

# Property claims on antibiotic effectiveness

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## **“Property claims on antibiotic effectiveness”**

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**Abstract:** The scope and type of property rights recognized over the effectiveness of antibiotics has a direct effect on how those claiming ownership engage in the exploitation and stewardship of this scarce resource. We examine the different property claims and rights the four major interest groups are asserting on antibiotics: (i) the inventors, (ii) those demanding that the resource be treated like any other transferable commodity, (iii) those advocating usage restrictions based on good stewardship principles and (iv) those considering the resource as common heritage of humankind.

**Keywords:** intellectual property rights, microbial resistance, common heritage, stewardship

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# Property claims on antibiotic effectiveness

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## Introduction

The discovery of the antibiotic properties of the fungus *penicillium* by Alexander Fleming in 1928 was first seen as the beginning of the end of infectious diseases. Yet the enthusiasm was short lived, as it took less than two decades to find the first bacteria that were resistant to Fleming's discovery (Fox 2011). The use of antibiotics in inadequate doses and for wrong purposes, such as using them to treat viral diseases, were seen as major factors contributing to antibiotic resistance from early on (Viens and Littmann 2015). Nowadays, it is widely recognized that antibiotic resistance poses a severe threat to global health (WHO 2014). To slow down antibiotic resistance, we need to implement policies and expand health education at a global level to make sure people use antibiotics following best practices (Rogers Van Katwyk, Weldon, *et al.* 2020). To achieve this goal, we face multiple obstacles. One of the problems is that usage restrictions clash with conventional understanding of what property rights entitle people to do. The aim of this article is to provide a better understanding of how to assess the different private and public interests claims on this scarce resource.

The good we want to maintain in the most socially just manner is antibiotic effectiveness, and we here understand this resource as "a measurable commodity that represents the stock of remaining doses of antibiotics that can be used to effectively target bacterial infections" (Littmann 2014). Extending the useful life of antibiotics is a wicked problem in the sense that there are multiple variables that all need to be considered to incentivize responsible use. First, antibiotic resistance can be reduced by using antibiotics only for severe cases, by following medical indication in view of responsible stewardship. Nonetheless, a certain rate of growing antibiotic resistance is unavoidable even after following best practices. Second, it is unclear whether we are tapping from a limited pool of possible antibiotic substances, or if future developments would be exponentially costlier (Hey and Kesselheim 2017). Third, as a scarce resource, the unrestrained exploitation of antibiotic effectiveness creates conflicts for distributive justice (Millar 2011; Wilson 2013). Low prices may lead to overuse (Hollis and Maybarduk 2015) and high prices may hinder the ability of

poor people to comply with medically indicated treatment (Selgelid 2007), both are outcomes with negative effects for conservation and justice. Fourth, the main incentive mechanisms to develop new antibiotics is to grant developers exclusive rights, predominantly in the form of patents. Inventors have a legitimate expectation to exploit their patents and therefore public interests claims need to be well-supported to limit innovators' exclusive rights.

A major difficulty for conserving antibiotic effectiveness is that it involves a so-called tragedy of commons problem. While the non-essential use of antibiotics causes relatively few problems to the individual, the cost of lost effectiveness of antibiotics is assumed by society at large and future generations (Rogers Van Katwyk, Giubilini, *et al.* 2020). Commercial entities who produce and sell antibiotics generally have a financial incentive to overprescribe antibiotics, while hardly being negatively affected by such practices in countries without strict regulations. Producers may even gain financially by selling more antibiotics than therapeutically necessary when patents are about to expire. These problems make it mandatory to examine how free individuals and institutions are to commercially exploit the antibiotics they control.

As long as antibiotics are treated as a tradable commodity, we need to gain clarity on what property rights entitle to and what they do not. We start our examination by distinguishing the different rights property titles recognize, and mapping the justifications used by the different ownership claimants. Then we examine the claims by the inventor, those demanding antibiotics as transferable assets, those making the exploitation of this resource subject to specific conditions, and those considering the resource as common heritage of humankind.

