understand whether the high proportion of patients who left against medical advice in this cohort, concentrated so heavily among the uninsured, may have been a response to this health insurance and service purchasing policy environment.

b. Patient and household characteristics associated with leaving against medical advice

i. Insurance status

In general, studies of risk factors for and the consequences of leaving hospital against medical advice are not well studied in LMICs. In high-income settings, the majority of research into risk factors for patients

LAMA has investigated patient-level predictors, rather than the potential context in which such decisions may occur, including the hospital, health system, and health financing context in which such decisions are made. This study is similarly focused on patient- and household-level characteristics associated with discharge against medical advice, as it takes place within a single health care setting, Ninh Bình Hospital.

The patient or household factor with the strongest association with the decision to leave against medical advice was if the patient was uninsured, which is consistent with other studies of discharge against medical advice. (Alfandre 2009; Baptist et al. 2007; Ibrahim et al. 2007; Jasperse et al. 2020; Lee et al. 2016; Spooner et al. 2017; Tawk et al. 2013) In this study, uninsured patients were over twice as likely to leave against medical advice compared to patients with any form of insurance, conditional on age, pre-hospital interventions, and injury severity score. Uninsured patients, who would be required to pay direct medical costs out-of-pocket, may have been more likely to leave against medical advice as compared to insured patients as a way to avoid those direct medical costs. The high proportion of patients LAMA may be a due to severe financial constraints by patients who are unable to either pay for the cost of treatment or take further time off from work. Financial considerations have been found to be a major cause of the decision to leave against medical advice. (Aliyu 2002; Ashrafi et al. 2017; Gautam et al. 2018; Mohseni et al. 2015; Naderi et al. 2014; Nasir and Babalola 2008) Indeed, as discussed further below, both insured and uninsured patients saved substantial amounts in hospital bills by LAMA, which uninsured patients would have had to pay out-of-pocket. However, financial dependence of the household on the patient did not seem to be a contributing factor, either in bivariate analysis or conditionally in regression analysis. Interestingly, the household's pre-injury income category was not associated with the decision to leave against medical advice, not even among the uninsured who would have to pay out-of-pocket, as might be expected if financial constraints were the driving force behind the patient's decision to leave against medical advice. This is also contrary to much of the literature examining patient factors associated with discharge against medical advice, although the majority of this literature comes from the United States. (Baptist et al. 2007; Ibrahim et al. 2007; Menendez, van Dijk, and Ring 2015; Nagarajan et al. 2018; Spooner et al. 2017)

ii. Pre-hospital medical care and source of referral

In bivariate analysis, patients who self-referred to the hospital were more likely to leave against medical advice compared to patients who were referred by a hospital or health care provider. However, after adjusting for insurance status in regression analysis, this association disappeared, as patients who were uninsured were much more likely to have self-referred than patients with insurance. This difference in referral pattern may be due in part to the gatekeeping function of primary care. Patients with insurance who bypass primary care and directly access a provincial or district hospital without a referral are required to pay higher copayments. (Barroy, Jarawan, and Bales 2014; Lieberman and Wagstaff 2009; Somanathan et al. 2014)

Patients were significantly less likely to leave against medical advice if they had received pre-hospital interventions, regardless of injury severity, age, or insurance status. Patients who sought pre-hospital medical interventions may have been more likely to seek out and receive medical care than patients who had no prehospital care; this may have translated into a propensity to remain for the full length of hospitalization. Alternatively, although patients of equivalent injury severity were more likely to be discharged if they had received pre-hospital medical care, having received pre-hospital interventions may have been a signal to patients that their injury was serious. Qualitative studies have found that patients who do not perceive their own health condition to be serious, who believed they would not have to be hospitalized, or that their hospitalization would be of short duration, may be more likely to leave against medical advice, as their expectations around treatment are not met. (Mohseni et al. 2015; Onukwugha et al. 2012; Steinglass, Grantham, and Hertzman 1980)

iii. Demographics

Multiple studies have found that younger patients are more likely to leave against medical advice than older patients. (Jasperse et al. 2020; Jimoh et al. 2015; Kim et al. 2011; Menendez et al. 2015; Spooner et al. 2017; Tawk et al. 2013) This study found that to be true for patients between the ages of 22 and 70. However, there was no relationship between age and discharge against medical advice for patients between 18 and 22, while there was an increase in the odds of discharge against medical advice with increasing age after 70 years. One study from South Korea found that elderly patients were more likely to leave against medical advice compared to younger patients, due to caretakers of the elderly rather than patients being the primary decision-makers around discharge. (Lee et al. 2016) There may be several reasons for this, including an unwillingness by households to continue treatment for an elderly person or an inability to continue to pay direct or indirect costs for a nonproductive household member.

In the bivariate analysis, family obligations, including being married as compared to being single, and a higher child dependency ratio in the household, were both associated with LAMA. However, when adjusting for insurance status in a multivariable logistic regression, associations between family obligations and discharge against medical advice became non-significant conditional on age. This may be because age, in addition to being a biological factor that is associated with resilience to injury, with older individuals being less resilient, is also a marker for stage of life, with older individuals less likely to have younger children in their household anymore, or in the case of multigenerational households, being less likely to be the primary caretakers for younger children. While the literature indicates that male sex is associated with higher probability of LAMA, it was not associated in this population. (Gautam et al. 2018; Jasperse et al. 2020; Mahajan et al. 2019; Menendez et al. 2015; Olufajo et al. 2016) In the United States, male sex is thought to be a proxy for substance use, while in LMICs, male sex may be a proxy for financial and familial obligations, or may reflect sex imbalances in those who seek medical care in the first place. (Alfandre 2018; Gautam et al. 2018)

c. Health and disability consequences of LAMA

Among insured patients, there was no significantly difference in reported functional outcomes by discharge type, though patients who left against medical advice had small and non-significant worse reported functional outcomes over time. If patients who left against medical advice had used more follow-up care to improve their own health compared to discharged patients, that could have explained the lack of difference in health and functional outcome by discharge status. However, there was no evidence that patients who left against medical advice visited a doctor or hospital, used rehabilitative health services, or utilized any form of follow-up care more over time than discharged patients. Indeed, only a very small proportion of patients used rehabilitative care following injury. This provides some support to the hypothesis that patients who were insured were overprovided care, or had less direct financial incentive to act to oppose overprovision of care. These patterns of health care usage reflect the larger, well-known inefficiencies in the health system in Vietnam, including an over-reliance on inpatient care followed by an under-utilization of follow-up care, particularly rehabilitative care. (Lieberman and Wagstaff 2009; Somanathan et al. 2014; Teo et al. 2019)

Uninsured patients who were discharged had significantly worse WHODAS scores at one month after discharge compared to uninsured patients who left against medical advice, but thereafter reported similar levels of functionality. It may be that, given the strong incentives that patients have to leave against medical advice in an environment of overprovision of services, particularly acute for uninsured patients who must pay costs out-of-pocket, that uninsured patients who were discharged experienced significantly worse recovery trajectories in-hospital. The propensity score matching process matched patients based on both injury related factors (the injury severity and cause, the number of injuries, the patient's Glasgow Coma Scale at arrival, the admitting department and source of referral), as well as potential measures of the patient's resilience to injury (the patient's pre-injury WHODAS score, sex, and age category). However, these measures account for factors related to needed medical care at the time of arrival to the hospital, but do not measure the patients progress during hospitalization. It may be that uninsured patients who were discharged, although matched using these measures, fared worse in-hospital for unknown reasons, and were therefore less likely to leave against medical advice to avoid further cost.

d. Financial consequences of leaving against medical advice

i. Direct medical costs and length of stay in-hospital

Patients who left hospital against medical advice experienced substantial savings in direct medical costs by cutting short their lengths of stay. Uninsured patients saved approximately I$154 dollars, or about 80% of the average monthly income per person prior to injury in this sample (which was I$192.96). Insured patients saved I$314 in hospital charges, or more than twice what uninsured patients saved by leaving hospital against medical advice, and more than 160% of the average monthly income per person in this sample. Insured and discharged patients incurred the highest charges, followed by uninsured, discharged patients. These patterns in hospital charges correspond to those observed in lengths of stay by insurance status and discharge type. Uninsured patients who left against medical advice left just over three days before uninsured patients who were discharged, while insured patients who left against medical advice left almost five and a quarter days earlier than insured patients who were discharged.

However, the experience of these savings was different between insured and uninsured patients in more than just the amount saved. Insured patients who left against medical advice saved the user fees which they would have to pay out-of-pocket, but the bulk of their savings in hospital charges would have been covered by insurance. For uninsured patients, by contrast, although their overall savings from LAMA were smaller, those costs would have had to been paid out-of-pocket. This finding accords which the literature on discharge against medical advice, in which financial reasons have been found to be a primary reason for patients LAMA. (Aliyu 2002; Ashrafi et al. 2017; Gautam et al. 2018; Mohseni et al. 2015; Naderi et al. 2014; Nasir and Babalola 2008)

While these results paint a picture of patients LAMA in order to save direct medical costs, this picture is complicated when examining the differences in total charges between insured and uninsured patients who were discharged. As mentioned, patients were propensity score matched by factors related to injury cause, severity, hospital admissions process, and health factors related to resilience to injury, which, if the propensity score matching model is correct, would indicate that matched patients do not differ in their need for medical care. However, insured patients who were discharged had hospital charges which were more than I$140 more than uninsured patients who were discharged. There are several possibilities that could explain this. First, it is possible that uninsured patients who were ultimately discharged refused some type of medical care during their hospitalization, possibly as a way to avoid additional costs, but their strategies to forgo medical care did not rise to the level of, or did not include the step of, leaving hospital against medical advice. Second, it may be that uninsured patients were discharged by health care providers without having received all necessary care. Neither of these hypotheses can be evaluated with the current data, and would require access to medical records. A third possibility is that propensity score model, necessarily restricted to observed and measured variables, was not successful in creating two groups identical in their experience of injury and need for medical care due to unobserved confounders. A final possibility is that patients who were insured were over-provided medical care by health care providers as a way to increase insurance reimbursement. Those who were insured, whose medical bills would be substantially covered by insurance, may have had less of a financial stake in opposing an overprovision of care. This final hypothesis is supported by the overall large proportion of patients who left against medical, in excess of what is found in other contexts.

ii. Indirect costs

Indirect costs by patients and household members showed distinct patterns by who incurred the costs, patient insurance status, patient discharge type, and time. During hospitalization, patients experienced equivalent income losses, by discharge type and insurance status. However, total household indirect costs were higher for patients who were discharged due to household members of patients having higher income losses. Household members of discharged patients had higher income losses due to both the longer lengths of stay among patients who were discharged, and because more household members per discharged patient lost any income during their hospitalization. It may be that discharged patients had more family members who earned any income compared to patients who left against medical advice, and therefore were more at risk for any indirect costs. Alternatively, patients who left against medical advice may have had less family support during their hospitalization, which could be related to the decision to leave against medical advice. Finally, given the relatively longer lengths of stay among patients who were discharged, more household members may have been required to substitute for each other in providing support to the patient or coping with changes in roles with the household due to the patient's longer hospitalization. If insured, discharged patients are being over-provided medical care, attributable in part to the passive nature of health care purchasing in Vietnam, then part of this increase in indirect costs experienced by those discharged patients is an unanticipated, negative consequence of this.

The 2015 Health Insurance Law aimed to expand the breadth of health insurance coverage in Vietnam by mandating health insurance coverage for all citizens. It simultaneously removed all supply-side funding supports and set the cost of health services at full cost recovery. However, it did not revise the coverage package, nor did it reform provider payment mechanisms. As a result, the health insurance law may reduce the experience of out-of-pocket costs and reduce the number of patients leaving hospital against medical advice, two issues highlighted by this study. However, it would not address the additional indirect costs experienced by household members of hospitalized patients who are over-provided inpatient, nor the inefficiencies introduced into the health system by an overreliance on inpatient care. For over a decade, Vietnam has been considering moving provider payment away from a fee-for-service mechanism to a case-based payment system, in which providers are remunerated in a standardized way based on the health condition of the patient, going so far as to pilot this system in 2009. (Tran Van Tien et al. 2011) However, there has been a lack of consensus about how to move forward with this change between the regulatory body, the Ministry of Health, and the insurance provider, Vietnam Social Security, and the Ministry of finance. There are currently no concrete plans to implement case-based payments for inpatient care, or a regulatory framework necessary to prevent the common pitfalls of such a system, such as classifying a patient as having a more severe diagnosis than they do in order to secure additional reimbursement, or reducing quality of care in order to reduce inputs.

Following hospital discharge, uninsured patients who left hospital against medical advice had lower indirect costs as compared to uninsured patients who were discharged, possibly due to uninsured patients who left hospital against medical advice returning to work faster than uninsured patients who were discharged. At one month after discharge, patients who left against medical advice reported significantly better WHODAS scores than uninsured, discharged patients. It may be that the same financial need which may have prompted the decision to leave hospital against medical advice to avoid direct medical costs also prompted the decision to return to work faster to avoid further indirect costs among these patients, enabled by relatively better health and functional outcomes, compared to patients who were discharged. While the patient's pre-injury income group was not associated with the decision to leave against medical advice, as has been commonly reported in the literature, it may be that the effort to avoid becoming lower income is associated with the decision to LAMA and to return to work faster among the uninsured, who face higher direct costs.

e. Strengths and limitations

This study had several strengths and limitations related to available data, variable definitions, and analytic methodology.

i. Forgoing medical care: Beyond discharge against medical advice

The first limitation is the definition of the outcome of forgoing medical care as discharge against medical advice. There are several ways that individuals may forgo medical care following an injury, in addition to leaving hospital against medical advice. First, as this is a hospital-based study, individuals who were injured but did not go hospital at all are omitted from the sample. The inclusion criteria for the study is assumed to set a minimum injury severity, as only patients who required hospitalization for at least one day were included in the study. The assumed effect of this inclusion criteria is to restrict the sample to a patient population for whom forgoing all inpatient medical care would have serious consequences, and would therefore be an unlikely decision. Among patients with less serious injuries, i.e. those did not require overnight admission, those unable to pay may have avoided seeking any hospital-based medical care while those who were able to pay may have sought hospital-based medical care; however, both groups are excluded from this dataset. This study relies on the assumption that while there may be an interaction between injury severity and willingness to pay direct medical costs in producing the outcome of seeking any medical care, that the interaction does not occur for injuries of sufficient severity to require a patient to stay in hospital for a minimum of 24 hours or longer.

Prior to discharge, there may have been patients who forwent some medical care during their hospitalization without LAMA, such as by refusing specific tests or procedures. These patients may have received some but not all required medical care; received medical care that was not appropriate to need; or received ineffective or poor quality medical care. However, these patients were of necessity classified as having been discharged; these forms of forgoing medical care cannot be detected with the available data and would likely require access to medical records. Forgoing medical care was restricted to what is perhaps its most extreme form, leaving hospital against medical advice. The outcome definition therefore traded-off lower sensitivity in favor of higher specificity, which is warranted in an environment of over-provision of medical care. As high as the estimated prevalence of discharge against medical advice is, it may yet be a conservative estimate of the proportion of patients who chose to forgo medical care in any form. Further research is needed to understand the full scope and impact of patients forgoing medical care, using an expanded definition.

ii. Propensity score matching methodology

There were several strengths and limitations related to the use of propensity score matching followed by doubly-robust regression adjustment. While it is a strength of propensity score matching is that it avoids extrapolating through regression adjustment when the distributions of covariates are not equivalent across groups, it does mean regression results must be interpreted as the average effect of treatment on the treated (ATT), rather than the average treatment effect (ATE). We cannot project whether and to what degree hospital bills, lengths of stay, indirect costs, and post-discharge functionality would have been affected if those who were discharged had left against medical advice; we can only estimate the effects of LAMA on those who left against medical advice.

Propensity score matching is meant to create two groups equivalent on all observed variables which may confound the relationship between the independent variable of interest and the outcome of interest. Propensity score matching methods develop scores for each patient's propensity to select into a value of an independent variable, in this case, LAMA. PSM methods assume that there is no unobserved confounding, and that the modeling of LAMA so entirely explains the choice of discharge type by the patient that, condition on the propensity score, that choice is in effect random. However, unlike in a randomized experiment, there really is no grounds for such an assumption. While the use of

PSM is intended to mimic a randomized experiment by creating two groups with equal distributions of confounders, unlike a randomized experiment, unobserved, unmeasured or imperfectly measured covariates are not also distributed equally between groups defined by the independent variable, on average. However, such methods are necessary and appropriate when the independent variable of interest cannot be randomized; leaving hospital against medical advice cannot, of course, be randomized for ethical reasons. Several factors give support to the findings, including the use of regression adjustment with the matching variables which provided “doubly robust” parameter estimates by accounting for uncertainty in the model used to predict propensity scores; the use of bootstrapping, which accounts for uncertainty around standard errors; and the number of sensitivity analyses conducted which were in accord with the main results.

While these are strengths and limitation of propensity score matching in general, there were also strengths and limitations for the application of these methods in this study. There were 8 patients who were discharged for whom propensity scores could not be estimated by any of the propensity score models tested which were able to achieve balance. These individuals either had injury types, severity scores, causes, or combinations of the above which were rare, resulting in an empty cell problem during regression. It is unlikely that any of these eight discharged individuals would have served as better matches for patients who left against medical advice that those which were found. First, these patients had uniquely severe, even devastating injuries, such as a crush injury to the cervical spine (one patient), or a traumatic brain injury which had resulted in coma (two patients). Additionally, both the low number of discharged patients who were discarded from consideration and the analysis of the standardized mean differences indicate that this was not a fatal limitation.

iii. Difference-in-difference methodology

One limitation of the difference-in-difference methodology used here is the inability to test the "parallel paths" assumption: the assumption that, prior to their discharge, patients who were discharged and patients who left against medical advice were experiencing similar trajectories in their health and functional limitation. However, if a better recovery trajectory in-hospital prompted some patients to make the decision to leave against medical advice, that assumption may not be borne out. Further research, including qualitative research, is needed to understand the patient, hospital, and health systems factors associated with discharge against medical advice in Vietnam.

iv. Indirect costs

The main limitation of measuring indirect costs as lost income by patients and household members is that such a definition only considers paid labor, and sets to zero the value of all lost unpaid labor performed in the household. As such, estimates of the magnitude of indirect costs attributable to injury are their most conservative value. As there is no reason to suppose that patients or household members of those who left against medical advice and those who were discharged had different unpaid obligations, after accounting for age and stage of life in the household, comparison of lost income as a proxy for all indirect costs are likely to be valid. Sex, which would be expected to be associated with different unpaid labor obligations, was not associated with the decision to leave against medical advice. Further, neither marital status or child dependency ratio, which also might be expected to be associated with unpaid labor obligations, were associated after accounting for age.

References

Alfandre D., ed. 2018. *Against-Medical-Advice Discharges from the Hospital: Optimizing Prevention and Management to Promote High Quality, Patient-Centered Care*. New York, NY: Springer.

Alfandre D. J. 2009. “I’m Going Home”: Discharges against Medical Advice. *Mayo Clinic Proceedings* **84**(3): 255–60.

Alfonso Y. N., Alonge O., Md D., Hoque E., Baset K. U., Hyder A. A., Bishai D. 2017. Care-Seeking Patterns and Direct Economic Burden of Injuries in Bangladesh. *International Journal of Environmental Research and Public Health* **14**(5): 472–80.

Aliyu Z. Y. 2002. Discharge against Medical Advice: Sociodemographic, Clinical and Financial Perspectives. *International Journal of Clinical Practice* **56**(5).

Ashrafi E., Nobakht S., Keykaleh M. S., Kakemam E., Hasanpoor E., Sokhanvar M. 2017. Discharge against Medical Advice (DAMA): Causes and Predictors. *Electronic Physician* **9**(6): 4563–70.

Austin P. C., Small D. S. 2014. The Use of Bootstrapping When Using Propensity-Score Matching without Replacement: A Simulation Study. *Statistics in Medicine* **33**: 4306–19.

Baptist A. P., Warrier I., Arora R., Ager J., Massanari R. M. 2007. Hospitalized Patients with Asthma Who Leave against Medical Advice: Characteristics, Reasons, and Outcomes. *J Allergy Cline Immunol* **115**(4): 924–29.

Barroy H., Jarawan E., Bales S. 2014. *Vietnam - Universal Health Coverage for Inclusive and Sustainable Development : Country Summary Report*.

Ciapponi A., S L., Herrera C., Opiyo N., Pantoja T., Paulsen E., Rada G., Wiysonge C., Bastías G., Dudley L., Flottorp S., Gagnon M., Garcia Marti S., Glenton C., Okwundu C., Peñaloza B., Suleman F., Oxman A. 2017. Delivery Arrangements for Health Systems in Low-Income Countries: An Overview of

Systematic Reviews (Review). *Cochrane Library Cochrane Database of Systematic Reviews* (9).

Clemens J., Gottlieb J. D. 2014. Do Physicians' Financial Incentives Affect Medical Treatment and Patient Health? *American Economic Review* **104**(4): 1320–1349.

Dao H. T., Waters H., Le Q. V, Noi H., Nam V. 2008. User Fees and Health Service Utilization in Vietnam: How to Protect the Poor? *Public Health* **122**: 1068–78.

Gautam N., Sharma J., Sharma A., Verma V., Arora P., Gautam P. 2018. Retrospective Evaluation of Patients Who Leave against Medical Advice in a Tertiary Teaching Care Institute. *Indian Journal of Critical Care Medicine* **22**(8): 591–96.

Gonçalves-Bradley D. C., Lannin N. A., Clemson L. M., Cameron I. D., Shepperd S. 2016. Discharge Planning from Hospital. *Cochrane Database of Systematic Reviews* **2016**(1).

Green K. M., Stuart E. A. 2014. Examining Moderation Analyses in Propensity Score Methods: Application to Depression and Substance Use. *J Consult Clin Psychol* **82**(5): 773–83.

Greenland S. 2003. Quantifying Biases in Causal Models: Classical Confounding. *Epidemiology* **14**: 300–306.

Haines K., Freeman J., Vastaas C., Rust C., Cox C., Kasotakis G., Fuller M., Krishnamoorthy V., Siciliano M., Alger A., Montgomery S., Agarwal S. 2020. "I'm Leaving": Factors That Impact Against Medical Advice Disposition Post-Trauma. *Journal of Emergency Medicine* **58**(4): 691–97.

Hasan O., Muhammad Adeel Samad, Khan H., Sarfraz M., Noordin S., Ahmad T., Nowshad G. 2019. Leaving against Medical Advice from In-Patients Departments Rate, Reasons and Predicting Risk Factors for Re-Visiting Hospital Retrospective Cohort from a Tertiary Care Hospital. *International Journal of Health Policy and Management* **8**(8): 474–79.

Hashempour R., Tahmasebi A., Veysi M., Amini M., Tavakoli N. 2019. *Cost Analysis of Accidents According to Demographic Factors in Iran*. Vol. 48.

Ho M.-T., La V.-P., Nguyen M.-H., Vuong T.-T., Nghiem K.-C. P., Tran T., Nguyen H.-K. T., Vuong Q.-H. 2019. Health Care, Medical Insurance, and Economic Destitution: A Dataset of 1042 Stories. *Data* **4**(57).

Hong T. T., Hoa N. P., Walker S. M., Hill P. S., Rao C. 2018. Completeness and Reliability of Mortality Data in Viet Nam : Implications for the National Routine Health Management Information System. *PLoS ONE* **69**: 1–16.

Huong C. 2018. Presentation from the Planning and Finance Department, Ministry of Health. in *Hanoi Trauma and Injury Program Symposium: Unified Data Systems for Trauma and Injury in Vietnam*. Hanoi, Vietnam: Hanoi University of Public Health.

Huyen N. T. T. 2018. Presentation from the Head of the Health Statistics Division, Ministry of Health. in *Hanoi Trauma and Injury Program Symposium: Unified Data Systems for Trauma and Injury in Vietnam*. Hanoi, Vietnam: Hanoi University of Public Health.

Hwang S. W., Li J., Gupta R., Chien V., Martin R. E. 2003. What Happens to Patients Who Leave Hospital against Medical Advice? *CMAJ* **168**(4): 417–20.

Ibrahim S. A., Kwoh C. K., Krishnan E. 2007. Factors Associated with Patients Who Leave Acute-Care Hospitals against Medical Advice. *American Journal of Public Health* **97**(12): 2204–8.

Imai K., King G., Stuart E. A. 2008. Misunderstandings between Experimentalists and Observationalists about Causal Inference. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* **171**(2): 481–502.

Imbens G. W. 2004. Nonparametric Estimation of Average Treatment Effects under Exogeneity: A

Review. *Review of Economics and Statistics* **86**(1): 4–29.

Jasperse N., Grigorian A., Delaplain P., Jutric Z., Schubl S. D., Kuza C. M., Nahmias J. 2020. Predictors of Discharge against Medical Advice in Adult Trauma Patients. *Surgeon* **18**(1): 12–18.

Jimoh B. M., Anthonia O. C., Chinwe I., Oluwafemi A., Ganiyu A., Haroun A., Chinwe E., Joshua A. 2015. Prospective Evaluation of Cases of Discharge against Medical Advice in Abuja, Nigeria. *Scientific World Journal* **2015**: 4–8.

Kim H., Colantonio A., Bayley M., Dawson D. 2011. Discharge against Medical Advice after Traumatic Brain Injury: Is Intentional Injury a Predictor? *Journal of Trauma - Injury, Infection and Critical Care* **71**(5): 1219–25.

Kutzin J. 2013. Health Financing for Universal Coverage and Health System Performance: Concepts and Implications for Policy. *Bull World Health Organ* **91**(8): 602–11.

Lee C. A., Cho J. P., Choi S. C., Kim H. H., Park J. O. 2016. Patients Who Leave the Emergency Department against Medical Advice. *Clinical and Experimental Emergency Medicine* **3**(2): 88–94.

Lieberman S., Wagstaff A. 2009. *Health Financing and Delivery in Vietnam: Looking Forward*. Washington, DC.

London J. D. 2013. The Promises and Perils of Hospital Autonomy. Reform by Decree in Viet Nam. *Social Science and Medicine* **96**: 232–40.

Mahajan R. K., Gautam P. L., Paul G., Mahajan R. 2019. Retrospective Evaluation of Patients Leaving against Medical Advice in a Tertiary Care Teaching Hospital. *Indian Journal of Critical Care Medicine* **23**(3): 150–53.

Menendez M. E., van Dijk C. N., Ring D. 2015. Who Leaves the Hospital Against Medical Advice in the

Orthopaedic Setting? *Clinical Orthopaedics and Related Research* **473**(3): 1140–49.

Minh T. H. 2018. Presentation from the Director of the National Traffic Safety Committee. in *Hanoi Trauma and Injury Program Symposium: Unified Data Systems for Trauma and Injury in Vietnam*. Hanoi, Vietnam: Hanoi University of Public Health.

Mohseni M., Alikhani M., Tourani S., Azami-Aghdash S., Royani S., Moradi-Joo M. 2015. Rate and Causes of Discharge against Medical Advice in Iranian Hospitals: A Systematic Review and Meta-Analysis. *Iranian Journal of Public Health* **44**(7): 902–12.

Morrow M., Nguyen Q. A., Caruana S., Biggs B. A., Doan N. H., Nong T. T. 2009. Pathways to Malaria Persistence in Remote Central Vietnam: A Mixed-Method Study of Health Care and the Community. *BMC Public Health* **9**(1): 85.

Naderi S., Acerra J. R., Bailey K., Mukherji P., Taraphdar T., Mukherjee T., Pal A., Ward M. F., Miele K., Mathias M., Tan R., Kline M., Alagappan K., Silverman R. 2014. *Patients in a Private Hospital in India Leave the Emergency Department against Medical Advice for Financial Reasons*.

Nagarajan M., Offurum A. I., Gulati M., Onukwugha E. 2018. Discharges Against Medical Advice: Prevalence, Predictors, and Populations. Pp. 11–29 in *Alfandre D., ed. 2018. Against-Medical-Advice Discharges from the Hospital: Optimizing Prevention and Management to Promote High Quality, Patient-Centered Care. New York, NY: Springer.*, edited by D. Alfandre. New York, NY: Springer.

Nasir A. A., Babalola O. M. 2008. Clinical Spectrum of Discharges against Medical Advice in a Developing Country. *Indian Journal of Surgery* **70**(2): 68–72.

Nguyen H., Ivers R., Jan S., Pham C. 2017. Analysis of Out-of-Pocket Costs Associated with Hospitalised Injuries in Vietnam. *BMJ Glob Health* **2**(1): e000082.

Nguyen T., Collins G. S., Spence J., Daurès J.-P., Devereaux P. J., Landais P., Le Manach Y. 2017. Double-Adjustment in Propensity Score Matching Analysis: Choosing a Threshold for Considering Residual Imbalance. *BMC Medical Research Methodology* **17**(78): 1–8.

Olufajo O. A., Metcalfe D., Yorkgitis B. K., Cooper Z., Askari R., Havens J. M., Brat G. A., Haider A. H., Salim A. 2016. Whatever Happens to Trauma Patients Who Leave against Medical Advice? *American Journal of Surgery* **211**(4): 677–83.

Onukwugha E., Saunders E., Mullins C. D., Pradel F. G., Zuckerman M., Loh F. E., Weir M. R. 2012. A Qualitative Study to Identify Reasons for Discharges against Medical Advice in the Cardiovascular Setting. *BMJ Open* (2).

Pan W., Bai H. 2015. Propensity Score Interval Matching: Using Bootstrap Confidence Intervals for Accommodating Estimation Errors of Propensity Scores. *BMC Medical Research Methodology* **15**(53).

Prinja S., Jagnoor J., Chauhan A. S., Aggarwal S., Nguyen H., Ivers R. 2016. Economic Burden of Hospitalization Due to Injuries in North India: A Cohort Study. *International Journal of Environmental Research and Public Health* **13**(7): 673–87.

Ramakrishnan N., Ranganathan L., Abraham B., Rajagopalan S., Venkataraman R. 2018. What Happens to Patients Discharged against Medical Advice? *Indian Journal of Critical Care Medicine* **22**(8): 580–84.

Rassen J. A., Glynn R. J., Rothman K. J., Setoguchi S., Schneeweiss S. 2012. Applying Propensity Scores Estimated in a Full Cohort to Adjust for Confounding in Subgroup Analyses. *Pharmacoepidemiol Drug Saf* **21**(7): 697–709.

Rubin D. B. 1973. The Use of Matched Sampling and Regression Adjustment to Remove Bias in

Observational Studies. *Biometrics* **29**(1): 185–203.

Rubin D. B. 1979. Using Multivariate Matched Sampling and Regression Adjustment to Control Bias in Observational Studies. *Journal of the American Statistical Association* **74**(366): 318–28.

Rubin D. B., Thomas N. 2000. Combining Propensity Score Matching with Additional Adjustments for Prognostic Covariates. *Journal of the American Statistical Association* **95**(450): 573–85.

Sepehri A. 2014. Does Autonomization of Public Hospitals and Exposure to Market Pressure Complement or Debilitate Social Health Insurance Systems? Evidence from a Low-Income Country. *International Journal of Health Services* **44**(1): 73–92.

Somanathan A., Tandon A., Dao H. L., Hurt K. L., Fuenzalida-Puelma H. L. 2014. *Moving towards Universal Health Coverage of Social Health Insurance in Vietnam: Assessment and Options.Directions in Development.* Washington, D.C.: The World Bank Group.

Southern W. N., Nahvi S., Arnsten J. H. 2012. Increased Risk of Mortality and Readmission among Patients Discharged Against Medical Advice. *American Journal of Medicine* **125**(6): 594–602.

Spooner K. K., Salemi J. L., Salihu H. M., Zoorob R. J. 2017. Discharge Against Medical Advice in the United. *Mayo Clin Proc* **92**(4): 525–35.

Steinglass P., Grantham C. E., Hertzman M. 1980. *Predicting Which Patients Will Be Discharged Against Medical Advice: A Pilot Study*.

Stevenson M. R., Ngoan L. T., Hung D. V., Thi N., Tu H., Mai A. L., Ivers R. Q., Huong H. T. 2012. Evaluation of the Vietnamese A6 Mortality Reporting System : Injury as a Cause of Death. *Injury Prevention* (1): 360–64.

Stuart E. A., Lee B. K., Leacy F. P. 2013. Prognostic Score–Based Balance Measures for Propensity Score

Methods in Comparative Effectiveness Research. *Journal of Clinical Epidemiology* **66**(8 SUPPL): S84–90.

Tawk R., Freels S., Mullner R. 2013. Associations of Mental, and Medical Illnesses with Against Medical Advice Discharges: The National Hospital Discharge Survey, 1988-2006. *Administration and Policy in Mental Health and Mental Health Services Research* **40**(2): 124–32.

Teo H. S., Bales S., Bredenkamp C., Cain J. S. 2019. *The Future of Health Financing in Vietnam: Ensuring Sufficiency, Efficiency, and Sustainability*. New York.

Thanh N. X., Tran B. X., Waye A., Harstall C., Lindholm L. 2014. “Socialization of Health Care” in Vietnam: What Is It and What Are Its Pros and Cons? *Value in Health Regional Issues* **3**(1): 24–26.

Tran Van Tien by, Thi Phuong H., Mathauer I., Thi Kim Phuong N. 2011. *A Health Financing Review of Viet Nam with a Focus on Social Health Insurance: Bottlenecks in Institutional Design and Organizational Practice of Health Financing and Options to Accelerate Progress towards Universal Coverage*.

Vian T., Brinkerhoff D. W., Feeley F. G., Salomon M., Vien N. T. K. 2012. Confronting Corruption in the Health Sector in Vietnam: Patterns and Prospects. *Public Administration and Development* **32**(1): 49–63.

Vietnam Ministry of Health, Institute H. S. and P., Bank W., Organization W. H. 2011. *Lessons for Hospital Autonomy: Implementation in Vietnam from International Experience*. Washington, DC: World Bank, Washington, DC.

Vuong Q. H. 2015. Be Rich or Don’t Be Sick: Estimating Vietnamese Patients’ Risk of Falling into Destitution. *SpringerPlus* **4**(1): 529.

Walton M., Harrison R., Chevalier A., Esguerra E., Van Duong D., Chinh N. D., Giang H. 2016. Improving

Hospital Death Certification in Viet Nam: Results of a Pilot Study Implementing an Adapted WHO Hospital Death Report Form in Two National Hospitals. *BMJ Global Health* **1**(1): e000014.

Wesson H. K. H., Boikhutso N., Bachani A. M., Hofman K. J., Hyder A. A. 2013. The Cost of Injury and Trauma Care in Low-and Middle-Income Countries: A Review of Economic Evidence. *Health Policy and Planning* **29**: 795–808.

World Health Organization. 2020. Global Health Expenditure Database. (http://apps.who.int/nha/database/ViewData/Indicators/en).

Paper 3: Repeated Hardship Financing following Moderate- to Severe Injury: Consequences for Household Living Standards

Introduction

Over the last several decades, health and development economists have changed their view of household experiences of poverty from being a static state commonly shared by all household members to a dynamic state over time and one which may be unequally or inequitably experienced within the household. Households living at, near, and especially below a poverty are now understood to experience high levels of variability in income over time, and that maintaining or smoothing consumption despite this variability becomes a central concern. (Morduch 1995; Morduch and Kamanou 2005) Households have been found to engage in a complex array of financial transactions over time, including borrowing and lending; saving and dissaving; buying, selling, and then repurchasing assets, not only to cope the regular and expected churn of income and consumption needs, but also in response to adverse events which result in sudden reductions in income or increases in expenditure needs. (Collins et al. 2009)

The choice of financial coping mechanisms may depend on household resources, the positionality of the individual affected within the household, the severity of the adverse event, the timescale over which the event was experienced, and whether the shock was experienced by a single individual, termed an idiosyncratic shock, or whether it was a shared experience among members of a community who share a common mutual support network, marketplace, geography, or policy environment. (Azeem, Mugera, and Schilizzi 2016; Berhanu 2011; Nguyen, Nguyen, and Grote 2020; Nguyen, White, and Ma 2008) When faced with covariate shocks such as a macroeconomic downturn, a weather event, conflict or political instability, or a pandemic, which affect an entire community simultaneously, individuals may be forced to allow consumption to vary in the face of an informal insurance network where all individuals are affected, and where a marketplace for assets may be flooded with sellers, causing the price to drop. (Berhanu 2011; Carter and Lybbert 2012; Dercon 2005; Nguyen et al. 2008; Noritomo and Takahashi 2020; Sen 1988) However, in the case of idiosyncratic shocks, such as an individual illness or injury, households may opt to intertemporally smooth consumption by storing value in assets, including productive assets; selling those assets as a risk-coping strategy; and then repurchasing those assets following some level of recovery from the shock. Borrowing money, with or without interest, also serves the same purpose. However, if the household's sale of a productive asset reduces their ability to earn income in the future to the point where it prevents them from repurchasing the productive asset; or, where the need to repay the interest on a loan leads to underinvestment in human or productive capital, this can lower household income and living standards over a long time period, sometimes permanently, a concept known as a poverty trap. (Barrett et al. 2006; Nguyen et al. 2008)

The literature on the impoverishing effects of health shocks, either through direct costs, indirect costs, or both, is extensive as is the literature on the prevalence of or factors associated with the use of various different financial coping mechanisms (discussed in Paper 1). These studies of the effects of direct and indirect medical costs on household living standards and financial coping mechanisms have found that both types of costs can have large impacts and can propel households to use hardship financing. However, few studies of the economic impact of health shocks have examined whether or how long these negative effects extend over time, and whether the particular type of financial coping mechanism used plays a role in lowering household living standards and financing well-being.

Typically, studies have indicated that the use of hardship financing is indicative of the impoverishing effect of a health shock, and that its use will deepen and prolong the effect of that negative health event; they have discussed their findings by highlighting the *potential* of hardship financing to independently contribute to changes in living standards, but without answering that question directly. (Binnendijk, Koren, and Dror 2012; Hasegawa 2017; Kaonga, Banda, and Masiyeid 2019; Khan et al. 2015; Kruk, Goldmann, and Galea 2009; Kwan et al. 2020; Mitra et al. 2016; Mock et al. 2003; Tahsina et al. 2018) However, there is significantly less empirical literature about whether certain financial risk-coping strategies themselves may have an effect on the household’s living standards, beyond the effects of the health shock itself.

A household may take a calculated risk and use hardship financing, either because they have no other options available due to socioeconomic status, incomplete risk protection from health insurance and social protection systems, or the timeliness with which those funds are needed. Given the complexity and ordinariness of financial coping mechanisms used to smooth consumption, a household may take this risk have it pay off, being able to pay off debt and repurchase equivalent productive assets and prove resilient against the health shock. However, this risk may instead backfire, leading the household into greater economic distress, boxing the household into taking on additional hardship financing and further lowering or prolonging a period of lower living standards.

This study attempts to understand whether the use of hardship financing in response to an injury-related health shock itself contributes to reductions in household living standards by attempting to answer two related questions. First, are households which use hardship financing more likely to continue to use hardship financing over time than those which use other methods, and second, does the use of repeated hardship financing lead to changes in household living standards.

Methods

a. Variable definitions

Except as described below, variable definitions are consistent with the definitions in Paper 1.

i. Household Living Standards and Impacts of Injury

As discussed in Paper 1, household living standards were measured using income, rather than expenditure or an asset index, which is a more appropriate choice when living standards are used as an independent variable in an analysis of factors associated with financial coping mechanisms such as borrowing money, selling assets, or using savings. Expenditure may be affected by borrowing, spending savings, or selling assets: if these financial behaviors are used to cope with an increase in needs such as from direct medical and non-medical costs, expenditure may increase by the size of the loan, the amount of savings spent, or the price of the asset sold; or, if financial behaviors are used to cope with a decrease in income, such as from indirect costs of an injury, then expenditure may remain constant. If financial needs from direct and indirect costs of the injury prompted the decision to use financial coping mechanisms, then the use of expenditure as a measure of living standards would conceal this or possibly induce a positive association.

However, income may not an appropriate outcome measure when trying to understand whether there is an association between repeated hardship financing and household living standards. Hardship financing, as discussed in Paper 1, is defined as selling productive assets, borrowing money with interest, or both. While the sale of productive assets may have an impact on the ability to earn income in the next time period, borrowing money with interest may be expected to have an impact on the remaining amount of income available for expenditure net of loan repayments.

In order to avoid these measurement issues related to income and expenditure, tangible impacts of reductions in household living standards were explored in this paper. Households were asked whether, as a result of the injury, they had had difficulties paying for rent or mortgage; utilities; school or childcare; medical care or rehabilitation for the injury; or if they and had to relocate entirely since the last interview. Each of these five questions was asked independently as a binary yes or no question. Descriptive and regression analysis used a binary outcome of any tangible impacts versus no tangible impacts, with households who experienced multiple simultaneous impacts not distinguished from those who experienced only one at a time. Given that the inability to pay for medical care may be endogenously related to the use of hardship financing, two outcomes were explored, including and excluding the inability to pay for the injury. While food consumption is often taken as a measure of household living standards, expenditure on food was measured with too much dependent missingness in this study, as discussed in Paper 1.

b. Data analysis

i. Repeated Hardship Financing: Transition or Lagged-Response Model

In order to understand whether the use of hardship financing in previous time periods increases the odds of use in a subsequent period, the outcome in the current time period was regressed onto the outcome in previous time periods, controlling for the variables found to be associated with current hardship financing in Paper 1. The use of a transition or lagged-response model allows us to evaluate whether previous hardship financing was associated with current hardship financing, controlling for other variables found to be associated current hardship financing. The variables found to be associated with current hardship financing in Paper 1 were rural residence; a child dependency ratio greater than 1:1; continuous WHODAS scores less than 46; whether or not the household had saving; post-injury household per capita daily income; and time. There was only one individual who reported hardship financing – borrowing with interest – at 12 months. Due to the lack of outcomes at this time point, analyses did not include the 12-month time point. Analyses were therefore restricted to outcomes at two and four months following discharge, with lagged outcomes at one and two months included as independent variables.

Transition models use the outcome measured at one or more previous time points as independent variables in a regression of the outcome at the current time point. The transition may be assessed between two time points by conditioning the odds of the outcome at the current time point on the outcome at one previous time point (autoregressive(1)), or across multiple time points by conditioning on outcomes at multiple different time points (autoregressive(k)). (Rabe-Hesketh and Skrondal 2008) A single lag may be the immediately previous time point, the penultimate time point, and so on, and multiple lags may be any combination of the above.

When time periods are not evenly spaced, including a lagged response as an independent variable assumes that the effect of the lagged response does not vary by the time interval between measurement instances. An antedependence model, which includes occasion-specific lagged outcomes by including an interaction between time and the lagged effect, may be more appropriate when measurement instances are irregularly spaced. (Rabe-Hesketh and Skrondal 2008) As measurement instances in this study were not only irregularly spaced, but also were unique in their distance from the injury, an antedependence model was explored through graphical analysis and tested through interacting discrete time with different lags of the outcome. In order to assess which of the preceding time points might be associated with subsequent hardship financing, graphical and tabular analysis was employed to understand patterns of hardship financing over time.

An example of an antedependence model to test whether using hardship financing at the previous time period, dependent on when following the injury that previous time period occurred, influences a household to maintain using hardship financing at the following time period is below. Categories of covariates are represented together in this model only for brevity.

$$log\left(\frac{\Pr(hardship_{ij}=1\mid X_i, X_{ij}, hardship_{ij-1})}{\Pr(hardship_{ij}=0\mid X_i, X_{ij}, hardship_{ij-1})}\right) = \beta_0 + \alpha_1 hardship_{ij-1} + \beta_1 X_i + \beta_2 X_{ij} + \beta_3 time_j + \beta_4 hardship_{ij-1} * time_j$$

Where:

- *i* signifies the individual patients from 1 to a maximum of 872 individuals who remained in the study after discharge
- *j* signifies the measurement instance for a patient, from 2 to 4 months post-discharge
- *j-1* signifies previous measurement instances for a patient, from 1 to 2 months post-discharge
- X_i represents time-invariant covariates
- X_{ij} represents time-varying covariates

There is necessarily a reduction in sample size when including a lagged outcome as an independent variable, as at least the first time the outcome is measured is no longer included in the vector of outcomes and only appears as an independent variable. In the current dataset, hardship financing was measured at the four time points following hospital discharge, which means that the lagged response includes time periods 1 and 2 months, and the outcome is measured at time periods 2 and 4 months, with outcomes at 12 months and lagged outcomes at 4 months excluded due to lack of events at 12 months.

ii. Transition Model Construction and Missing Data Considerations

As discussed in Paper 1, the dataset was unbalanced, as measurement instances were irregularly spaced and respondents were able to return to the study after missing one or more interviews, creating non-monotone missing data patterns. Due to the unbalanced measurement instances and the non-monotonic missing data patterns, a logistic longitudinal mixed model with a random intercept was used in Paper 1 to evaluate factors associated with different types of financial coping mechanisms. However, a lagged outcome measurement cannot be simply added to these models in order to test whether, considering other factors, previous use of financial coping is associated with present use. In a mixed model with a random intercept, the random intercept defines the correlation across the vector of outcomes, obviating the need to model the correlation separately. A key assumption of a mixed model is that the random effect is not associated with any of the independent variables included in the model. However, a transition model uses sequential elements of the vector of outcomes, lagged in time, as an independent variable in the model. This violates a key assumption of a linear mixed model, since by definition the random intercept is associated with independent variables in a transition model, i.e. the vector of outcomes lagged in time. (Rabe-Hesketh and Skrondal 2008)

Instead of a linear mixed model, a generalized linear model with a binomial distribution for the dependent variable, clustered by the study subject and a robust standard error was used to model hardship financing onto lagged hardship financing and the demographic, socioeconomic, and injury-related factors earlier found to be related to this type of financial coping. This modeling approach assumes that the incorporation lagged outcomes as independent variables captures the correlation in outcomes over time. As mentioned above, descriptive and graphic analysis was used to understand the type and timing of correlation in outcomes over time to include appropriate lags in the transition model, to meet this assumption.

However, because such a model may be sensitive to missing data at both the current time period and the time period of the lagged outcome, a lagged-response model requires a complete case analysis. Therefore, multiple imputation by chained equations was used to impute not only covariates missing when a respondent was present for a particular panel, but also to fill in covariates and outcomes for a respondent who was missing for an entire wave. A modified multiple imputation by chained equations procedure was used to complete these imputations, and inverse probability weighted analyses and a complete case analysis were also completed and compared to the results from the MICE datasets as a check, as discussed further below.

1. Multiple Imputation by Chained Equations

As discussed in Paper 1, the MICE procedure involves regressing a variable with missingness at a particular measurement instance onto other variables at the same time point, other variables at other time points, and the variable with missingness itself across time. Random error is incorporated into predictions from this model, and the predicted values are then themselves used in subsequent imputations in an iterative and sequential fashion. However, for respondents with whole wave missingness, it is not possible to develop predictions by regressing a missing variable onto other variables at the same time point, as all of those other variables are themselves also missing.

In order to achieve the first step in this iterative, sequential modeling procedure, three variables were predicted deterministically from data at other time points. First, descriptive analysis of the household size and child dependency ratio was examined for consistency over time, and missing values were imputed under the assumption that missing values would be the same as non-missing values, if non-missing observations were consistent across time. For these two variables, if non-missing values were inconsistent across time, a linear trajectory of change in those values was assumed, and missing values were imputed as existing along that linear trajectory. The majority (70.99%) of respondents did not experience any change in values over time in household size or dependency ratios. Second, descriptive analysis of respondents' WHODAS scores over time was conducted, with missing values extrapolated from a recovery trajectory plotted for each patient. The majority of respondents followed a trajectory of low disability prior to the injury, relatively high disability in the month following hospital discharge, followed by faster recovery earlier on, and increasingly slower health gains over time later on. Of all missing variables relevant for the analysis, these three variables were chosen as they were the most reasonable to infer, as they were either stable over time or had a clear and consistent trajectory across time.

One baseline variable, household per capita income prior to injury, was imputed. Post-injury variables which were imputed at 1, 2, 4, and 12 months post hospital discharge included household per capita income post-injury, whether the patient had visited a doctor, whether the patient had used rehabilitation services, the proportion of post-injury household income spent on direct medical expenditure, and the percent of pre-injury household income lost as indirect costs, whether the household had any savings, whether the household had borrowed money, whether the household had sold assets, and whether the household had engaged in hardship financing. Household per capita income, direct medical costs as a proportion of post-injury income, and indirect costs as a proportion of pre-injury income were imputed using ordinal logistic regression, while the remaining variables were imputed using logistic regression.

There were no respondents who reported selling assets and only one individual who reported using hardship financing at 12 months following hospital discharge; it was therefore not possible to construct a regression for asset sale or hardship financing at this time point. Asset sale at this time point was imputed as having not happened for all respondents missing at 12 months; as this variable was used as an auxiliary variable in the MICE procedure and served as neither an outcome variable nor a covariate in regression of hardship financing, this was judged to be an acceptable limitation. Hardship financing at 12 months was not used as an outcome in a chained equation for the MICE procedure.

2. *Comparative Analyses: Complete Case Analysis and Inverse Probability Weights*

As the MICE procedure had to be modified in order to be completed, the results of regression analysis using the multiply imputed datasets was compared to two other analyses: a complete case analysis and an analysis using inverse probability weights. A complete case analysis makes the assumption that variables are missing completely at random (MCAR), meaning not dependent on the history or present value of outcomes, but may be dependent on the history or present values of covariates. The complete case analysis used only the 720 individuals who were present for all four of the post-hospital discharge follow-ups. As an aside, as there was no entry into the study except during hospitalization through completing the baseline survey, these 720 individuals were present for all four follow-ups.

Inverse probability weights, by contrast, can be used under the weaker assumption of data being missing at random (MAR), allowing for missingness to depend on both the history of outcomes and the history and present values of covariates. The missing data mechanism is modeled on observables for each time point at which there missingness, with weights calculated from the inverse of the probability of remaining in the study up to each time point. Inverse probability weights are used to upweight individuals with similar outcome and covariate patterns who remain in the study after each time point such that their outcome vectors can represent those who have dropped out. The missing data mechanism under the assumption of data missing at random cannot depend on the values of missing variables; when data is non-monotone, the history of covariates and outcomes will include missing variables, violating this assumption.

In order to avoid violating this assumption, two sets of inverse probability weights were constructed at time points of 2 and 4 months following discharge, giving the inverse probability of remaining in the study if present only at study visit immediately prior. Exploratory data analysis and regression building were used to construct the models for inverse probability weights. Histograms were constructed to assess the dispersion of the weights.

Separate transition models using inverse probability weights were constructed for each time point and compared to the antedependence model tested using the MICE data sets and the complete case analysis.

3. *Missing Measurement: Use of Financial Coping during Hospitalization versus in the Year after Discharge*

Hardship financing was only measured during post-discharge time points, while other forms of financial coping were measured both during hospitalization and after discharge. Omitting hardship financing at baseline as an independent variable (a lagged outcome) also means omitting hardship financing at one month post-discharge as part of the vector of outcomes. To gain some indication of whether these omissions could influence a transition model of the use of hardship financing, graphical, tabular, and simple regression analysis were used to explore the influence of baseline financial coping on financial coping post-discharge. Transition probabilities between using any form of financial coping during hospitalization and ever using following discharge were calculated. Simple linear logistic mixed models using the MICE dataset were conducted associating any type of financial coping post-discharge with use while in-hospital, considering in-hospital use as a time-invariant covariate.

iii. Impacts of Injury and Hardship Financing

A logistic linear mixed model was constructed associating the impact of hardship financing and repeated hardship financing on one or more of: inability to pay for rent or mortgage; utilities; school or childcare; medical care or rehabilitation for the injury; or if they and had to relocate entirely since the last interview due to financing need.

A second logistic mixed model was constructed excluding the ability to pay for medical or rehabilitative care in the outcome definition. This was done for two reasons: first, in a binary response asking if patients were unable to afford injury treatment or rehabilitation, patients who were able to afford treatment would be classified together with those who did not need treatment. Second, given the results from Paper 2 indicating that at least some prescribed health care was not necessary, patients' inability to afford prescribed health care may not reflect inaccessibility of needed care but an inability to afford potentially inflated levels of prescribed care.

For both of these models, while hardship financing and lagged hardship financing were used as predictors, since they were not part of the outcome vector, the use of the random intercept was the method used to cope with the unbalanced nature of the dataset. Multiple imputation by chained equations was used to cope with missing covariate values. Adjusted odds ratios were marginalized, as discussed in Paper 1.

Results

a. Multiple Imputation by Chained Equations for Transition Model

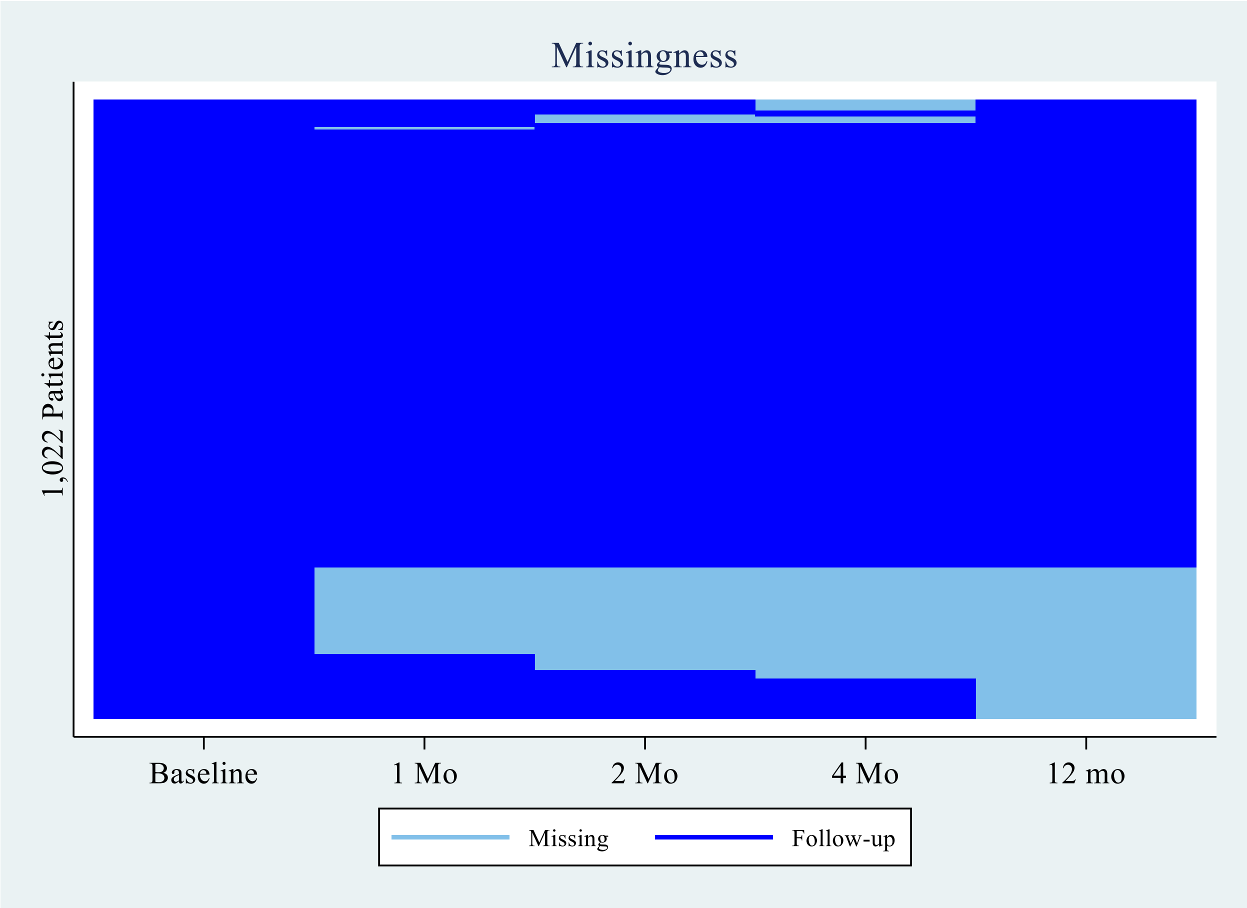
Out of the 1,022 individuals in the HEALS cohort, 150 dropped out of the study following the baseline survey. As information on hardship financing, asset sale, and all post injury disability and health care utilization measures were only asked following discharge, these 150 individuals were not going to be included in analyses and their information was not used to predict missing values using MICE. Of the 872 individuals who had at least one follow-up after hospital discharge, 720 were complete cases and 152 missed at least one wave following hospital discharge. (Table 28 and Figure 45**Error! Reference source not found.**) There were 242 missing data measurement instances across these 152 respondents.

Table 28: Missing data patterns

Missing Data Pattern*		Count	Percent
Complete Cases	11111	720	70.45
Baseline only	10000	150	14.68
Other missing data patterns	11110	61	5.97
	11000	27	2.64
	11101	18	1.76
	11001	17	1.66
	11100	14	1.37
	10111	8	0.78
	11011	4	0.39
	10001	2	0.20
	10110	1	0.10
Total		1022	100.00

* 1 = present and 0 = absent for that wave

Figure 45: Missing data patterns



50 datasets were imputed, with 20 'burn-in' imputations developed prior to storing the actual imputation. Trace plots of these burn-in imputations for each variable at each time point did not show any trend, indicating stability and convergence around the imputations. (Figure 46, Figure 47, and Figure 48)

Figure 46: Trace Graphs from MICE procedure: Borrowed money, Sold Assets, and Hardship Financing Following Hospital Discharge

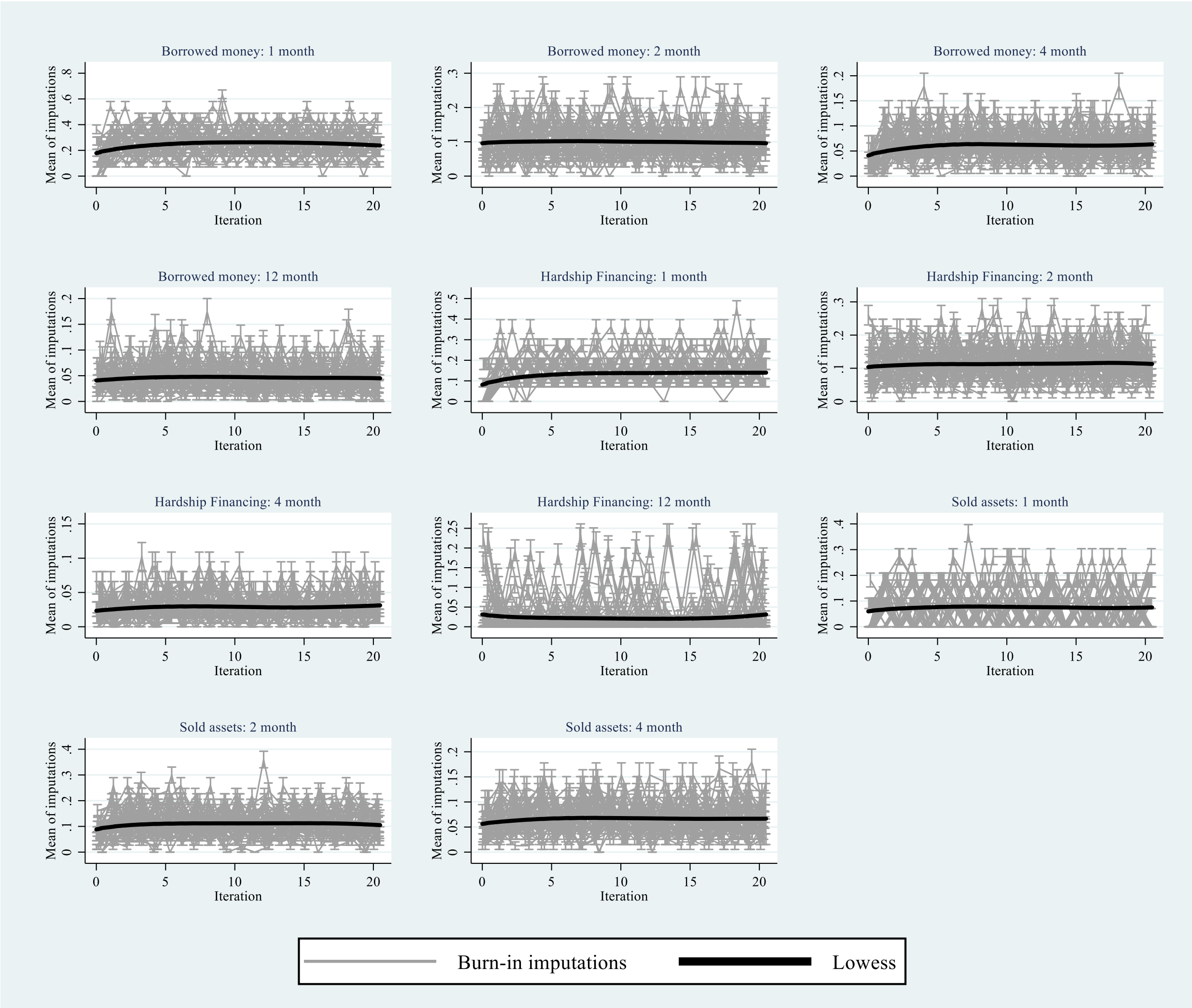


Figure 47: Trace Graphs from MICE procedure: Have any Savings Following Hospital Discharge and Household Per-Capita Income Category Pre- and Post-Injury

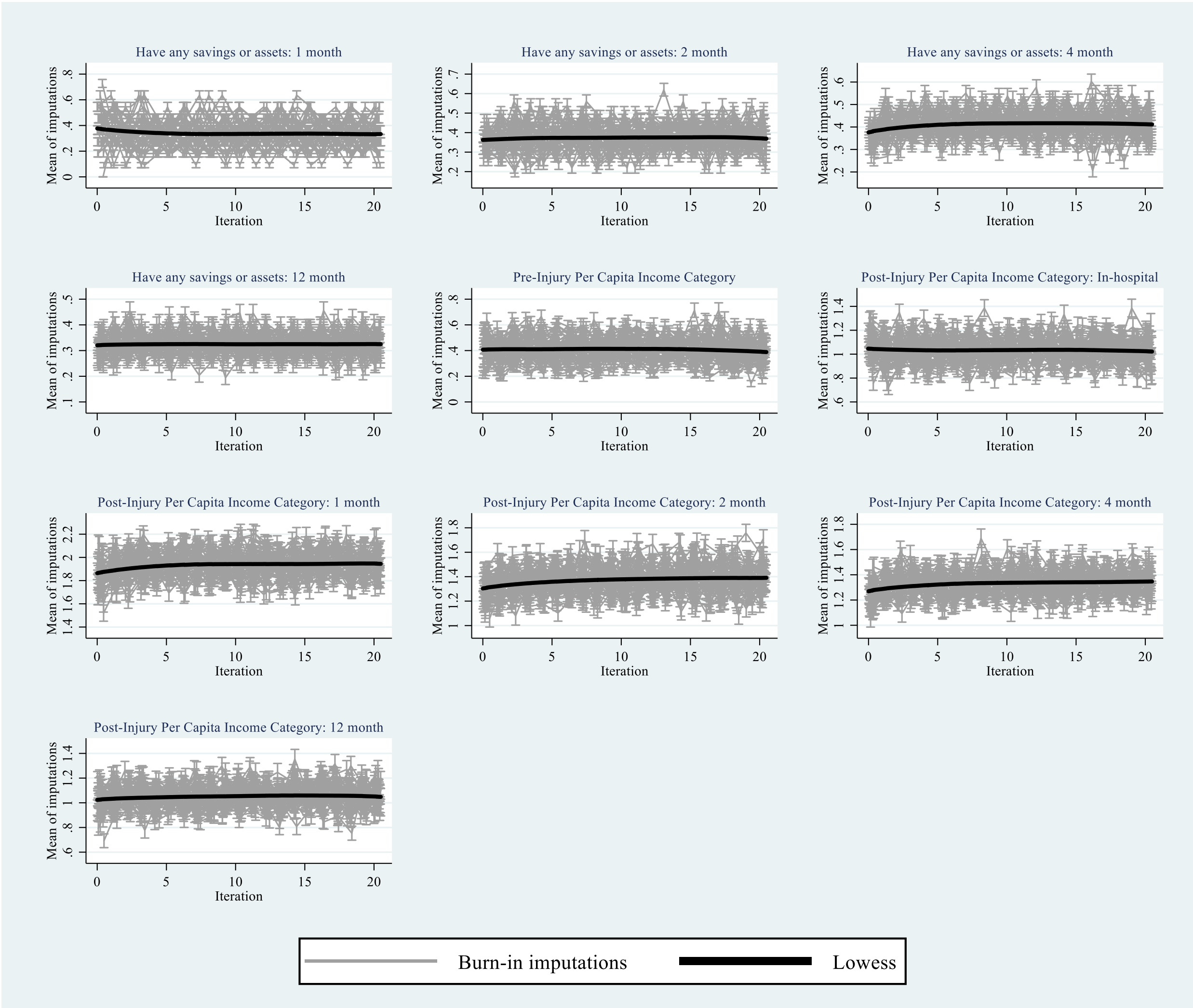
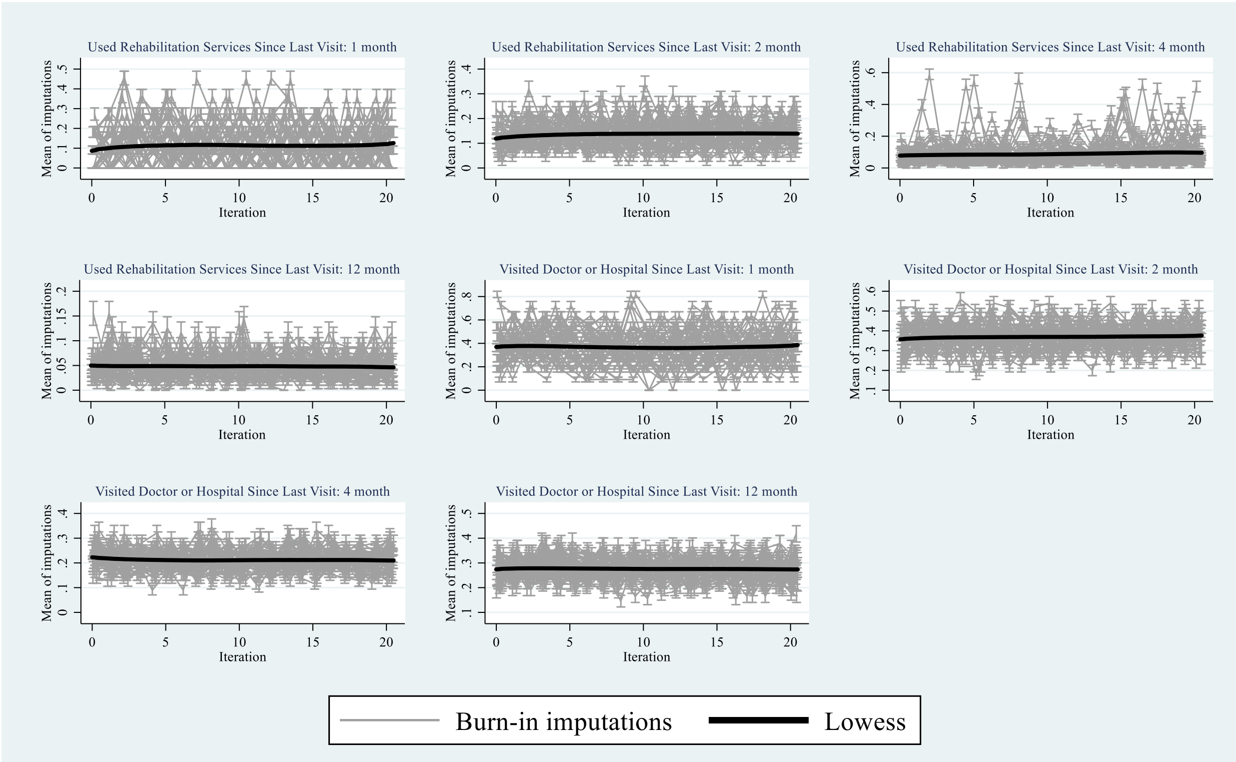


Figure 48: Trace plot from MICE procedure: Visited a Doctor or Hospital, Used Rehabilitation Services Following Hospital Discharge



b. Patterns of Financial Coping Mechanism Use Over Time: Use and Repeated Use

i. Use of Financial Coping during Hospitalization versus in the Year after Discharge

Use of financial coping mechanisms (FCM) during hospitalization did not appear to be related to whether households ever used them over the course of the year following discharge. Households which did and did not borrow money, sell assets or spend savings prior to hospital discharge had similar probabilities of using any of the financial coping strategies once or more over the year of follow up (20.12% versus 17.09%). (Table 29 and Figure 49) However, considering only the period following hospital discharge, 36.54% of households which used financial coping mechanism were likely to use them in the next time period, while only 0.69% of households which had not used FCM in the previous time period were likely to start. (Table 30) Looking at borrowing alone, similar results are observed, with similar percentages of households borrowing money after discharge among those who did and did not borrow during hospitalization, but borrowing in one time period highly related to use in the next time period when considering only post-discharge time points. (Table 31 and Table 32)

Table 29: Transition probabilities for use of any financial coping mechanism: in-hospital versus ever post-discharge

	At least once after discharge		
In-hospital	Yes	No	Total
Yes	33 (20.12%)	131 (79.88%)	164 (100%)
No	121 (17.09%)	587 (82.91%)	708 (100%)
Total	154 (17.66%)	718 (82.34%)	872 (100%)

Table 30: Transition probabilities for use of any financial coping mechanism: post-hospital discharge time points

	Current time period		
Previous time period	Yes	No	Total
Yes	36.54%	63.46%	100%
No	0.69%	99.31%	100%
Total	3.83%	96.17%	100%

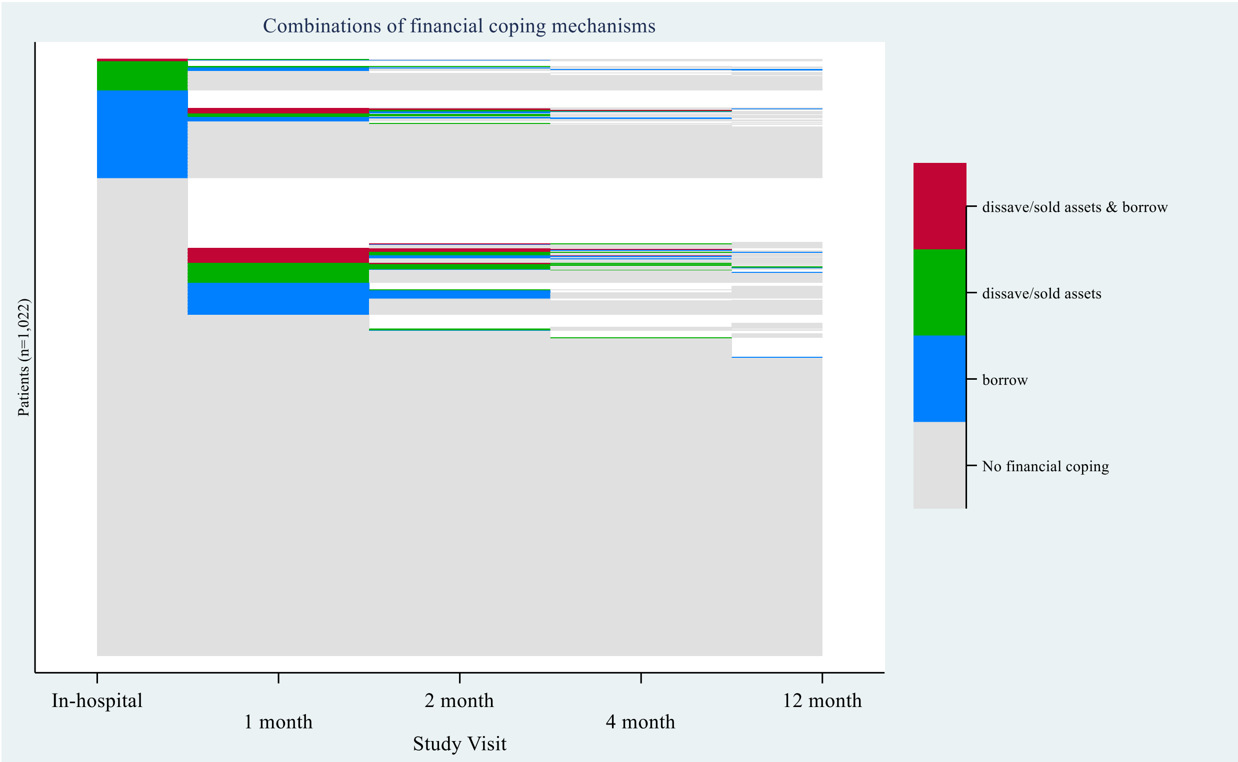
Table 31: Transition probabilities for borrowing: in-hospital versus ever post-discharge

	At least once after discharge		
In-hospital	Yes	No	Total
Yes	17 (13.82%)	106 (86.18%)	123 (100%)
No	94 (12.55%)	655 (87.45%)	749 (100%)
Total	111 (12.73%)	761 (87.27%)	872 (100%)

Table 32: Transition probabilities for borrowing: post-hospital discharge time points

	Current time period		
Previous time period	Yes	No	Total
Yes	29.93%	70.07%	100%
No	0.63%	99.37%	100%
Total	2.32%	97.68%	100%

Figure 49: Patterns of financial coping mechanisms over time



ii. Household Choice of Financial Coping

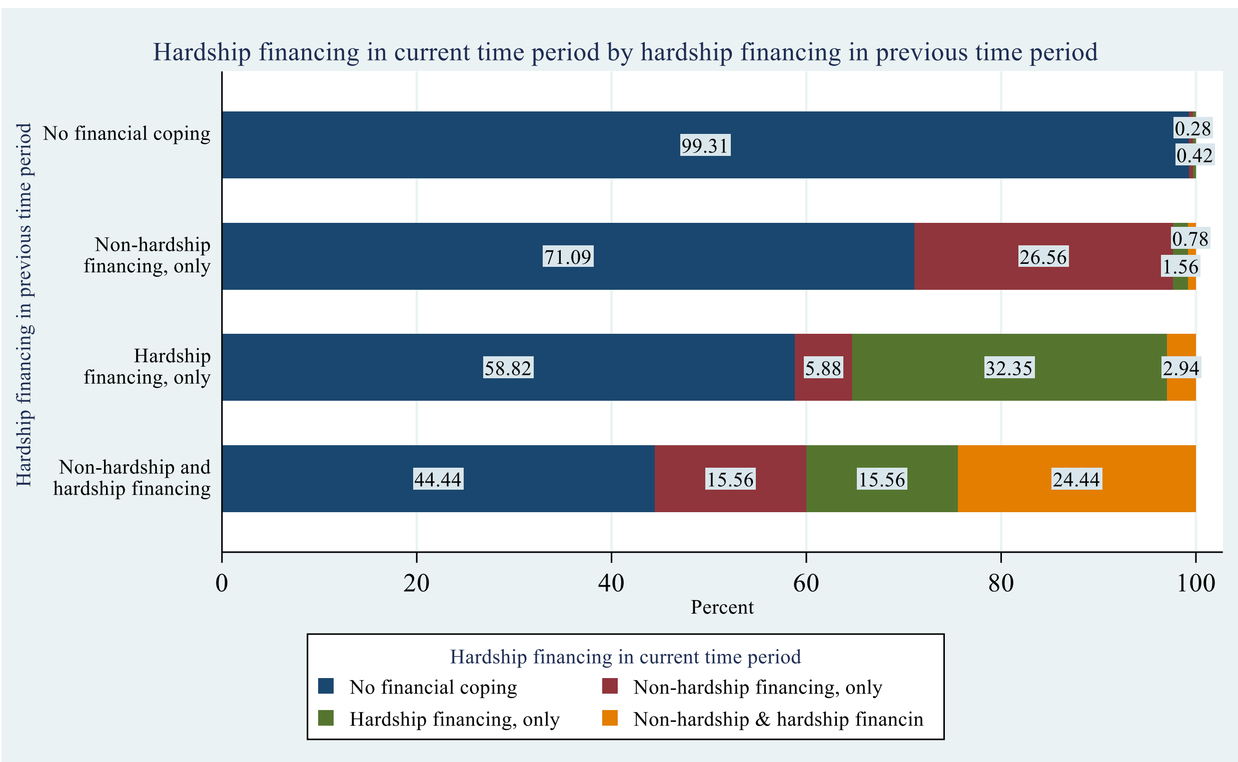
Households choice of type of financial coping over time was related to whether the household had savings or not. Among those households which had savings to spend, there were no households which did not spend their savings and instead used hardship financing. (Table 33) If households had savings, they spent those savings, sometimes along with using hardship financing. Hardship financing was most common among households which did not have any savings to spend.

Table 33: Proportion of households which used hardship financing by whether they had and spent savings and time

	Did not have savings	Have but did not spend savings	Have and spent savings
1 month	42 (9.23%)	0 (0%)	8 (20.51%)
2 month	20 (4.59%)	0 (0%)	7 (41.18%)
4 month	12 (2.86%)	0 (0%)	0 (0%)
12 month	1 (0.29%)	0 (0%)	0 (0%)

Households also showed distinct patterns of using hardship and non-hardship financing over time. Among households who had not used hardship financing in the previous time period, either because they used only non-hardship financing or no financial coping, 2.34% and 0.70% started using hardship financing in the next time period. (Figure 50) Among households which had used hardship financing in the previous time period, either alone or alongside non-hardship financing, 35.29% and 40.00% used hardship financing again in the next time period. Most commonly, households discontinued use of any forms of borrowing, asset sale, or dissaving to cope with direct and indirect costs of the injury, with the second most common choice being to maintain the mixture of hardship and non-hardship financing used in the previous time period.

Figure 50: Transition probabilities for hardship financing: Probability of use in current time period by use in previous time period



iii. Choice of lagged outcome as independent variable

The timing and choice of lag for hardship financing was explored through tabular and graphical analysis as well as simple regressions. Transition probabilities discussed in the last section indicate that households rarely initiate using hardship financing if it had not been used in the previous time period. Graphical analysis reflects this, indicating that households which used hardship financing seemed to do so continuously, from one time period to the next, rather than intermittently across time periods. (Figure 51) The probability of initiating use of hardship financing if it had not been used in the previous time period or the penultimate time period was less than 1% over follow up. (Figure 52 and Figure 53) While having used hardship financing in the penultimate (lag 2) time period was associated with use in the current time period, a lag 2 effect is the effect of using hardship financing in the penultimate time period on use in the last time period. In other words, a lag 2 effect reflect the results of the graphical and tabular analysis which show that households rarely initiate use of hardship financing at any time period after the first follow-up. Given this, and the fact that using a lag 2 effect necessitates a further reduction in sample size, a lag 1 effect was chosen for further regression analysis.

Figure 51: Patterns of hardship and non-hardship financing over time, by time post-discharge

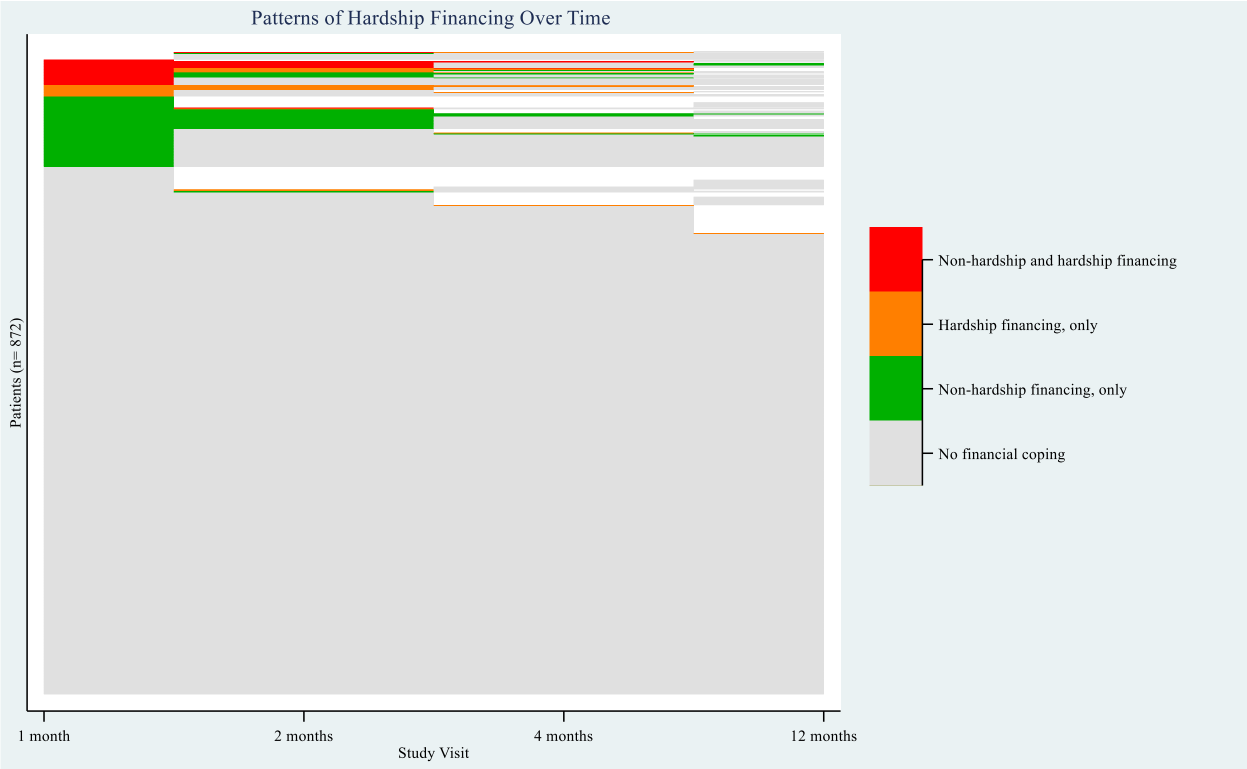


Figure 52: Proportion of households using hardship financing by lag 1 hardship financing

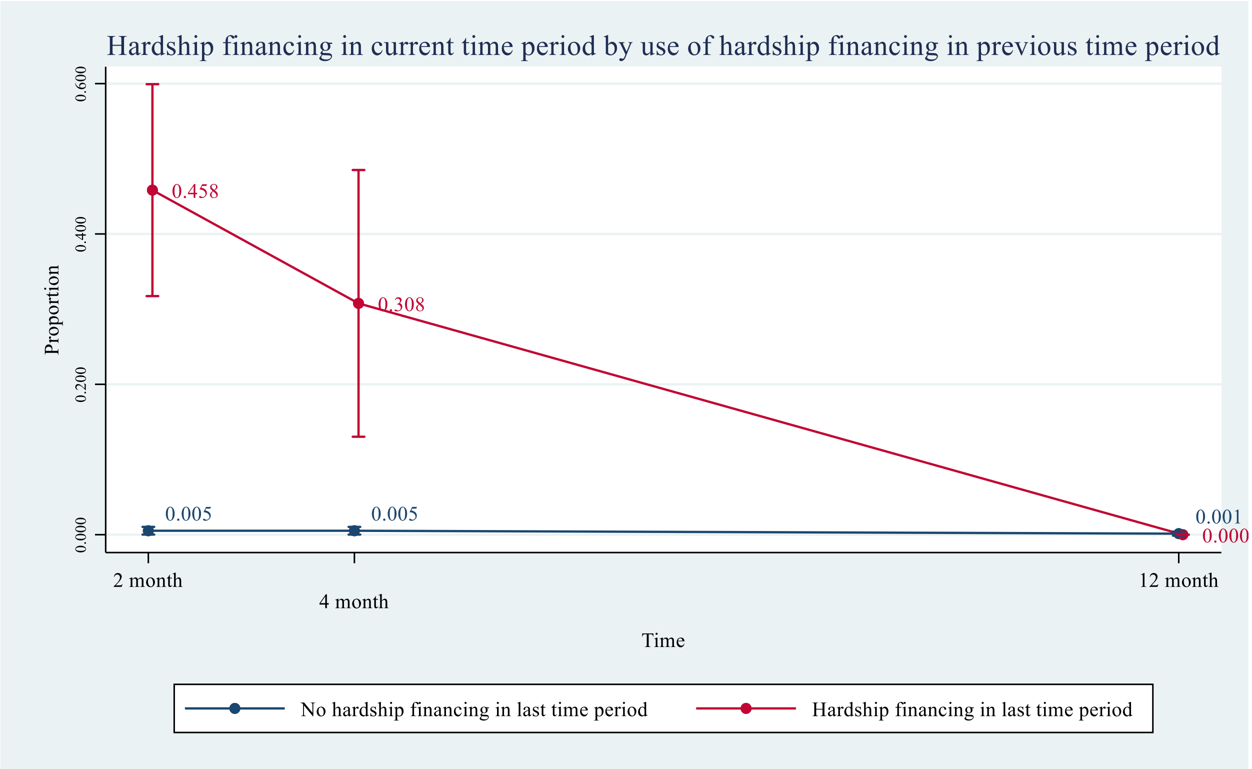
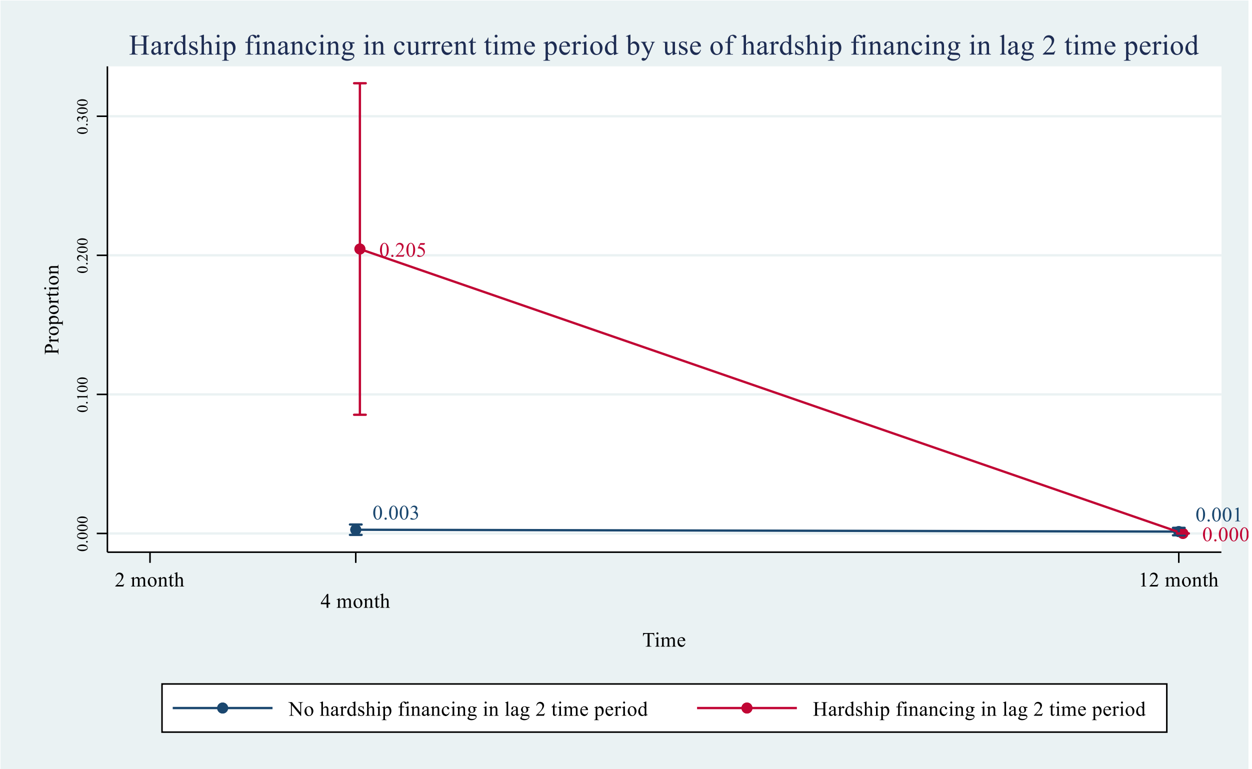


Figure 53: Proportion of households using hardship financing by lag 2 hardship financing



c. Hardship Financing Across Time: Comparison of Transition Models using Complete Cases, MICE, and IPWs

Hardship financing in the previous time period was strongly associated with hardship financing in the current time period, after accounting for all factors found to be independently associated with the outcome in Paper 1, including per capita household income, patient level of disability measured using WHODAS, child dependency ratio, rural residence, and whether the household had any savings. (Table 34) However, depending on the method used to cope with intermittent missingness in the dataset, the effect size was quite different across the three datasets. Use the MICE dataset, the odds of using hardship financing 2 months was 33 times higher if hardship financing had been used at 1 month, compared to those who had not used hardship financing at 1 month post-discharge. This estimate was quite different in the other two datasets – 56 and 100 times the odds for the complete case dataset and the dataset that used inverse probability respectively. Differences across the datasets were not as stark at four months post-discharge. Using the MICE, complete case, and IPW datasets, the odds of using hardship financing between 2 and 4 months post-discharge was 22, 22, and 27 times higher among those who had used it in the previous time period compared to those who had not.

The interaction term between the lagged outcome and time was not significant in the MICE dataset (p=0.562) and only marginally significant in the complete case analysis (p=0.074). However, given the need for comparison with the time-specific estimates in the IPW datasets, and the large differences in the magnitude of the estimates at 2 and 4 months following discharge, an antedependence model was retained.

Hardship financing was an almost exclusively rural phenomenon, and after the second month following hospital discharge, only rural households who did not have any savings used hardship financing; estimates in the inverse probability weight dataset at four months include only rural households without savings.

Table 34: Multiple logistic regression of hardship financing on lagged hardship financing: A comparison of methods

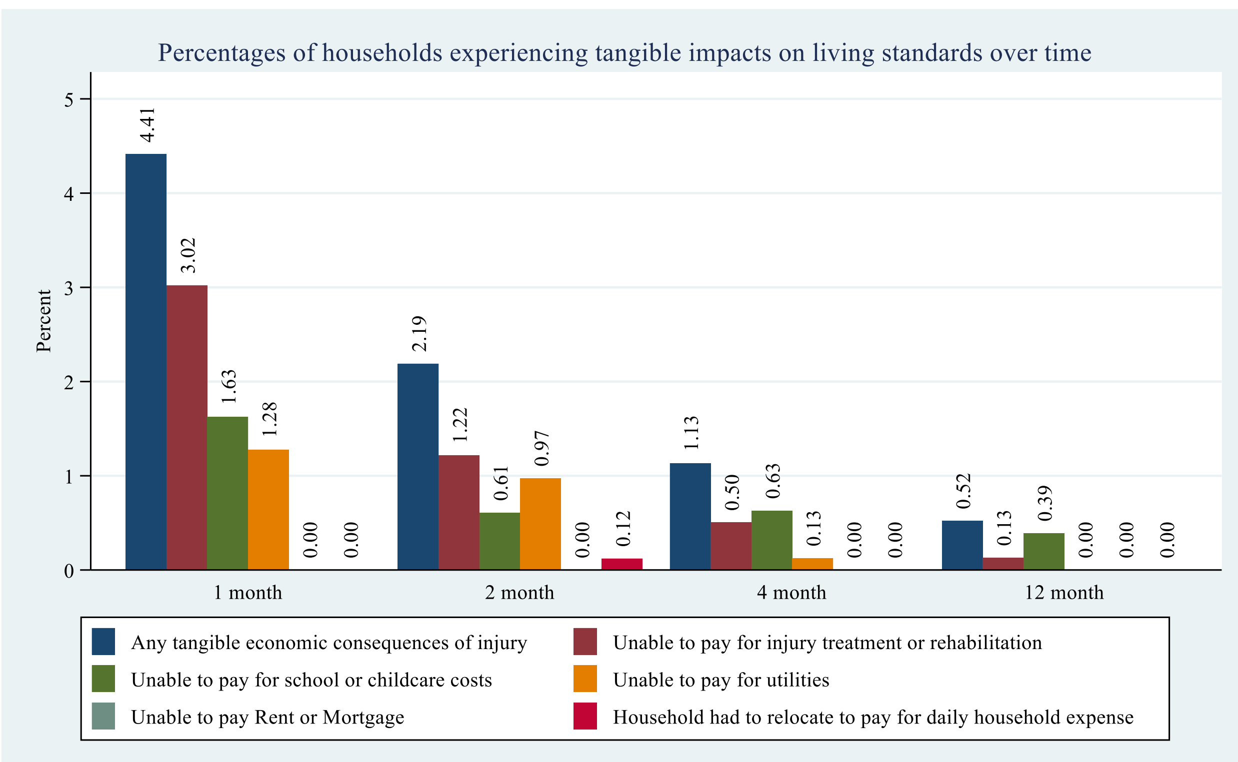
	MICE		Complete Case		IPW, 2 months		IPW, 4 months	
Variables	aOR	p-value	aOR	p-value	aOR	p-value	aOR	p-value
Time and lagged hardship financing								
2 months post-discharge								
Did not use hardship financing at 1 month post-discharge	ref		ref		ref		-	
Used hardship financing at 1 month post-discharge	33.667	<0.001	56.015	<0.001	99.559	<0.001	-	
4 months post-discharge								
Did not use hardship financing at 2 months post-discharge	ref		ref		-		ref	
Used hardship financing at 2 months post-discharge	22.015	<0.001	22.495	0.008	-		27.413	<0.001
Post-injury daily per capita income								
More than I$5.50	ref		ref		ref		ref	
I$3.21 to 5.50	1.390	0.599	1.725	0.450	1.958	0.466	0.832	0.849
I$1.91 to 3.20	1.321	0.695	1.759	0.477	2.699	0.355	0.653	0.686
I$1.90 or less	1.789	0.347	2.070	0.307	1.583	0.614	2.890	0.286
WHODAS								
0-45	1.079	<0.001	1.090	<0.001	1.072	0.003	1.096	0.001
46-100	0.991	0.655	0.979	0.454	1.006	0.807	0.959	0.176
Residence								
Urban	ref		ref		ref		-	
Rural	3.731	0.112	4.141	0.021	2.734	0.179	-	
Child dependency ratio								
≤1	ref		ref		ref		ref	
>1	2.009	0.113	2.508	0.131	2.952	0.142	1.533	0.619
Household has savings								
No	ref		ref		ref		-	
Yes	1.625	0.330	1.745	0.235	3.959	0.040	-	
Constant	0.0003	<0.001	.00003	<0.001	.00006	<0.001	0.0005	<0.001

Number of time periods where outcomes measured	2	2	1	1
Observations	1,744	1484	774	359
Patients	872	756	774	359

d. Association between Hardship Financing and Impacts of Injury

Tangible impacts of reductions in household living standards were relatively rare. Over the course of follow-up, a maximum of 4.4% of households experienced the need to relocate, or the inability to pay for school or childcare costs, rent or mortgage, injury treatment or rehabilitation, utilities, or more than one of the above at the same time. (Figure 54) No household experienced the inability to pay for rent or mortgage over the course of follow-up and only one household was required to relocate, between the first and second months following hospital discharge. Most commonly, households experienced an inability to pay for injury treatment or rehabilitation. This 4.4% of households represents 202 individuals including both patients and their household members, considering all tangible impacts, and 123 individuals including only impacts other than the inability to pay for treatment.

Figure 54: Proportions of households experiencing tangible impacts of change in living standards since last survey over time

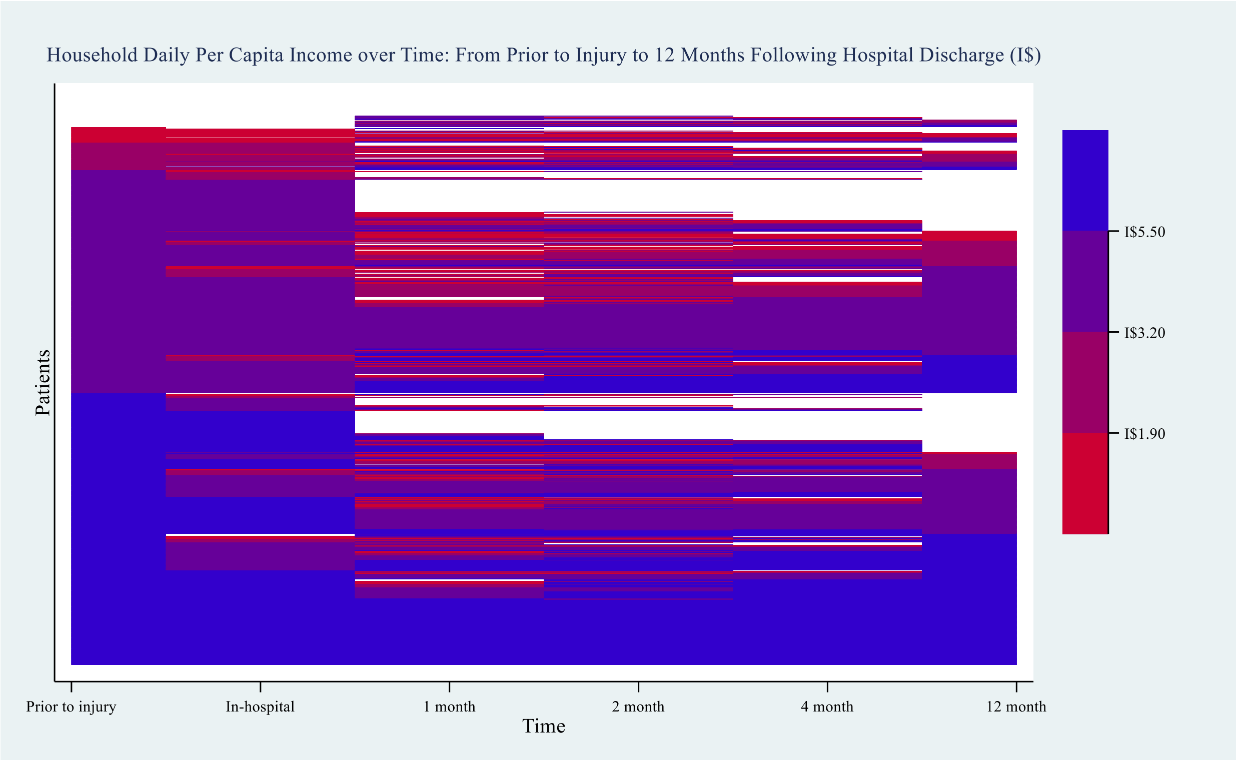


A logistic longitudinal mixed model examining associations with any tangible impact of reductions in living standards reflected the results of the descriptive analysis, finding that the odds of experiencing these negative outcomes steadily decreased over time, with households at two, four and twelve months post-discharge having 0.78 ($p = 0.19$), 0.64 ($p=0.059$), and 0.54 ($p=0.043$) times the odds as compared to one month post-discharge. (Further, neither insurance status, nor non-hardship forms of borrowing or asset sale were associated with tangible impacts of changes in living standards.

Table 35) Current hardship financing increased the odds of experiencing tangible impacts of a reduction in living standards by 2.6 times compared to those who did not use hardship financing, after controlling for time, continuing disability, current daily per capita income, and whether the household had any savings. Tested independently, current hardship financing and previous hardship financing were associated with changes in living standards; however, an interaction term between current and previous hardship financing was non-significant, and so was not included in the final model. Continued disability was also associated with experiencing tangible impacts, with every point increase in WHODAS scores above WHODAS scores prior to injury associated with a two percent increase in odds. Not having any savings was associated with almost four times the odds of using hardship financing ($p<0.001$).

While the household's daily per capita income was independently associated with tangible impacts of changes in living standards, showing a gradient of increasing odds with decreasing income, this association became nonsignificant after the inclusion of the use of hardship financing and whether the household had any savings. Household per capita income prior to the injury was not associated with tangible impacts of reduced living standards. Changes in household per capita income in the year following the injury were common, with 52.84% (n=512) of households experiencing at least one reduction in daily per capita income category, and 44.73% (n=229) of those who ever experienced such a significant drop in income recovering to pre-injury income levels by the end of their follow-up. (Figure 55) Since household size was relatively stable over time, as discussed above, changes in per capita income reflect changes in total household income rather than changes in household size.

Figure 55: Household daily per capita income over time, from prior to injury to the year following hospital discharge (I$)



As mentioned, hardship financing was a choice primarily made by rural households without savings, and so residence was non-significant after including hardship financing and whether the household had any savings in associations with consequences for living standards The households level of dependence on the patient prior to the injury – either child dependency ratio, child and elderly dependency ratio, or the proportion of the household's income earned by the patient prior to the injury – were not associated with having any tangible consequences for changes in living standards. Further, neither insurance status, nor non-hardship forms of borrowing or asset sale were associated with tangible impacts of changes in living standards.

Table 35: Adjusted and marginalized odds ratios for at least one tangible impact of injury on living standards (unable to pay rent/mortgage, utilities, health care, school/childcare, and/or forced to relocate)

Variables	Any tangible impact	p-value	Excepting health care	p-value
Hardship financing				
Did not use hardship financing	ref		ref	
Used hardship financing	2.591	0.007	2.595	0.023
Time since hospital discharge				
1 month	ref		ref	
2 months	0.780	0.187	0.951	0.832
4 months	0.641	0.059	0.727	0.275
12 months	0.536	0.043	0.609	0.170
Increase in WHODAS score from pre-injury	1.016	0.002	1.004	0.517
Post-injury daily per capita income				
More than I$5.50	ref		ref	
I$3.21 to 5.50	0.946	0.820	0.952	0.870
I$1.91 to 3.20	1.054	0.870	1.054	0.892
I$1.90 or less	1.124	0.704	1.054	0.893
Household has savings				
Yes	ref		ref	
No	3.704	<0.001	3.663	0.002
Constant	0.039	<0.001	0.030	<0.001
Number of observations	3,218		3,218	
Number of individuals	865		865	
SD of random intercept (sigma)	3.937		3.885	
Intra-cluster Correlation Coefficient (rho)	0.825		0.821	
Quadrature points	90		90	

Results were mostly similar for both in magnitude and statistical significance whether or not the ability to pay for health care was included in the outcome definition. The effects of time and of continued disability were more pronounced when including the inability to pay for health care in the outcome definition.

Discussion

a. Financial Coping During Hospitalization and After Discharge

Patient use of financial coping during hospitalization did not show a relationship to ever using financial coping in the year following hospital discharge in the descriptive analysis, while the use of financial coping during time periods following discharge were related to subsequent financial coping. As discussed in Paper 1, there were both common and different factors which were associated with financial coping during hospitalization as compared to its use after discharge. This, and the lack of relationship between the use of financial coping during hospitalization and use following discharge, suggests that the motivation for or consequences of use in-hospital were distinct from those following discharge. This suggests that modeling financial coping separately between pre- and post-discharge time points is a correct choice, reflecting different decision-making processes, rather than a loss of information, as was found for borrowing in Paper 1. Other literature has reflected the fact that inpatient care versus outpatient care drives different rates and types of financial coping. (Sangar, Dutt, and Thakur 2019a, 2019c) If the same is true for hardship financing, this suggests that omitting hardship financing during hospitalization from transition models may be a good choice, not only one borne of measurement challenges, and future work should separately model financial coping in-hospital from that which takes place after discharge.

b. Preferences for Different Financial Coping Mechanisms

The descriptive analysis shows distinctive patterns between hardship and non-hardship financing over time. Among households which used hardship financing, the majority chose in the next time period to use less potentially harmful forms of financing or discontinue use of any financial coping mechanisms. Hardship financing was very rarely initiated if it had not been used in the previous time period, with hardship financing used consistently rather than intermittently across time periods, and households most often “stepping down” from more potentially harmful forms to less potentially harmful or no forms of financial coping. This suggests that households have a preference to use non-hardship forms of financial coping when any financial coping is required, and that a lack of savings is a constraint to fully expressing a preference for non-hardship financial coping.

Multiple studies have examined the prevalence of use of different coping mechanisms in cross-sectional surveys, finding alternatively that dissaving, asset sale, borrowing, consumption reduction, or labor substitution were the most prevalent coping strategies in responding to health shocks, depending on different factors such as country or health financing context, household socioeconomic status, rurality, definition of a health shock, and need for inpatient versus outpatient care. (Bonfrer and Gustafsson-Wright 2017; Genoni 2012; Heltberg and Lund 2009; Islam and Maitra 2012; Kanchanachitra et al. 2011; Khan, Bedi, and Sparrow 2015; Lawson and Kasirye 2013; Mitra et al. 2016; Morudu and Kollamparambil 2020; Nguyen et al. 2012, 2020; Sparrow et al. 2014) Other work as found that savings is used primarily for outpatient care, likely due to it involving smaller repeated expenses, with borrowing and asset sale reserved for inpatient care, which involves larger, single outlays of money. (Sangar, Dutt, and Thakur 2019b) However, due to the cross-sectional nature of the data and the measurements of coping strategies used in these studies, these studies were not able to examine choice of coping strategy over time or provide indications about whether the use of these different coping strategies was the result of preference or constraint.

One qualitative study was able to track the use of coping mechanisms over time by households, in a study spanning multiple years and countries. (Krishna 2010) This study, examining the role of health shocks in how and why individuals experience descents and escapes into poverty, found that households experiencing health shocks by and large began coping strategies by using non-hardship forms of financing, only resorting to hardship financing after other options had been exhausted. This study examined not only single, sudden, large shocks, such as an injury or death, but also gradual, chronic, and intermittent smaller shocks over a period of multiple years, finding that sudden, large health shocks were a relatively rare experience relative to other events that may propel a household to employ financial coping strategies. This study reflects other work on the sequencing of coping strategies used by households to respond to shocks, in which less risky forms of coping were used prior to hardship financing. (Corbett 1988; Lawson and Kasirye 2013) Other studies of the effect of multiple shocks, including not only health-related shocks, but economic or environmental as well, have found that the experience of multiple, smaller shocks is common, particularly in low- and middle-income countries. (Bonfrer and Gustafsson-Wright 2017; Capuno et al. 2019; Khan et al. 2015; Nguyen et al. 2020; Quintussi et al. 2015; Wagstaff and Lindelow 2014) Notably, for each of these studies, health shocks have stood out as the most frequent or consequential type of shock, particularly for the poor. This suggests that households affected by an injury, requiring a large outlay to fund inpatient care, may need to resort to hardship financing immediately, but may be able to recover and discontinue its use, particularly over a moderate time frame such as a single year.

c. Association of Hardship Financing with Future Hardship Financing

i. Consistency in Use of Hardship Financing

The longitudinal design of this study allowed us to evaluate whether past hardship financing was associated with current use of hardship financing, conditional on all other variables found to be independently associated in Paper 1. We were not able to find other longitudinal studies that examined this particular question; other studies in the field of health financing which examined hardship financing have been restricted to evaluating its prevalence and the factors associated with its use (discussed in Paper 1), and in some cases, whether its use is associated with negative impacts on living standards and quality of life (discussed further below).

The descriptive and graphical analysis found that households in general do not initiate hardship financing if it had not previously been used, following the first month post-release. Past hardship financing, after controlling for demographics and household structure, recovery from injury, current household socioeconomic status, and time, had the greatest association with current hardship financing, with very large but variable effects observed at two and four months post-discharge. This consistency in use, rather than intermittent or initiated use, is reflected in the magnitude of effect of lagged hardship financing on further hardship financing use over time in regression analysis. Regardless of method used to cope with missing data, previous hardship financing was associated with further hardship financing, after controlling for all factors independently associated with current hardship financing.

Our tested antedependence model involved interaction terms among time, current, and lagged hardship financing. Although the interaction terms were not significant, the magnitude of differences in the estimate reflects the descriptive analysis, which showed that diminishing numbers of households used hardship financing over time. However, it is not clear if this reduction in use over time is the result of the waning influence of the injury over time as patients may recover and households adapt financially, or the fact that patients were followed up at increasing intervals over time, potentially affecting recall.

We also saw large and meaningful differences in the estimated magnitude of effect of lagged hardship financing when comparing across datasets that used different methods for coping with missing data. There are several possible reasons for these differences. First, the use of hardship financing was a relatively rare event, making estimating the effect across time challenging. Further research with larger sample sizes are needed in this context to understand the true magnitude of effect. However, while the magnitude of effect is in question, the direction and significance is not: after controlling for all other factors which are independently associated with the use of hardship financing in the current time period, previous use of hardship financing increases the odds of future use. The second potential reason is due to the lack of individuals who used hardship financing who had not used it in the previous time period. The descriptive analysis showed that it was rare for households to initiate using hardship financing after the first month post-discharge; rather, individuals tended to continue to use hardship financing across time periods, with or without also using less potentially maladaptive forms of financial coping. This led to an "empty cell" problem in the comparison group when trying to estimate the odds of use in one time period, given use or non-use in the previous time period. The relatively lower estimates in the MICE dataset are likely due to the error introduced - into the coefficients, the error distributions, and the value of the error term itself – which produced greater variability than appeared in the complete case dataset or those which used inverse probability weights.

ii. Potential Explanations for Consistency in Use

There may be several reasons for this consistency in use. One option may be that households choose to return to the same source or the same method of financial coping when need arises multiple times. However, the consistency in use of hardship financing does not appear to be a choice made for the sake of consistency or for a preference for familiarity in choice of financial coping mechanisms. The variability over time observed in the choice for combinations of borrowing, asset sale, and dissaving, and for hardship versus non-hardship forms of financing, indicate against a preference for consistency. Additionally, as mentioned, the common choice of households which used hardship financing to "step down" to non-hardship or no forms of financing over time suggests against this.

A second option is that the repeated use of hardship financing by some households might reflect a classic poverty trap, wherein hardship financing led to lower living standards, either through the sale of productive assets reducing the ability of the household to earn income over time, or the need to repay loans with interest reducing the ability of the household to fund consumption and investment over time, leading to further hardship financing. (Kraay and Mckenzie 2014) However, this is not borne out by the lack of hardship financing following the fourth month post-discharge, the reductions in tangible impacts of changes in living standards. The pattern of financial coping uncovered in qualitative research of the role of financial coping in poverty traps is that households exhaust less risky options for financial coping before resorting to more risky forms. (Krishna 2010) Unlike an injury, many of the shocks that were experienced by the research participants in this study were slow-moving, including several years of cumulative shocks and failed efforts at coping.

This last point leads to a third option is that, in deciding on a financial coping strategy, households without savings may face a trade-off between the risk of a financial coping strategy with how quickly that strategy can provide them with needed resources. Other work has shown that households which have to raise funds on an emergency basis have to forgo less risky mechanisms for obtaining funds for coping strategies which provide money very quickly. (Perera, Gunatilleke, and Bird 2007) The requirement to pay for high inpatient direct medical costs at the point of discharge or soon thereafter may propel households to make these sorts of choices. Alternatively, the repeated use of hardship financing, which peters out by the fifth month post-discharge, could indicate that households are still making choices on an emergency basis within a four-month time horizon. The lack of hardship financing between months four and twelve post-discharge, and the pattern of use in which households do not initiate but rather transition out of hardship financing to less risky but perhaps slower to marshal form of financing (or no financing), supports this last explanation.

A fourth option, which is not exclusive of the third, is the consistency over time in the types of variables that are associated with hardship financing. In Paper 1, we found that the two variables most strongly associated with the use of hardship financing were the child dependency ratio and rurality. The child dependency ratio was largely stable over the course of the year, a feature that was exploited in order to generate multiple imputations of missing variables. Rurality was also not considered a time-varying variable, although it was only measured once during the patient's hospitalization. Although the transition model controlled for rurality and child dependency ratio, the parameterization of these variables may have left residual confounding, or there may be unmeasured factors which are similarly invariant over time and associated with hardship financing.

d. Association between Hardship Financing and Changes to Living Standards

There have been only a handful of studies that have directly examined the effects of hardship financing resulting from health shocks on living standards or impoverishment. The present study contributes longitudinal evidence to a small body of work consisting mostly of cross-sectional and qualitative designs, with limited contributions from longitudinal or panel studies. The conclusions of this small body of evidence are cohesive, finding that hardship financing led to changes in living standards and quality of life. As a result of hardship financing, in addition to the underlying health shock, households experienced cycles of indebtedness from borrowing with interest; loss of future income from the sale of productive assets; sharp increases in labor supply; reductions in total, food, medical, and educational expenditure; and experienced social stigma and shame. (Bigdeli et al. 2016; Daivadanam 2012; Hutchison et al. 2017; Jackson et al. 2006; Khan et al. 2015; Krishna 2010; Mock et al. 2003; Perera et al. 2007)

The relationships amongst previous hardship financing, current hardship financing and changes in living standards are challenging to tease out. Hardship financing in the previous time period was associated with current hardship financing; previous hardship financing and current hardship financing were associated with tangible impacts of negative changes in living standards. Yet, hardship financing in the last time period was not associated with a change in odds of these tangible impacts over and above the effect of current hardship financing, as the interaction term was not significant.

There are several potential reasons for this. First, it may be that previous hardship financing does not actually increase the odds of changes in living standards over and above the use of hardship financing in the current time period, and similarly current hardship financing does not increase the odds of changes in living standards over and above previous hardship financing. In other words, any use of hardship financing, either previous or current, is associated with tangible impacts of changes in living standards, and repeated use does contribute further. Second, there may be issues with parameterizing hardship financing as a binary variable that may obscure heterogeneity within the category of using hardship financing. Individuals who borrow different amounts of money with interest, and who sell different numbers or values of productive assets are classified together as using hardship financing. It may be that subsequent use of hardship financing following initial use involves borrowing lower amounts or selling fewer or less valuable productive assets, similar to apparent preferences for households to “step down” from hardship to non-hardship or no financial coping. However, this hypothesis cannot be tested thoroughly since this study did not quantify either the price received for assets sold nor the amount of income expected to be generated by that asset in the future. Finally, the most likely explanation lies in the patterns in use of hardship financing over time, which show that households in this sample rarely initiate hardship financing if it was not used in the previous time period. This presents an “empty cell” problem when comparing individuals who used hardship financing in the current and last time period to those who used in the current but not last time period, as the latter group consists of almost no households.

e. Strengths and Limitations

The strengths of this study lie in the measurement of outcome and independent variables and its longitudinal design. First, this study was able to improve over other definitions of hardship financing by distinguishing the source of borrowing between those which would entail paying an interest rate and those which would involve participation in an informal mutual insurance network, and between the sale of productive and non-productive assets, with some assumptions. Other studies of the use and consequences of hardship financing has labeled all borrowing and all asset sale as hardship financing. (Joe 2015; Kaonga et al. 2019; Kruk et al. 2009; Peters et al. 2002; Sangar et al. 2019a; Yadav et al. 2021)

Using a more inclusive definition may have dilute the effects of hardship financing on outcomes such as the effect on living standards.

Additionally, as discussed earlier, there are challenges with the measurement of living standards using either income or expenditure when assessing the association of hardship financing with changes in the material welfare of households. The measurement of changes in household living standards using tangible impacts on living situation, including inability to pay rent or mortgage, being forced to relocate, or being unable to pay utilities; or inability to continue investment in human capital, including medical or rehabilitative care for the patient's injury, or the ability to pay for education.

Second, the longitudinal design allowed us to observe and evaluate the changing prevalence of hardship financing, its relationship to further hardship financing, and its relationship over time to the use of other forms of financial coping. We were not able to find any study that examined the effect of hardship financing on the use of further hardship financing, an evaluation of which required a longitudinal design. It also allowed us to explore the relationship of hardship financing on tangible impacts of changes in living standards over time.

This study also had several limitations, related to missing data, measurements, rare outcomes, and limited follow-up. Missing data and measurement limitations interacted together to impact the study: there were 150 patients who were lost to follow up following hospital discharge; without any post-discharge measurement instances, it was not possible to use either multiple imputation, inverse probability weights or complete case analysis to evaluate how these individuals might have contributed to our understanding of hardship financing, which was not measured during hospitalization. A second measurement limitation was in the definitions of hardship financing, which was defined as any borrowing with interest and any sale of productive assets. While the amount borrowed from different sources was measured, neither the price received for the asset or the importance of its loss to future earnings were quantified in the survey. Due to this measurement loss, it was not possible to explore the relationship between different “doses” of hardship financing and impacts on living standards. Future wok could help resolve this measurement issues.

Third, the rare use of hardship financing, which was only used by one household between four and twelve months following hospitalization, prevented us from fully exploiting the longitudinal design of the study to understand the trajectory of use of hardship financing had the study sample size been larger. Finally, other work examining the role of health shock-related hardship financing in poverty dynamics, discussed above, has examined multiple years of accumulated shocks, rather than restricted to the effect of a single health shock over the course of twelve months. While these limitations prevented us from answering larger questions about how injury-related hardship financing affects long-term household living standards in Vietnam, the available sample and design allow us to answer more limited questions about mid-term effects. Future work could consider expanding the measurement of shocks to other household members over a longer timeline, considering the imposition of such extensive measurement on households.

References

Azeem M. M., Mugera A. W., Schilizzi S. 2016. Poverty and Vulnerability in the Punjab, Pakistan: A Multilevel Analysis. *Journal of Asian Economics* **44**: 57–72.

Barrett C. B., Marenya P. P., Mcpeak J., Minten B., Murithi F., Oluoch-Kosura W., Place F., Randrianarisoa J. C., Rasambainarivo J., Wangila J. 2006. Welfare Dynamics in Rural Kenya and Madagascar. *Journal of Development Studies* **42**(2): 248–77.

Berhanu W. 2011. Recurrent Shocks, Poverty Traps and the Degradation of Pastoralists' Social Capital in Southern Ethiopia. *African Journal of Agricultural and Resrouce Economics* **6**(1): 1–15.

Bigdeli M., Jacobs B., Men C. R., Nilsen K., Von Damme W., Dujardin B., Damme W. Van, Dujardin B. 2016. Access to Treatment for Diabetes and Hypertension in Rural Cambodia: Performance of Existing Social Health Protection Schemes. *PLoS ONE* **11**(1): 1–18.

Binnendijk E., Koren R., Dror D. M. 2012. *Hardship Financing of Healthcare among Rural Poor in Orissa, India*. Vol. 12.

Bonfrer I., Gustafsson-Wright E. 2017. Health Shocks, Coping Strategies and Foregone Healthcare among Agricultural Households in Kenya. *Global Public Health* **12**(11): 1369–90.

Capuno J. J., Kraft A. D., Camille Poco L., Quimbo S. A., Antonio Tan Jr C. R. 2019. Health Conditions, Payments, Proximity, and Opportunity Costs: Examining Delays in Seeking Inpatient and Outpatient Care in the Philippines.

Carter M. R., Lybbert T. J. 2012. Consumption versus Asset Smoothing: Testing the Implications of Poverty Trap Theory in Burkina Faso. *Journal of Development Economics* **99**(2): 255–64.

Collins D., Morduch J., Rutherford S., Ruthven O. 2009. *Portfolios of the Poor: How the World's Poor Live on $2 a Day*. Princeton: Princeton University Press.

Corbett J. 1988. Famine and Household Coping Strategies. *World Development* **16**(9): 1099–1112.

Daivadanam M. 2012. Pathways to Catastrophic Health Expenditure for Acute Coronary Syndrome in Kerala: Good Health at Low Cost? *BMC Public Health* **12**(1): 1.

Dercon S. 2005. Risk, Insurance, and Poverty: A Review. Pp. 9–37 in *Insurance against Poverty* , edited by S. Dercon. New York : Oxford University Press .

Flores G., Krishnakumar J., O'Donnell O., Van Doorslaer E. 2008. Coping with Health-Care Costs: Implications for the Measurement of Catastrophic Expenditures and Poverty. *Health Economics* **17**: 1393–1412.

Genoni M. E. 2012. Health Shocks and Consumption Smoothing: Evidence from Indonesia. *Economic Development and Cultural Change* **60**(3): 475–506.

Hasegawa M. 2017. Risk-Coping Measures against Health Shocks during the Process of Penetration of Health Insurance in Vietnam. *Asian Economic Journal* **31**(2): 139–64.

Heltberg R., Lund N. 2009. Shocks , Coping , and Outcomes for Pakistan's Poor: Health Risks Predominate. (905780325): 1–38.

Hutchison C., Khan M. S., Yoong J., Lin X., Coker R. J. 2017. Financial Barriers and Coping Strategies: A Qualitative Study of Accessing Multidrug-Resistant Tuberculosis and Tuberculosis Care in Yunnan, China. *BMC Public Health* **17**(1): 1–11.

Islam A., Maitra P. 2012. Health Shocks and Consumption Smoothing in Rural Households: Does Microcredit Have a Role to Play? *Journal of Development Economics* **97**(2): 232–43.

Jackson S., Sleigh A. C., Wang G. J., Liu X. L. 2006. Poverty and the Economic Effects of TB in Rural China. *International Journal of Tuberculosis and Lung Disease* **10**(10): 1104–10.

Joe W. 2015. Distressed Financing of Household Out-of-Pocket Health Care Payments in India: Incidence and Correlates. *Health Policy and Planning* **30**(6): 728–41.

Kanchanachitra C., Lindelow M., Johnston T., Hanvoravongchai P., Lorenzo F. M., Huong N. L., Wilopo S. A., dela Rosa J. F. 2011. Human Resources for Health in Southeast Asia: Shortages, Distributional Challenges, and International Trade in Health Services. *Lancet* **377**(9767): 769–81.

Kaonga O., Banda C., Masiyeid F. 2019. Hardship Financing of Out-of-Pocket Payments in the Context of Free Healthcare in Zambia. *PLOS ONE* **14**(4).

Khan F., Bedi A. S., Sparrow R. 2015. Sickness and Death: Economic Consequences and Coping Strategies of the Urban Poor in Bangladesh. *World Development* **72**(Supplement C): 255–66.

Kraay A., Mckenzie D. 2014. Do Poverty Traps Exist? *Journal of Economic Perspectives* **28**(3): 127–48.

Krishna A. 2010. *One Illness Away : Why People Become Poor and How They Escape Poverty*. Oxford University Press.

Kruk M. Eo. in four households in forty developing countries resort to “hardship financing” to pay for health care, Goldmann E., Galea S. 2009. Borrowing And Selling To Pay For Health Care In Low-And Middle-Income Countries. *Health Affairs* **28**(4).

Kwan G. F., Yan L. D., Isaac B. D., Bhangdia K., Jean-Baptiste W., Belony D., Gururaj A., Martineau L., Vertilus S., Pierre-Louis D., Fenelon D. L., Hirschhorn L. R., Benjamin E. J., Bukhman G. 2020. High Poverty and Hardship Financing among Patients with Noncommunicable Diseases in Rural Haiti. *Global Heart* **15**(1).

Lawson D., Kasirye I. 2013. How the Extreme Poor Cope with Crises: Understanding the Role of Assets and Consumption. *Journal of International Development* **25**(8): 1129–43.

Leive A., Xu K. 2008. Coping with Out-of-Pocket Health Payments: Empirical Evidence from 15 African Countries. *Bulletin of the World Health Organization* **86**(11): 849–56.

Mitra S., Palmer M., Mont D., Groce N. 2016. Can Households Cope with Health Shocks in Vietnam? *Health Economics (United Kingdom)* **25**(7): 888–907.

Mock C. N., Gloyd S., Adjei S., Acheampong F., Gish O. 2003. Economic Consequences of Injury and Resulting Family Coping Strategies in Ghana. *Accident Analysis and Prevention* **35**(1): 81–90.

Morduch J. 1995. Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives* **9**: 103–14.

Morduch J., Kamanou G. 2005. Measuring Vulnerability to Poverty. in *Insurance Against Poverty*.

Morudu P., Kollamparambil U. 2020. Health Shocks, Medical Insurance and Household Vulnerability: Evidence from South Africa. *PLoS ONE* **15**(2).

Nguyen G. T. H., White B., Ma C. 2008. When Faced with Income and Asset Shocks, Do Poor Rural Households in Vietnam Smooth Food Consumption or Assets? *The Journal of Development Studies* **55**(9).

Nguyen K. T., Hai Khuat O. T., Ma S., Pham D. C., Hong Khuat G. T., Ruger J. P. 2012. Coping with Health Care Expenses among Poor Households: Evidence from a Rural Commune in Vietnam. *Social Science and Medicine* **74**(5): 724–33.

Nguyen Thanh Tung, Nguyen Trung Thanh, Grote U. 2020. Multiple Shocks and Households' Choice of Coping Strategies in Rural Cambodia. *Ecological Economics* **167**(August 2019): 106442.

Noritomo Y., Takahashi K. 2020. Can Insurance Payouts Prevent a Poverty Trap? Evidence from Randomised Experiments in Northern Kenya. *Journal of Development Studies* **56**(11): 2079–96.

Perera M., Gunatilleke G., Bird P. 2007. Falling into the Medical Poverty Trap in Sri Lanka: What Can Be Done? *International Journal of Health Services* **37**(2): 379–98.

Peters D. H., Yazbeck A. S., Sharma R. R., Ramana G. N. V, Pritchett L. H., Wagstaff A. 2002. *Better Health Systems for India's Poor : Findings, Analysis, and Options*. Washington, D.C.: The World Bank Group.

Quintussi M., Van De Poel E., Panda P., Rutten F. 2015. Economic Consequences of Ill-Health for Households in Northern Rural India. *BMC Health Services Research* **15**(1).

Rabe-Hesketh S., Skrondal A. 2008. Lagged-Response or Dynamic Models. Pp. 269–72 in *Multilevel and Longitudinal Modeling using Stata*. College Station, TX: Stata Press Publication.

Sangar S., Dutt V., Thakur R. 2019a. Coping with Out-of-Pocket Health Expenditure in India: Evidence from NSS 71st Round. *Global Social Welfare* (2015).

Sangar S., Dutt V., Thakur R. 2019b. Distress Financing of Out-of-Pocket Health Expenditure in India. *Review of Development Economics* **23**(1): 314–30.

Sangar S., Dutt V., Thakur R. 2019c. Economic Burden, Impoverishment, and Coping Mechanisms Associated with out-of-Pocket Health Expenditure in India: A Disaggregated Analysis at the State Level. *International Journal of Health Planning and Management* **34**(1): e301–13.

Sen A. 1988. *Poverty and Famines : An Essay on Entitlement and Deprivation*. New York: Oxford University Press.

Sparrow R., de Poel E. Van, Hadiwidjaja G., Yumna A., Warda N., Suryahadi A. 2014. Coping with the Economic Consequences of Ill Health in Indonesia. *Health Economics* **23**(6): 719–28.

Tahsina T., Ali N. B., Siddique A. B., Ahmed S., Rahman Mubashshira, Islam S., Rahman Mezanur, Amena

B., Emdadul Hoque D. M., Huda T. M., Arifeen S. El. 2018. Determinants of Hardship Financing in Coping with out of Pocket Payment for Care Seeking of under Five Children in Selected Rural Areas of Bangladesh. *PLoS ONE* **13**(5): 1–17.

Wagstaff A., Lindelow M. 2014. Are Health Shocks Different? Evidence from a Multishock Survey in Laos. *Health Economics (United Kingdom)* **23**(6): 706–18.

Yadav J., John D., Menon G. R., Allarakha S. 2021. Out-of-Pocket Payments for Delivery Care in India: Do Households Face Hardship Financing? *Journal of Health Management* **23**(2): 197–225.

Conclusion: Health Financing Incentives, Governance, and Integration with Social Protection Systems

Health System Financial Sustainability in Vietnam: Incentives, Governance, and Universe Health Coverage

Vietnam has made impressive advancements in improving the household incomes and reducing poverty, moving from being one of the poorest countries in the world in the 1980s, to being a lower-middle income country within the space of 25 years. (The World Bank 2021) Rapid economic development combined with a strong and successful effort to increase the availability of preventative and curative health services have also improved both the health and longevity of the population. Vietnam has undergone an epidemiological transition, with non-communicable diseases replacing infectious disease, malnutrition and undernutrition as the most prominent causes of morbidity and mortality. (Nguyen and Trevisan 2020) While Vietnam continues to struggle with health equity by socioeconomic status, ethnicity, and geography, overall, maternal mortality, under-five mortality, infectious disease morbidity and mortality, and a host of other indicators of health show that Vietnam is outperforming other countries with similar national income. (World Health Organization 2015)

While at least a part these achievements is attributable to health system performance, the ability to sustain and improve on such gains over time is in question. Since the beginning of the reintroduction of market mechanisms into the economy during the *Doi Moi*, the government of Vietnam has been slowly and then rapidly moving away from health financing through supply side subsidies toward demand-side sources of funding for health service. Government subsidies for services were reduced in 1986, and then again in 2006, and were finally eliminated entirely with the Health Insurance Law of 2015. (Lieberman and Wagstaff 2009; Teo et al. 2019) The focus of recent health financing legislation has been on increasing the breadth of health insurance coverage, with the intention of creating a system in which all individuals are covered by health insurance and where all health care costs are covered by demand-side supports through insurance reimbursement payments for health care users. Vietnam's goal for ensuring the availability, financial accessibility, and sustainability of health services has centered around achieving close to 100% breadth of health insurance coverage.

However, the work towards achieving Universal Health Coverage is now at a critical period. Universal Health Coverage requires having a health system that sustainably and equitably provides all individuals with the full range of needed health services, from promotive, to preventative, to curative, to rehabilitative, without incurring financial hardship. There are several factors which are inhibiting the financial sustainability of the current health system. First, the incremental path towards full population coverage which has enabled and incentivized adverse selection into health insurance among the population. As discussed, health insurance has either been made mandatory or been subsidized for different sectors of the population over time, with individuals above the poverty line in the informal sector the last to be required to have insurance. (Barroy, Jarawan, and Bales 2014; Le et al. 2020; Somanathan et al. 2014; Somanathan, Dao, and Tien 2013; Thuong et al. 2020) While having health insurance was made mandatory in Vietnam as of the 2015 Health Insurance Law, there is no penalty or enforcement mechanism for ensuring compliance, and even if there were penalties, given the proportion of the population working in the informal sector, there is no easy, practical way to ensure compliance. (Le et al. 2020) This has led to a problem with adverse selection, with individuals with greater or perceived greater health care needs being more likely to select into health insurance, a common pattern reflected in the HEALS Cohort, as observed in Paper 1.

Second, even if Vietnam were to achieve 100% population coverage of insurance, this would likely still not result in the sustainability of the current demand-side health financing structure due to the changing demographics of the country. Due to rising incomes, increasing education among women, and explicit population control policies during the 1980s and 1990s, Vietnam has seen longer lifespans and fewer children per person giving birth leading to an overall older population. (Johansson et al. 1996; The Economist 2018) Unlike many other lower-middle income countries, Vietnam cannot expect a demographic dividend on which it can rely to fund either government expenditure on health care through any supply-side subsidies, nor to contribute through demand-side health care utilization sufficient to balance the health care utilization of older and elderly individuals, who would require additional health services in response to the illnesses of aging and non-communicable diseases.

Finally, the effect of adverse selection and an aging population on health system financial sustainability has been further compromised by the passive purchasing system used for inpatient care and the decentralized health system governance structure, which have respectively incentivized and enabled an overprovision of health services, particularly inpatient services, and an under-provision of outpatient, rehabilitative and follow-up services. (Lieberman and Wagstaff 2009; Sepehri 2014; Teo et al. 2019; Thanh et al. 2014; Vian et al. 2012) These inefficiencies, brought about by a combination of misaligned incentives and devolved governance, has implications not only for the financial sustainability of health system financing, but for the provision of effective coverage, a central component of Universal Health Coverage. These patterns were reflected in this study, which found that among those who accepted all prescribed care, those with health insurance were provided with additional services compared to those without health insurance likely as a way to obtain additional insurance reimbursement payments from a group without personal financial stake in incurring those direct costs (Paper 2); very few individuals used any sort of rehabilitative or follow-up care (Paper 1); and there were no or very time-limited differences in health effects of forgoing prescribed medical care by leaving hospital against medical advice (Paper 2). Additionally, the incredibly high proportion of patients who left against medical advice seen in this study, seemingly as a way to pushback against this overprovision of inpatient care and the additional costs incurred, did not result in differences in health outcomes on average; however, pushing back against overprovision of care could have health implications for patients who 'overcorrect' and forgo truly needed medical care. Changing incentives and improved governance of service delivery could shift focus of service delivery systems away from inpatient hospitalization, rebalancing service delivery towards follow-up and rehabilitative care. This could potentially have an impact not only on the financial sustainability of the health system, but also improving health outcomes for individuals who have experienced an injury, both through providing a continuum of care and reducing the drivers of patients leaving hospital against medical advice.

At Vietnam's current stage of economic development, there is no additional fiscal space to increase funding of health services, at least in the near term. (Somanathan et al. 2014; Teo et al. 2019) Addressing these inefficiencies in health system governance and financial incentive structure are key for effectively increasing funding for health services and improving health outcomes. As the current fee-for-service purchasing mechanism, combined with the removal of all supply-side supports, devolved governance of service delivery to hospitals, and potentially a lack of clinical judgment, has resulted in an environment of overprovision of care, replacing multiple elements from this system is essential. Vietnam piloted and studied the introduction of case-based payments in order to address escalating costs of inpatient care through overprovision of health services. The Health Insurance Law of 2008 defined and permitted case-based payments and their use was piloted the following year; however, ten years later, there is still no coordination between the Ministry of Health and Vietnam Social Services (VSS) to implement changes to purchasing mechanisms for curative care. (Teo et al. 2019; Tran Van Tien et al. 2011) However, case-based payments, in which an average cost per type of diagnosis is paid regardless of actual cost of care, come with their own set of incentives to underprovide care per case or select for treatment only those cases which will be the easiest and least expensive to treat. Vietnam cannot rely only on the incentives inherent to particular types of strategic purchasing mechanisms, but must also simultaneously increase oversight and governance of health service delivery. Past suggestions include leveraging the single-payer system through VSS as a way to document adherence to clinical guidelines, no longer requiring VSS to contract with all public hospitals regardless of such adherence to quality standards, and reducing hospital autonomy in resource mobilization and sharing of profits among providers. (Lieberman and Wagstaff 2009; London 2013; Oanh and Thi Phuong 2016; Sepehri 2014; Teo et al. 2019)

None of these suggestions are mutually exclusive; yet each urgent reform is being delayed by a lack of coordination and consensus among the various stakeholder government agencies and a disempowered VSS. In order to attempt to address the high rate of road traffic injuries in the country, Vietnam has developed the National Traffic Safety Commission, and inter-agency coordinating body which reports directly to the Prime Minister. To address needed changes to health financing purchasing mechanisms and oversee service delivery governance, a similar body working across the Ministry of Health, the Ministry of Finance, and Vietnam Social Services, and with a similarly high level of reporting and empowerment, may serve to break through the current logjam.

Health Shocks, Financial Coping, and Social Protection

A lack of coordination among government agencies is also apparent in the magnitude and inequitable financial impact on patients and households in the year following an injury-related health shock. As seen in Paper 1, income losses at the household level led households to use hardship financing, which was discovered in Paper 3 to be a maladaptive form of coping which itself led to further hardship financing and to tangible impacts of reductions in living standards. The use of these maladaptive coping mechanisms was inequitable employed by rural households and by households without other coping options such as the use of savings, and which were potentially constrained in their use of labor substitution by having high child dependency ratios.

As mentioned in Paper 1, approximately 3% of the households received any sort of government social protection systems or non-governmental supports, and this use of support occurred only in the month following hospital discharge. Other work in Vietnam has found that individuals and households which experience health shocks do not access social protection systems or charitable supports at higher rates than those who did not experience a health shock. (Mitra et al. 2016) Studies examining whether health insurance can prevent hardship financing, consumption reduction, or other definitions of welfare loss have found that it is insufficient, as health insurance only address direct costs and does not alleviate indirect costs. (Dhanaraj 2016; Mitra et al. 2016; Neelsen et al. 2019) This study, which did not find that direct costs contributed to the use of hardship financing or tangible impacts of changes in living standards in the year following an injury-related hospitalization, echoes these findings and points to a lack of integration between health insurance and anti-poverty programs in Vietnam.

Social protection systems fall into three different categories: social insurance, including health insurance, which is intended to prevent households from falling below their current standard of living; social assistance programs, which are intended to prevent a household from falling below an absolute standard of living; and active labor market interventions, which are designed to help households improve their standard of living over time through education and livelihoods interventions. (Nguyen and O'keefe 2019) These partially echo Pritchett's (2000) description of social insurance and anti-poverty programs described in the introduction, with social insurance programs acting as a safety rope and social assistance acting as a safety net; labor market interventions, which fall outside Pritchett's schema, are interventions which support households in climbing up.

However, the goals of these separate policy streams do not reflect the conceptual integration of risk management and risk coping strategies as experienced by households. As discussed in the introduction, risk management and risk coping strategies carry with them welfare costs. Households which are not protected from risk may attempt to limit potential exposure by making low risk and low return investments, or expend resources or hold back from investment to have potential informal risk coping strategies such as informal insurance networks and precautionary savings at their disposal. Such risk management and anticipatory risk coping strategies direct affect livelihood development.

In Vietnam, these three systems are not well integrated with each other, with households experiencing income losses and tangible impacts of poverty remaining unconnected to social assistance programs even if they have and have used social insurance, as was seen in this study; and without an understanding that risk protection influences choices about livelihood development. There is an urgent need to form service linkages with health insurance, income support, disability payments, and other social protection services and programs in Vietnam. In this study, household income prior to the injury was not associated with the use of hardship financing, or with the experience of tangible impacts on living standards, but current household income was associated with both. This echoes a common theme in this study, that poverty is flow rather than a stock variable; while social insurance programs are designed to address exactly this fact, social assistance programs are much less responsive to rapid changes in a household's living standards in response to a shock, and labor market interventions do consider risk protection offered by social insurance and assistance as a necessary precondition. Given the rapidity with which financial circumstances may change, particularly in response to a sudden, unexpected and costly health shock such as an injury, a lack of integration between social assistance and health insurance in particular left households turning to financial coping mechanisms, including hardship financing.

One measure for the success of social assistance programs integrating with social insurance programs into a social protection system could be reductions over time in the prevalence of hardship financing among individuals who have experienced a health shock. (Binnendijk, Koren, and Dror 2012) Using hardship financing as an indicator may be measured at the household level in Vietnam, as this study did not find evidence of inequitable intrahousehold risk-sharing following an injury-related health shock. Neither the use of financial coping mechanisms nor the choice of mechanism varied by the patient's gender, age, marital status, occupation or financial role within the household prior to the injury.

Similarly, there was no evidence that insurance status interacted with any of these categories, which might suggest a reluctance to use financial coping mechanisms, or hardship financing in particular, for uninsured patients by their immutable characteristics or financial or caregiving importance household. However, there was an indication that leaving against medical advice was a more likely choice among or for patients who were elderly, indicating that this effort to avoid costs rather than cope with them may be a choice made based on the patient's age.

Vietnam has been engaging with international institutions such as the World Bank and UNICEF around improving and integrating its social protection systems for more than 12 years, and has made incremental progress in furthering development and reach of each of the three elements of its social protection policies, however, fragmentation of these systems has remained a problem. (Nguyen and O'keefe 2019; Razavi et al. 2020) Recently however, the widespread economic impacts of the Covid-19 pandemic seem to have provided additional impetus to Vietnam to integrate social assistance, social insurance and health insurance systems, and labor support systems to make these three arms a core component of economic development policies rather than social welfare policies, to expand the reach of social protection to the informal sector, and to develop specific policies to address the inequitable impacts of health shocks. (United Nations Joint Sustainable Development Goals Fund 2020) The authors are eager for the results of this push to integrate social protection systems in Vietnam, and the potential protections such integration may offer against households having to choose maladaptive financial coping mechanism following an injury.

References

Barroy H., Jarawan E., Bales S. 2014. *Vietnam - Universal Health Coverage for Inclusive and Sustainable Development : Country Summary Report*.

Dhanaraj S. 2016. Economic Vulnerability to Health Shocks and Coping Strategies: Evidence from Andhra Pradesh, India. *Health Policy and Planning* **31**(6): 749–58.

Johansson A., Hoa H. T., Lap N. T., Diwan V., Eriksson B. 1996. Population Policies and Reproductive Patterns in Vietnam. *Lancet* **347**(9014): 1529–32.

Le Q. N., Blizzard L., Si L., Giang L. T., Neil A. L. 2020. The Evolution of Social Health Insurance in Vietnam and Its Role towards Achieving Universal Health Coverage. *Health Policy OPEN* **1**: 100011.

Lieberman S., Wagstaff A. 2009. *Health Financing and Delivery in Vietnam: Looking Forward*. Washington, DC.

London J. D. 2013. The Promises and Perils of Hospital Autonomy. Reform by Decree in Viet Nam. *Social Science and Medicine* **96**: 232–40.

Mitra S., Palmer M., Mont D., Groce N. 2016. Can Households Cope with Health Shocks in Vietnam? *Health Economics (United Kingdom)* **25**(7): 888–907.

Neelsen S., Limwattananon S., van Doorslaer E., World Bank T. 2019. Universal Health Coverage: A (Social Insurance) Job Half Done? *World Development* **113**: 246–58.

Nguyen N. N., O'keefe P. 2019. *A Vision for the 2030 Social Protection System in Vietnam* . New York.

Nguyen T. T., Trevisan M. 2020. Vietnam a Country in Transition: Health Challenges. *BMJ Nutrition, Prevention & Health* **3**(1): bmjnph-2020-000069.

Oanh T. T. M., Thi Phuong H. 2016. *Strategic Purchasing for Universal Health Coverage: A Critical*

Assessment of Social Health Insurance Fund, Vietnam. Hanoi.

Pritchett L. 2000. Quantifying Vulnerability to Poverty : A Proposed Measure, Applied to Indonesia edited by S. Sumarto and A. Suryahadi.

Razavi S., Behrendt C., Bierbaum M., Orton I., Tessier L. 2020. Reinvigorating the Social Contract and Strengthening Social Cohesion: Social Protection Responses to COVID-19. *International Social Security Review* **73**(3): 55–80.

Sepehri A. 2014. Does Autonomization of Public Hospitals and Exposure to Market Pressure Complement or Debilitate Social Health Insurance Systems? Evidence from a Low-Income Country. *International Journal of Health Services* **44**(1): 73–92.

Somanathan A., Dao H. L., Tien T. Van. 2013. *Integrating the Poor into Universal Health Coverage in Vietnam*. World Bank, Washington DC.

Somanathan A., Tandon A., Dao H. L., Hurt K. L., Fuenzalida-Puelma H. L. 2014. *Moving towards Universal Health Coverage of Social Health Insurance in Vietnam: Assessment and Options.Directions in Development.* Washington, D.C.: The World Bank Group.

Teo H. S., Bales S., Bredenkamp C., Cain J. S. 2019. *The Future of Health Financing in Vietnam: Ensuring Sufficiency, Efficiency, and Sustainability*. New York.

Thanh N. X., Tran B. X., Waye A., Harstall C., Lindholm L. 2014. "Socialization of Health Care" in Vietnam: What Is It and What Are Its Pros and Cons? *Value in Health Regional Issues* **3**(1): 24–26.

The Economist. 2018. Vietnam Is Getting Old before It Gets Rich. *The Economist*.

The World Bank. 2021. Vietnam Country Context: Overview. Retrieved (https://www.worldbank.org/en/country/vietnam/overview#1).

Thuong N. T. T., Huy T. Q., Tai D. A., Kien T. N. 2020. Impact of Health Insurance on Health Care Utilisation and Out-of-Pocket Health Expenditure in Vietnam. *BioMed Research International* **2020**.

Tran Van Tien by, Thi Phuong H., Mathauer I., Thi Kim Phuong N. 2011. *A Health Financing Review of Viet Nam with a Focus on Social Health Insurance: Bottlenecks in Institutional Design and Organizational Practice of Health Financing and Options to Accelerate Progress towards Universal Coverage*.

United Nations Joint Sustainable Development Goals Fund. 2020. Towards Inclusive and Integrated Social Protection to Leave No One Behind in Viet Nam. Retrieved (https://jointsdgfund.org/article/towards-inclusive-and-integrated-social-protection-leave-no-one-behind-viet-nam).

Vian T., Brinkerhoff D. W., Feeley F. G., Salomon M., Vien N. T. K. 2012. Confronting Corruption in the Health Sector in Vietnam: Patterns and Prospects. *Public Administration and Development* **32**(1): 49–63.

World Health Organization. 2015. Vietnam Country Cooperation Strategy - At A Glance. *Global Health Observatory* (April).

Bibliography

Alam K., Mahal A. 2014. Economic Impacts of Health Shocks on Households in Low and Middle Income Countries: A Review of the Literature. *Globalization and Health* **10**(1): 21.

Alfandre D., ed. 2018. *Against-Medical-Advice Discharges from the Hospital: Optimizing Prevention and Management to Promote High Quality, Patient-Centered Care*. New York, NY: Springer.

Alfandre D. J. 2009. "I'm Going Home": Discharges against Medical Advice. *Mayo Clinic Proceedings* **84**(3): 255–60.

Alfonso N. Y., Alonge O., Hoque D. M. E., Baset K. U., Hyder A. A., Bishai D., Alfonso Y. N., Alonge O., Md D., Hoque E., Baset K. U., Hyder A. A., Bishai D. 2017. Care-Seeking Patterns and Direct Economic Burden of Injuries in Bangladesh. *International Journal of Environmental Research and Public Health* **14**(5): 472–80.

Ali S., Cookson R., Dusheiko M. 2017. Addressing Care-Seeking as Well as Insurance-Seeking Selection Biases in Estimating the Impact of Health Insurance on out-of-Pocket Expenditure. *Social Science and Medicine* **177**: 127–40.

Aliyu Z. Y. 2002. Discharge against Medical Advice: Sociodemographic, Clinical and Financial Perspectives. *International Journal of Clinical Practice* **56**(5).

Allison P. D. 2002. *Missing Data*. Thousand Oaks, Calif: Sage Publications.

Amponsah S. 2016. The Incidence of Health Shocks, Formal Health Insurance, and Informal Coping Mechanisms. *Perspectives on Global Development and Technology* **15**(6): 665–95.

Ashrafi E., Nobakht S., Keykaleh M. S., Kakemam E., Hasanpoor E., Sokhanvar M. 2017. Discharge against Medical Advice (DAMA): Causes and Predictors. *Electronic Physician* **9**(6): 4563–70.

Austin P. C., Small D. S. 2014. The Use of Bootstrapping When Using Propensity-Score Matching without Replacement: A Simulation Study. *Statistics in Medicine* **33**: 4306–19.

Azeem M. M., Mugera A. W., Schilizzi S. 2016. Poverty and Vulnerability in the Punjab, Pakistan: A Multilevel Analysis. *Journal of Asian Economics* **44**: 57–72.

Baptist A. P., Warrier I., Arora R., Ager J., Massanari R. M. 2007. Hospitalized Patients with Asthma Who Leave against Medical Advice: Characteristics, Reasons, and Outcomes. *J Allergy Cline Immunol* **115**(4): 924–29.

Baron R. M., Kenny D. A. 1986. The Moderator-Mediator Variable Distinction in Social Psychological Research : Conceptual , Strategic , and Statistical Considerations. (6): 1173–82.

Barrett C. B., Marenya P. P., Mcpeak J., Minten B., Murithi F., Oluoch-Kosura W., Place F., Randrianarisoa J. C., Rasambainarivo J., Wangila J. 2006. Welfare Dynamics in Rural Kenya and Madagascar. *Journal of Development Studies* **42**(2): 248–77.

Barroy H., Jarawan E., Bales S. 2014. *Vietnam - Universal Health Coverage for Inclusive and Sustainable Development : Country Summary Report*.

Berhanu W. 2011. Recurrent Shocks, Poverty Traps and the Degradation of Pastoralists' Social Capital in Southern Ethiopia. *African Journal of Agricultural and Resrouce Economics* **6**(1): 1–15.

Berman P., Ahuja R., Bhandari L. 2010. The Impoverishing Effect of Healthcare Payments in India: New Methodology and Findings. *Economic and Political Weekly* **XLV**(16): 65–71.

Bigdeli M., Jacobs B., Men C. R., Nilsen K., Von Damme W., Dujardin B., Damme W. Van, Dujardin B. 2016. Access to Treatment for Diabetes and Hypertension in Rural Cambodia: Performance of Existing Social Health Protection Schemes. *PLoS ONE* **11**(1): 1–18.

Binnendijk E., Koren R., Dror D. M. 2012. *Hardship Financing of Healthcare among Rural Poor in Orissa, India*. Vol. 12.

Bonfrer I., Gustafsson-Wright E. 2017. Health Shocks, Coping Strategies and Foregone Healthcare among Agricultural Households in Kenya. *Global Public Health* **12**(11): 1369–90.

de Brauw A. 2012. Seasonal Migration and Agriculture in Vietnam. *SSRN Electronic Journal* (202).

De Brauw A., Herskowitz S., Ambler K., Le N., Truong H., Thu T., Nguyen T., Thuy T., Tuan B., Nguyen A., Trung C., Moyes T., Middleton M., Toth R. 2020. *Agriculture Value Chain Finance in Viet Nam*. Washington, DC.

Brown C., Calvi R., Penglase J. 2018. Sharing the Pie: Undernutrition, Intra-Household Allocation, and Poverty. *SSRN Electronic Journal*.

Brown C., Ravallion M., van de Walle D. 2017. *Are Poor Individuals Mainly Found in Poor Households? Evidence Using Nutrition Data for Africa*. The World Bank.

Capuno J. J., Kraft A. D., Camille Poco L., Quimbo S. A., Antonio Tan Jr C. R. 2019. Health Conditions, Payments, Proximity, and Opportunity Costs: Examining Delays in Seeking Inpatient and Outpatient Care in the Philippines.

Carlsson A. M. 1983. Assessment of Chronic Pain. I. Aspects of the Reliability and Validity of the Visual Analogue Scale. *Pain* **16**(1): 87–101.

Carter M. R., Lybbert T. J. 2012. Consumption versus Asset Smoothing: Testing the Implications of Poverty Trap Theory in Burkina Faso. *Journal of Development Economics* **99**(2): 255–64.

Ciapponi A., S L., Herrera C., Opiyo N., Pantoja T., Paulsen E., Rada G., Wiysonge C., Bastías G., Dudley L., Flottorp S., Gagnon M., Garcia Marti S., Glenton C., Okwundu C., Peñaloza B., Suleman F., Oxman A.

2017. Delivery Arrangements for Health Systems in Low-Income Countries: An Overview of Systematic Reviews (Review). *Cochrane Library Cochrane Database of Systematic Reviews* (9).

Clemens J., Gottlieb J. D. 2014. Do Physicians' Financial Incentives Affect Medical Treatment and Patient Health? *American Economic Review* **104**(4): 1320–1349.

Collins D., Morduch J., Rutherford S., Ruthven O. 2009. *Portfolios of the Poor: How the World's Poor Live on $2 a Day*. Princeton: Princeton University Press.

Corbett J. 1988. Famine and Household Coping Strategies. *World Development* **16**(9): 1099–1112.

Currie J., Madrian B. C. 1999. Health, Health Insurance and the Labor Market. Pp. 3309–3416 in *Handbook of Labor Economics*. Vols. 3, Part C, edited by O. Ashenfelter, R. Layard, and D. Card. Elsevier.

Daivadanam M. 2012. Pathways to Catastrophic Health Expenditure for Acute Coronary Syndrome in Kerala: Good Health at Low Cost? *BMC Public Health* **12**(1): 1.

Dao A. 2020. What It Means to Say "I Don't Have Any Money to Buy Health Insurance" in Rural Vietnam: How Anticipatory Activities Shape Health Insurance Enrollment. *Social Science and Medicine* **266**.

Dao H. T., Waters H., Le Q. V., Noi H., Nam V. 2008. User Fees and Health Service Utilization in Vietnam: How to Protect the Poor? *Public Health* **122**(10): 1068–78.

Decker S., Schmitz H. 2016. Health Shocks and Risk Aversion. *Journal of Health Economics* **50**(Supplement C): 156–70.

Demombynes G., Vu L. V. 2015. *Demystifying Poverty Measurement in Vietnam* . Washington, DC: World Bank .

Department of International and Social Affairs Statistical Office,. 1982. *Provisional Guidelines on*

Standard International Age Classifications. New York.

Dercon S. 2005. Risk, Insurance, and Poverty: A Review. Pp. 9–37 in *Insurance against Poverty* , edited by S. Dercon. New York : Oxford University Press .

Dercon S., Krishnan P. 2000. In Sickness and in Health : Risk Sharing within Households in Rural Ethiopia. *Journal of Political Economy* **108**(4): 688–727.

Dhanaraj S. 2016. Economic Vulnerability to Health Shocks and Coping Strategies: Evidence from Andhra Pradesh, India. *Health Policy and Planning* **31**(6): 749–58.

Doorslaer E. Van, Donnell O. O., Rannan-eliya R. P., Herrin A. N., Lee T., Leung G. M., Lu J. R. 2005. *Paying Out-Of-Pocket for Health Care in Asia : Catastrophic and Poverty Impact*. 2.

Drummond M., Sculpher M. J., Claxton K., Stoddart G. L., Torrance G. W. 2015. Cost Analysis. Pp. 219–66 in *Methods for the economic evaluation of health care programmes*. Oxford: Oxford University Press.

Duflo E., Udry C. 2004. Intrahousehold Resource Allocation in Côte D'Ivoire: Social Norms, Separate Accounts and Consumption Choices. *NBER Working Papers* **1542**: 33–36.

Dutta I., Foster J., Mishra A. 2011. On Measuring Vulnerability to Poverty. *Social Choice and Welfare* **37**(4): 743–61.

Ekman B. 2007. Catastrophic Health Payments and Health Insurance: Some Counterintuitive Evidence from One Low-Income Country. *Health Policy* **83**: 304–13.

Fafchamps M. 1999. *Rural Poverty, Risk and Development*. Oxford.

Filmer D., Pritchett L. H. 2001. Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India. *Demography* **38**(1): 115–32.

Fiszbein A., Schady N. 2009. *Conditional Cash Transfers: Reducing Present and Future Poverty*. Washington, D.C.: The World Bank Group.

Fitzmaurice G. M., Laird N. M., Ware J. H. 2011a. *Applied Longitudinal Analysis*. 2nd ed. Hoboken: Wiley.

Fitzmaurice G. M., Laird N. M., Ware J. H. 2011b. Missing Data and Dropout: Multiple Imputation and Weighting Methods. Pp. 965–1030 in *Applied Longitudinal Analysis*. Hoboken: Wiley.

Fitzmaurice G. M., Laird N. M., Ware J. H. 2011c. Missing Data and Dropout: Overview of Concepts and Methods. Pp. 916–64 in *Applied Longitudinal Analysis*. Hoboken: Wiley.

Flores G., Krishnakumar J., O'Donnell O., Van Doorslaer E. 2008. Coping with Health-Care Costs: Implications for the Measurement of Catastrophic Expenditures and Poverty. *Health Economics* **17**: 1393–1412.

Foster J., Greer J., Thorbecke E. 1984. A Class of Decomposable Poverty Measures. *Econometrica* **52**(3): 761–66.

Gautam N., Sharma J., Sharma A., Verma V., Arora P., Gautam P. 2018. Retrospective Evaluation of Patients Who Leave against Medical Advice in a Tertiary Teaching Care Institute. *Indian Journal of Critical Care Medicine* **22**(8): 591–96.

General Statistics Office. 2016. *Vietnam Household Living Standards Survey 2016*. Hanoi.

General Statistics Office of Vietnam,. 2017. *Statistical Yearbook of Vietnam, 2016*. Hanoi, Vietnam.

General Statistics Office of Vietnam,. 2020. *Statistical Yearbook of Vietnam 2019*. Hanoi, Vietnam.

Genoni M. E. 2012. Health Shocks and Consumption Smoothing: Evidence from Indonesia. *Economic Development and Cultural Change* **60**(3): 475–506.

Gertler P., Gruber J. 2002. Insuring Consumption Against Illness. *Am Econ Rev* **92**(1): 51–70.

Goldstein M. 1999. Chop Time, No Friends: Intrahousehold and Individual Insurance Mechanisms in Southern Ghana. *University of California at Berkeley, Department of Agricultural and Resource Economics* 1–59.

Gonçalves-Bradley D. C., Lannin N. A., Clemson L. M., Cameron I. D., Shepperd S. 2016. Discharge Planning from Hospital. *Cochrane Database of Systematic Reviews* **2016**(1).

Green K. M., Stuart E. A. 2014. Examining Moderation Analyses in Propensity Score Methods: Application to Depression and Substance Use. *J Consult Clin Psychol* **82**(5): 773–83.

Greenland S. 2003. Quantifying Biases in Causal Models: Classical Confounding. *Epidemiology* **14**: 300–306.

Haddad L., Hoddinott J., Alderman H. 1997. *Intrahousehold Resource Allocation in Developing Countries: Methods, Models, and Policy*. Baltimore and London: Johns Hopkins University Press.

Haines K., Freeman J., Vastaas C., Rust C., Cox C., Kasotakis G., Fuller M., Krishnamoorthy V., Siciliano M., Alger A., Montgomery S., Agarwal S. 2020. "I'm Leaving": Factors That Impact Against Medical Advice Disposition Post-Trauma. *Journal of Emergency Medicine* **58**(4): 691–97.

Hang H. M., Byass P., Svanström L. 2004. Incidence and Seasonal Variation of Injury in Rural Vietnam: A Community-Based Survey. *Safety Science* **42**(8): 691–701.

Hasan O., Muhammad Adeel Samad, Khan H., Sarfraz M., Noordin S., Ahmad T., Nowshad G. 2019. Leaving against Medical Advice from In-Patients Departments Rate, Reasons and Predicting Risk Factors for Re-Visiting Hospital Retrospective Cohort from a Tertiary Care Hospital. *International Journal of Health Policy and Management* **8**(8): 474–79.

Hasegawa M. 2017. Risk-Coping Measures against Health Shocks during the Process of Penetration of Health Insurance in Vietnam. *Asian Economic Journal* **31**(2): 139–64.

Hashempour R., Tahmasebi A., Veysi M., Amini M., Tavakoli N. 2019. *Cost Analysis of Accidents According to Demographic Factors in Iran*. Vol. 48.

Haughton J., Khandker S. 2009. Measuring Poverty. Pp. 9–37 in *Handbook on Poverty and Inequality*. Washington, DC: World Bank Group.

Hedeker D., du Toit S. H. C., Demirtas H., Gibbons R. D. 2018. A Note on Marginalization of Regression Parameters from Mixed Models of Binary Outcomes. *Biometrics* **74**(1): 354–61.

Heltberg R., Lund N. 2009. Shocks , Coping , and Outcomes for Pakistan's Poor: Health Risks Predominate. (905780325): 1–38.

Von Hippel P. T. n.d. How Many Imputations Do You Need? A Two-Stage Calculation Using a Quadratic Rule. *Sociological Methods & Research* **2020**(3): 699–718.

Ho M.-T., La V.-P., Nguyen M.-H., Vuong T.-T., Nghiem K.-C. P., Tran T., Nguyen H.-K. T., Vuong Q.-H. 2019. Health Care, Medical Insurance, and Economic Destitution: A Dataset of 1042 Stories. *Data* **4**(57).

Hu H., Sawhney M., Shi L., Duan S., Yu Y., Wu Z., Qiu G., Dong H. 2015. A Systematic Review of the Direct Economic Burden of Type 2 Diabetes in China. *Diabetes Ther* **6**: 7–16.

Hung Y. W., He H., Mehmood A., Botchey I., Saidi H., Hyder A. A., Bachani A. M. 2017. Exploring Injury Severity Measures and In-Hospital Mortality: A Multi-Hospital Study in Kenya. *Injury* **48**(10): 2112–18.

Hussmanns R. 1993. *Defining and Measuring Informal Employment*. Geneva.

Hutchison C., Khan M. S., Yoong J., Lin X., Coker R. J. 2017. Financial Barriers and Coping Strategies: A Qualitative Study of Accessing Multidrug-Resistant Tuberculosis and Tuberculosis Care in Yunnan, China. *BMC Public Health* **17**(1): 1–11.

Hwang S. W., Li J., Gupta R., Chien V., Martin R. E. 2003. What Happens to Patients Who Leave Hospital against Medical Advice? *CMAJ* **168**(4): 417–20.

Ibrahim S. A., Kwoh C. K., Krishnan E. 2007. Factors Associated with Patients Who Leave Acute-Care Hospitals against Medical Advice. *American Journal of Public Health* **97**(12): 2204–8.

Imai K., King G., Stuart E. A. 2008. Misunderstandings between Experimentalists and Observationalists about Causal Inference. *Journal of the Royal Statistical Society: Series A (Statistics in Society)* **171**(2): 481–502.

Imbens G. W. 2004. Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review. *Review of Economics and Statistics* **86**(1): 4–29.

International Comparison Program. 2018. PPP Conversion Factor, Private Consumption (LCU per International $) . *World Development Indicators Database, World Bank / Eurostat-OECD PPP Programme.* Retrieved June 17, 2020 (https://data.worldbank.org/indicator/PA.NUS.PRVT.PP).

International Labour Organization (ILO). 1993. *Resolutions Concerning Statistics of Employment in the Informal Sector, Adopted by the 15th International Conference of Labour Statisticians*. New York.

Islam A., Maitra P. 2012. Health Shocks and Consumption Smoothing in Rural Households: Does Microcredit Have a Role to Play? *Journal of Development Economics* **97**(2): 232–43.

Jackson S., Sleigh A. C., Wang G. J., Liu X. L. 2006. Poverty and the Economic Effects of TB in Rural China. *International Journal of Tuberculosis and Lung Disease* **10**(10): 1104–10.

Jakobsen J. C., Gluud C., Wetterslev J., Winkel P. 2017. When and How Should Multiple Imputation Be Used for Handling Missing Data in Randomised Clinical Trials - A Practical Guide with Flowcharts.

BMC Medical Research Methodology **17**(1): 162–72.

Jalan J., Ravallion M. 1999. Are the Poor Less Well Insured? Evidence on Vulnerability to Income Risk in Rural China. *Journal of Development Economics* **58**(1): 61–81.

Jasperse N., Grigorian A., Delaplain P., Jutric Z., Schubl S. D., Kuza C. M., Nahmias J. 2020. Predictors of Discharge against Medical Advice in Adult Trauma Patients. *Surgeon* **18**(1): 12–18.

Jimoh B. M., Anthonia O. C., Chinwe I., Oluwafemi A., Ganiyu A., Haroun A., Chinwe E., Joshua A. 2015. Prospective Evaluation of Cases of Discharge against Medical Advice in Abuja, Nigeria. *Scientific World Journal* **2015**: 4–8.

Joe W. 2015. Distressed Financing of Household Out-of-Pocket Health Care Payments in India: Incidence and Correlates. *Health Policy and Planning* **30**(6): 728–41.

Johansson A., Hoa H. T., Lap N. T., Diwan V., Eriksson B. 1996. Population Policies and Reproductive Patterns in Vietnam. *Lancet* **347**(9014): 1529–32.

Jolliffe D. M., Prydz E. B. 2016. *Estimating International Poverty Lines from Comparable National Thresholds.* Washington, D.C.

Kanchanachitra C., Lindelow M., Johnston T., Hanvoravongchai P., Lorenzo F. M., Huong N. L., Wilopo S. A., dela Rosa J. F. 2011. Human Resources for Health in Southeast Asia: Shortages, Distributional Challenges, and International Trade in Health Services. *Lancet* **377**(9767): 769–81.

Kaonga O., Banda C., Masiyeid F. 2019. Hardship Financing of Out-of-Pocket Payments in the Context of Free Healthcare in Zambia. *PLOS ONE* **14**(4).

Khan F., Bedi A. S., Sparrow R. 2015. Sickness and Death: Economic Consequences and Coping Strategies of the Urban Poor in Bangladesh. *World Development* **72**(Supplement C): 255–66.

Kieu T. T. M., Trinh H. N., Pham H. T. K., Nguyen T. B., Ng J. Y. S. 2020. Direct Non-Medical and Indirect Costs of Diabetes and Its Associated Complications in Vietnam: An Estimation Using National Health Insurance Claims from a Cross-Sectional Survey. *BMJ Open* **10**(3).

Kim H., Colantonio A., Bayley M., Dawson D. 2011. Discharge against Medical Advice after Traumatic Brain Injury: Is Intentional Injury a Predictor? *Journal of Trauma - Injury, Infection and Critical Care* **71**(5): 1219–25.

Kraay A., Mckenzie D. 2014. Do Poverty Traps Exist? *Journal of Economic Perspectives* **28**(3): 127–48.

Krishna A. 2010. *One Illness Away : Why People Become Poor and How They Escape Poverty*. Oxford University Press.

Kruk M. Eo. in four households in forty developing countries resort to “hardship financing” to pay for health care, Goldmann E., Galea S. 2009. Borrowing And Selling To Pay For Health Care In Low-And Middle-Income Countries. *Health Affairs* **28**(4).

Kutzin J. 2013. Health Financing for Universal Coverage and Health System Performance: Concepts and Implications for Policy. *Bull World Health Organ* **91**(8): 602–11.

Kwan G. F., Yan L. D., Isaac B. D., Bhangdia K., Jean-Baptiste W., Belony D., Gururaj A., Martineau L., Vertilus S., Pierre-Louis D., Fenelon D. L., Hirschhorn L. R., Benjamin E. J., Bukhman G. 2020. High Poverty and Hardship Financing among Patients with Noncommunicable Diseases in Rural Haiti. *Global Heart* **15**(1).

Lawson D., Kasirye I. 2013. How the Extreme Poor Cope with Crises: Understanding the Role of Assets and Consumption. *Journal of International Development* **25**(8): 1129–43.

Le Q. N., Blizzard L., Si L., Giang L. T., Neil A. L. 2020. The Evolution of Social Health Insurance in Vietnam and Its Role towards Achieving Universal Health Coverage. *Health Policy OPEN* **1**: 100011.

Lee C. A., Cho J. P., Choi S. C., Kim H. H., Park J. O. 2016. Patients Who Leave the Emergency Department against Medical Advice. *Clinical and Experimental Emergency Medicine* **3**(2): 88–94.

Leive A., Xu K. 2008. Coping with Out-of-Pocket Health Payments: Empirical Evidence from 15 African Countries. *Bulletin of the World Health Organization* **86**(11): 849–56.

Lieberman S., Wagstaff A. 2009. *Health Financing and Delivery in Vietnam: Looking Forward*. Washington, DC.

Liljas B. 1998. How to Calculate Indirect Costs in Economic Evaluations. *PharmacoEconomics* **13**(1 PART I): 1–7.

London J. D. 2013. The Promises and Perils of Hospital Autonomy. Reform by Decree in Viet Nam. *Social Science and Medicine* **96**: 232–40.

Madley-dowd P., Hughes R., Tilling K., Heron J. 2019. The Proportion of Missing Data Should Not Be Used to Guide Decisions on Multiple Imputation. *Journal of Clinical Epidemiology* **110**: 63–73.

Mahajan R. K., Gautam P. L., Paul G., Mahajan R. 2019. Retrospective Evaluation of Patients Leaving against Medical Advice in a Tertiary Care Teaching Hospital. *Indian Journal of Critical Care Medicine* **23**(3): 150–53.

Menendez M. E., van Dijk C. N., Ring D. 2015. Who Leaves the Hospital Against Medical Advice in the Orthopaedic Setting? *Clinical Orthopaedics and Related Research* **473**(3): 1140–49.

Ministry of Labor, Invalids and Social Affairs (MOLISA),. 2015. Poverty Reduction Still Has Many Challenges. February 7.

Mitra S., Palmer M., Mont D., Groce N. 2016. Can Households Cope with Health Shocks in Vietnam? *Health Economics (United Kingdom)* **25**(7): 888–907.

Mock C. N., Gloyd S., Adjei S., Acheampong F., Gish O. 2003. Economic Consequences of Injury and Resulting Family Coping Strategies in Ghana. *Accident Analysis and Prevention* **35**(1): 81–90.

Mohanan M. 2013. Causal Effects of Health Shocks on Consumption and Debt: Quasi-Experimental Evidence from Bus Accident Injuries. *Review of Economics and Statistics* **95**(2): 673–81.

Mohseni M., Alikhani M., Tourani S., Azami-Aghdash S., Royani S., Moradi-Joo M. 2015. Rate and Causes of Discharge against Medical Advice in Iranian Hospitals: A Systematic Review and Meta-Analysis. *Iranian Journal of Public Health* **44**(7): 902–12.

Morduch J. 1994. Poverty and Vulnerability. *The American Economic Review* **84**(2): 221–25.

Morduch J. 1995. Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives* **9**: 103–14.

Morduch J., Kamanou G. 2005. Measuring Vulnerability to Poverty. in *Insurance Against Poverty*.

Morrow M., Nguyen Q. A., Caruana S., Biggs B. A., Doan N. H., Nong T. T. 2009. Pathways to Malaria Persistence in Remote Central Vietnam: A Mixed-Method Study of Health Care and the Community. *BMC Public Health* **9**(1): 85.

Morudu P., Kollamparambil U. 2020. Health Shocks, Medical Insurance and Household Vulnerability: Evidence from South Africa. *PLoS ONE* **15**(2).

Naderi S., Acerra J. R., Bailey K., Mukherji P., Taraphdar T., Mukherjee T., Pal A., Ward M. F., Miele K., Mathias M., Tan R., Kline M., Alagappan K., Silverman R. 2014. *Patients in a Private Hospital in India Leave the Emergency Department against Medical Advice for Financial Reasons*.

Nagarajan M., Offurum A. I., Gulati M., Onukwugha E. 2018. Discharges Against Medical Advice: Prevalence, Predictors, and Populations. Pp. 11–29 in *Alfandre D., ed. 2018. Against-Medical-*

Advice Discharges from the Hospital: Optimizing Prevention and Management to Promote High Quality, Patient-Centered Care. New York, NY: Springer., edited by D. Alfandre. New York, NY: Springer.

Narloch U. 2016. *The Varying Income Effects of Weather Variation: Initial Insights from Rural Vietnam*. Washington, DC: The World Bank.

Nasir A. A., Babalola O. M. 2008. Clinical Spectrum of Discharges against Medical Advice in a Developing Country. *Indian Journal of Surgery* **70**(2): 68–72.

National Assembly of the Socialist Republic of Vietnam. 2014. *Vietnamese Law on Health Insurance of 2014*. Government of Vietnam; Hanoi, Vietnam.

Neelsen S., Limwattananon S., van Doorslaer E., World Bank T. 2019. Universal Health Coverage: A (Social Insurance) Job Half Done? *World Development* **113**: 246–58.

Nguyen G. T. H., White B., Ma C. 2008. When Faced with Income and Asset Shocks, Do Poor Rural Households in Vietnam Smooth Food Consumption or Assets? *The Journal of Development Studies* **55**(9).

Nguyen H, Ivers R., Jan S., Martiniuk A., Pham C. 2013. Catastrophic Household Costs Due to Injury in Vietnam. *Injury* **44**(5): 684–90.

Nguyen H., Ivers R., Jan S., Pham C. 2017. Analysis of Out-of-Pocket Costs Associated with Hospitalised Injuries in Vietnam. *BMJ Glob Health* **2**(1): e000082.

Nguyen Ha, Ivers R. Q., Jan S., Martiniuk A. L. C., Li Q., Pham C. 2013. The Economic Burden of Road Traffic Injuries: Evidence from a Provincial General Hospital in Vietnam. *Injury Prevention* **19**: 79–84.

Nguyen K. T., Hai Khuat O. T., Ma S., Pham D. C., Hong Khuat G. T., Ruger J. P. 2012. Coping with Health Care Expenses among Poor Households: Evidence from a Rural Commune in Vietnam. *Social Science and Medicine* **74**(5): 724–33.

Nguyen N. N., O'keefe P. 2019. *A Vision for the 2030 Social Protection System in Vietnam* . New York.

Nguyen T., Collins G. S., Spence J., Daurès J.-P., Devereaux P. J., Landais P., Le Manach Y. 2017. Double-Adjustment in Propensity Score Matching Analysis: Choosing a Threshold for Considering Residual Imbalance. *BMC Medical Research Methodology* **17**(78): 1–8.

Nguyen T. T., Trevisan M. 2020. Vietnam a Country in Transition: Health Challenges. *BMJ Nutrition, Prevention & Health* **3**(1): bmjnph-2020-000069.

Nguyen Thanh Tung, Nguyen Trung Thanh, Grote U. 2020. Multiple Shocks and Households' Choice of Coping Strategies in Rural Cambodia. *Ecological Economics* **167**(August 2019): 106442.

Nguyen X. T., Hoang M. H., Nguyen T. K. C., Byass P., Lindholm L. 2005. Does Poverty Lead to Non-Fatal Unintentional Injuries in Rural Vietnam? *International Journal of Injury Control and Safety Promotion* **12**(1): 31–37.

Noritomo Y., Takahashi K. 2020. Can Insurance Payouts Prevent a Poverty Trap? Evidence from Randomised Experiments in Northern Kenya. *Journal of Development Studies* **56**(11): 2079–96.

O'Donnell O., van Doorslaer E., Wagstaff A., Lindelow M. 2008a. Catastrophic Payments for Health Care. Pp. 203–12 in *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation*. Washington, DC.

O'Donnell O., van Doorslaer E., Wagstaff A., Lindelow M. 2008b. Measurement of Living Standards. Pp. 69–82 in *Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation*. Washington, D.C.

Oanh T. T. M., Thi Phuong H. 2016. *Strategic Purchasing for Universal Health Coverage: A Critical Assessment of Social Health Insurance Fund, Vietnam*. Hanoi.

Olufajo O. A., Metcalfe D., Yorkgitis B. K., Cooper Z., Askari R., Havens J. M., Brat G. A., Haider A. H., Salim A. 2016. Whatever Happens to Trauma Patients Who Leave against Medical Advice? *American Journal of Surgery* **211**(4): 677–83.

Onukwugha E., Saunders E., Mullins C. D., Pradel F. G., Zuckerman M., Loh F. E., Weir M. R. 2012. A Qualitative Study to Identify Reasons for Discharges against Medical Advice in the Cardiovascular Setting. *BMJ Open* (2).

Pan W., Bai H. 2015. Propensity Score Interval Matching: Using Bootstrap Confidence Intervals for Accommodating Estimation Errors of Propensity Scores. *BMC Medical Research Methodology* **15**(53).

Perera M., Gunatilleke G., Bird P. 2007. Falling into the Medical Poverty Trap in Sri Lanka: What Can Be Done? *International Journal of Health Services* **37**(2): 379–98.

Peters D. H., Yazbeck A. S., Sharma R. R., Ramana G. N. V, Pritchett L. H., Wagstaff A. 2002. *Better Health Systems for India's Poor : Findings, Analysis, and Options*. Washington, D.C.: The World Bank Group.

Phan D. N., Coxhead I. 2016. Rural-Urban Migration and Remittances in Vietnam: Evidence from Migrant Tracer Data. *SSRN Electronic Journal*.

PovcalNet. n.d. CPI--Consumer Price Index. Base Year 2011. *The World Bank Group*. Retrieved June 17, 2020 (http://iresearch.worldbank.org/PovcalNet/data.aspx).

Prinja S., Jagnoor J., Chauhan A. S., Aggarwal S., Nguyen H., Ivers R. 2016. Economic Burden of Hospitalization Due to Injuries in North India: A Cohort Study. *International Journal of*

Environmental Research and Public Health **13**(7): 673–87.

Pritchett L. 2000. Quantifying Vulnerability to Poverty : A Proposed Measure, Applied to Indonesia edited by S. Sumarto and A. Suryahadi.

Quintussi M., Van De Poel E., Panda P., Rutten F. 2015. Economic Consequences of Ill-Health for Households in Northern Rural India. *BMC Health Services Research* **15**(1).

Rabe-Hesketh S., Skrondal A. 2008a. Dichomous or Binary Responses. Pp. 501–74 in *Multilevel and Longitudinal Modeling using Stata2*. College Station, TX: Stata Press Publication.

Rabe-Hesketh S., Skrondal A. 2008b. Lagged-Response or Dynamic Models. Pp. 269–72 in *Multilevel and Longitudinal Modeling using Stata*. College Station, TX: Stata Press Publication.

Ramakrishnan N., Ranganathan L., Abraham B., Rajagopalan S., Venkataraman R. 2018. What Happens to Patients Discharged against Medical Advice? *Indian Journal of Critical Care Medicine* **22**(8): 580–84.

Rassen J. A., Glynn R. J., Rothman K. J., Setoguchi S., Schneeweiss S. 2012. Applying Propensity Scores Estimated in a Full Cohort to Adjust for Confounding in Subgroup Analyses. *Pharmacoepidemiol Drug Saf* **21**(7): 697–709.

Razavi S., Behrendt C., Bierbaum M., Orton I., Tessier L. 2020. Reinvigorating the Social Contract and Strengthening Social Cohesion: Social Protection Responses to COVID-19. *International Social Security Review* **73**(3): 55–80.

Royston P., White I. R. 2011. Multiple Imputation by Chained Equations (MICE): Implementation in Stata. *Journal of Statistical Software* **45**(4): 1–20.

Rubin D. B. 1973. The Use of Matched Sampling and Regression Adjustment to Remove Bias in

Observational Studies. *Biometrics* **29**(1): 185–203.

Rubin D. B. 1979. Using Multivariate Matched Sampling and Regression Adjustment to Control Bias in Observational Studies. *Journal of the American Statistical Association* **74**(366): 318–28.

Rubin D. B., Thomas N. 2000. Combining Propensity Score Matching with Additional Adjustments for Prognostic Covariates. *Journal of the American Statistical Association* **95**(450): 573–85.

Sangar S., Dutt V., Thakur R. 2019a. Coping with Out-of-Pocket Health Expenditure in India: Evidence from NSS 71st Round. *Global Social Welfare* (2015).

Sangar S., Dutt V., Thakur R. 2019b. Distress Financing of Out-of-Pocket Health Expenditure in India. *Review of Development Economics* **23**(1): 314–30.

Sangar S., Dutt V., Thakur R. 2019c. Economic Burden, Impoverishment, and Coping Mechanisms Associated with out-of-Pocket Health Expenditure in India: A Disaggregated Analysis at the State Level. *International Journal of Health Planning and Management* **34**(1): e301–13.

Segui-Gomez M., Lopez-Valdes F. J. 2012. Injury Severity Scaling. Pp. 281–96 in *Injury Research: Theories, Methods, and Approaches*, edited by G. Li and S. Baker. New York: Springer.

Sen A. 1988. *Poverty and Famines : An Essay on Entitlement and Deprivation*. New York: Oxford University Press.

Sepehri A. 2014. Does Autonomization of Public Hospitals and Exposure to Market Pressure Complement or Debilitate Social Health Insurance Systems? Evidence from a Low-Income Country. *International Journal of Health Services* **44**(1): 73–92.

Sepehri A., Vu P. H. 2019. Severe Injuries and Household Catastrophic Health Expenditure in Vietnam: Findings from the Household Living Standard Survey 2014. *Public Health* **174**(204): 145–53.

Sipahimalani-Rao V. 2006. *Income Volatility and Social Protection in Developing Asia*. Manila.

Somanathan A., Dao H. L., Tien T. Van. 2013. *Integrating the Poor into Universal Health Coverage in Vietnam*. World Bank, Washington DC.

Somanathan A., Tandon A., Dao H. L., Hurt K. L., Fuenzalida-Puelma H. L. 2014. *Moving towards Universal Health Coverage of Social Health Insurance in Vietnam: Assessment and Options.Directions in Development.* Washington, D.C.: The World Bank Group.

Southern W. N., Nahvi S., Arnsten J. H. 2012. Increased Risk of Mortality and Readmission among Patients Discharged Against Medical Advice. *American Journal of Medicine* **125**(6): 594–602.

Sparrow R., de Poel E. Van, Hadiwidjaja G., Yumna A., Warda N., Suryahadi A. 2014. Coping with the Economic Consequences of Ill Health in Indonesia. *Health Economics* **23**(6): 719–28.

Spooner K. K., Salemi J. L., Salihu H. M., Zoorob R. J. 2017. Discharge Against Medical Advice in the United. *Mayo Clin Proc* **92**(4): 525–35.

StataCorp. 2017. Stata Statistical Software: Release 15.

Steinglass P., Grantham C. E., Hertzman M. 1980. *Predicting Which Patients Will Be Discharged Against Medical Advice: A Pilot Study*.

Strauss J., Thomas D. 1995. Human Resources: Empirical Modeling of Household And Family Decisions. *Handbook of Development Economics* **III**.

Stuart E. A., Lee B. K., Leacy F. P. 2013. Prognostic Score–Based Balance Measures for Propensity Score Methods in Comparative Effectiveness Research. *Journal of Clinical Epidemiology* **66**(8 SUPPL): S84–90.

Tahsina T., Ali N. B., Siddique A. B., Ahmed S., Rahman Mubashshira, Islam S., Rahman Mezanur, Amena

B., Emdadul Hoque D. M., Huda T. M., Arifeen S. El. 2018. Determinants of Hardship Financing in Coping with out of Pocket Payment for Care Seeking of under Five Children in Selected Rural Areas of Bangladesh. *PLoS ONE* **13**(5): 1–17.

Tawk R., Freels S., Mullner R. 2013. Associations of Mental, and Medical Illnesses with Against Medical Advice Discharges: The National Hospital Discharge Survey, 1988-2006. *Administration and Policy in Mental Health and Mental Health Services Research* **40**(2): 124–32.

Teo H. S., Bales S., Bredenkamp C., Cain J. S. 2019. *The Future of Health Financing in Vietnam: Ensuring Sufficiency, Efficiency, and Sustainability*. New York.

Thanh N. X., Hang H. M., Chuc N. T. K., Rudholm N., Emmelin A., Lindholm L. 2006. Does "the Injury Poverty Trap" Exist?: A Longitudinal Study in Bavi, Vietnam. *Health Policy* **78**(2): 249–57.

Thanh N. X., Tran B. X., Waye A., Harstall C., Lindholm L. 2014. "Socialization of Health Care" in Vietnam: What Is It and What Are Its Pros and Cons? *Value in Health Regional Issues* **3**(1): 24–26.

The Economist. 2018. Vietnam Is Getting Old before It Gets Rich. *The Economist*.

The World Bank. 2017. Moving toward UHC : Vietnam - National Initiatives, Key Challenges, and the Role of Collaborative Activities. 1–9.

The World Bank. 2021. Vietnam Country Context: Overview. Retrieved (https://www.worldbank.org/en/country/vietnam/overview#1).

Thuong N. T. T., Huy T. Q., Tai D. A., Kien T. N. 2020. Impact of Health Insurance on Health Care Utilisation and Out-of-Pocket Health Expenditure in Vietnam. *BioMed Research International* **2020**.

Tran T. M. O., Tran V. T., Duong H. L., Khuong A. T., Nguyen K. P., Le Q. C., Taye A., Kombe G., Helfenbein S. 2009. *Assessing Provincial Health Systems in Vietnam: Lessons from Two Provinces*. Bethesda, MD.

Tran V. Q. 2015. Household's Coping Strategies and Recoveries from Shocks in Vietnam. *Quarterly Review of Economics and Finance* **56**: 15–29.

Tran Van Tien by, Thi Phuong H., Mathauer I., Thi Kim Phuong N. 2011. *A Health Financing Review of Viet Nam with a Focus on Social Health Insurance: Bottlenecks in Institutional Design and Organizational Practice of Health Financing and Options to Accelerate Progress towards Universal Coverage*.

United Nations Joint Sustainable Development Goals Fund. 2020. Towards Inclusive and Integrated Social Protection to Leave No One Behind in Viet Nam. Retrieved (https://jointsdgfund.org/article/towards-inclusive-and-integrated-social-protection-leave-no-one-behind-viet-nam).

Üstün T., Kostanjsek N., Chatterji S., Rehm J., eds. 2010. *Measuring Health and Disability: Manual for WHO Disability Assessment Schedule (WHODAS 2.0 WHO Library Cataloguing-in-Publication Data Measuring Health and Disability: Manual for WHO Disability Assessment Schedule (WHODAS 2.0)* . Malta: World Health Organization.

Vian T., Brinkerhoff D. W., Feeley F. G., Salomon M., Vien N. T. K. 2012. Confronting Corruption in the Health Sector in Vietnam: Patterns and Prospects. *Public Administration and Development* **32**(1): 49–63.

Vietnam Ministry of Health, Institute H. S. and P., Bank W., Organization W. H. 2011. *Lessons for Hospital Autonomy: Implementation in Vietnam from International Experience*. Washington, DC: World Bank, Washington, DC.

Vuong Q. H. 2015. Be Rich or Don't Be Sick: Estimating Vietnamese Patients' Risk of Falling into

Destitution. *SpringerPlus* **4**(1): 529.

Wagstaff A. 2005. *The Economic Consequences of Health Shocks*. Washington, DC: The World Bank.

Wagstaff A. 2007. The Economic Consequences of Health Shocks: Evidence from Vietnam. *Journal of Health Economics* **26**(1): 82–100.

Wagstaff A., Lindelow M. 2014. Are Health Shocks Different? Evidence from a Multishock Survey in Laos. *Health Economics (United Kingdom)* **23**(6): 706–18.

Wesson H. K. H., Boikhutso N., Bachani A. M., Hofman K. J., Hyder A. A. 2013. The Cost of Injury and Trauma Care in Low-and Middle-Income Countries: A Review of Economic Evidence. *Health Policy and Planning* **29**: 795–808.

White H., Masset E. 2003. The Importance of Household Size and Composition in Constructing Poverty Profiles: An Illustration from Vietnam. *Development and Change* **34**(1): 105–26.

White I. R., Daniel R., Royston P. 2010. Avoiding Bias Due to Perfect Prediction in Multiple Imputation of Incomplete Categorical Variables. *Computational Statistics and Data Analysis* **54**(10): 2267–75.

White I. R., Royston P., Wood A. M. 2011. Multiple Imputation Using Chained Equations: Issues and Guidance for Practice. *Statistics in Medicine* **30**(4): 377–99.

WHO. 2009. *Guide to Identifying the Economic Consequences of Disease and Injury*. Geneva.

WHO. 2015. *Tracking Universal Health Coverage: First Global Monitoring Report*. Geneva.

World Bank Group. 2019. *Poverty & Equity Brief: Vietnam*. Washington, DC.

World Bank Group. 2020. *Poverty & Equity Brief: East Asia and Pacific*. Washington, DC.

World Health Organization. 2015. Vietnam Country Cooperation Strategy - At A Glance. *Global Health Observatory* (April).

World Health Organization. 2020. Global Health Expenditure Database. Retrieved (http://apps.who.int/nha/database/ViewData/Indicators/en).

Yadav J., John D., Menon G. R., Allarakha S. 2021. Out-of-Pocket Payments for Delivery Care in India: Do Households Face Hardship Financing? *Journal of Health Management* **23**(2): 197–225.

Young R., Johnson D. R. 2015. Handling Missing Values in Longitudinal Panel Data With Multiple Imputation. *Journal of Marriage and Family* **77**(1): 277–94.

Zimmerman F. J., Carter M. R. 2003. Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints. *Journal of Development Economics* **71**: 233–60.