### **The different sub-rights within property rights**

In the case of intellectual property on antibiotics, we have to draw a distinction between ownership of (1) the non-rivalrous consumption of the knowledge to make the compound, and (2) rivalrous consumption of the antibiotic effectiveness of the compound. The knowledge related to the process of making the compound will remain unaffected as more people learn how to replicate the invention. We will continue to be able to produce the compound. The resulting compounds however, will become therapeutically less valuable as more people use it and microbial resistance develops. The effective doses of an antibiotic are limited, and since future demand is likely to exceed overall availability, they are also scarce resources (Kades 2005). Here we need to underline that access to the intangible benefits of a resource does not imply a right to access the material benefits of another resource (Kinsella 2001). The reason why it is crucial to draw such distinctions, is that since the origins of patents in the late 15<sup>th</sup> century, exclusive rights are of temporary nature (May 2007). Society recognizes temporary exclusivity in view of having knowledge on the invention added to the public domain after the period of exclusivity expires. The disclosure of the knowledge related to the invention is deemed useful, hence the term patent bargain, signalling a common agreement that mutually benefits both public and private interests (Moore 2012; Liivak and Peñalver 2013). Antibiotic effectiveness is a resource of rivalrous consumption and therefore the knowledge on the antibiotic nature of the active ingredient loses its social value as bacterial resistance develops. As a consequence, inventors take most benefits from temporary exclusivity while society gains knowledge of decreased or little social utility after the period of exclusivity elapses (Outterson 2005, Timmermann 2015).

As antibiotics are exhaustible resources, we need to gain a better insight on who (if anyone) owns antibiotic effectiveness and what obligations and rights are associated with such property. While there is a strong debate on the duties one may assign to property rights

holders, the most widely accepted constraint is that owning an object does not entitle to harm others with it (Shoked 2014, Moore 1997). This minimum obligation is already difficult to address when using antibiotics. The largescale use of antibiotics causes genetic pollution, which may cause harm to others (Anomaly 2010).

Prominent within property theory is to claim that property consists in a so-called “bundle of rights” (Honoré 1961). Among the identified incidents that constitute ownership, we can name the following as of special concern for this examination: “the right to use”, “the right to manage”, “the right to derive income”, “the right to alienate” and “the right to destroy” (cf. Honoré 1961; Ostrom 2003; Faraci and Jaworski 2014). We will show that the different ownership claims by the different interest groups only justify some of these rights, but not the others. To do so, we will examine the different ownership claims by the inventor, interested private parties and humankind.

### **Benefiting from one’s labour in seeking an antibiotic substance**

In both political theory and law, the most-developed claims on property rights over a resource are associated with the inventor. Invention involves work and there is a strong tradition that claims that we are entitled to the fruits of our labour (Locke 1689/1960). This reasoning does not come without problems. First, one may question from a moral and scientific perspective in how far antibiotics are really invented and not merely discovered. Bringing an asset into existence brings in other kinds of normative claims than “merely” discovering it (Moore 1997), although recognizing the potential social value of a discovery requires considerable training – involving previous effort (Cwik 2014). As a second issue, comes the problem of the social character of scientific innovation. As a collective endeavour, innovation builds up on the previous work of others and relies on the existence of a series of public institutions and public goods (Hettinger 1989). Inventions in today’s world rarely emerge from individual genius, but are part of a collective enterprise, and patents are generally owned and managed by companies (Dutfield 2013). This makes it much more difficult to give due credit for authorship to those who played a significant role in the development. The patent system is a winner-takes-all system – an inventor coming up with the same invention independently a day after the patent was filed receives no benefits (Nozick 1974). Not only effort is rewarded, but to a considerable extent, and especially in highly competitive areas, also luck.

The most prominent justifications for intellectual property are based on rights-based reasoning, arguing that inventors are entitled to a fair reward, and utilitarian arguments, claiming that we need exclusive rights to stimulate innovation which ultimately benefit society as a whole. We proceed discussing these two justifications in turn.

#### *Rights-based arguments*

Rights-based arguments have been used to assert claims on various levels, ranging from very strong claims, such as a right to intellectual property, to the less demanding rights to the economic interests over an invention, and to the weaker claims on deserving to benefit from the fruits of one’s labour. A central purpose of property titles is to allow the inventor to benefit from the fruits of her labour, or to put it in the words of the Universal Declaration of Human Rights (1948), assist in the “protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author” (art. 27.2). Property titles facilitate the legitimate exploitation of an invention.

Weaker claims on economic interests are formulated around notions of desert. Based on principles of fairness, we can argue that if society welcomes work on antibiotic research and draws a substantial benefit from this effort, those engaged in this enterprise should be entitled to some type of return for their contribution. Desert does not necessarily entitle to the product (antibiotic effectiveness); under this perspective the demands of justice are also met when an adequate trade-off is offered. An exclusive right over antibiotic effectiveness is just one of the many possibilities one could think of as a fair reward (Outterson 2014). In this context, it is important to be aware that exclusive rights do not necessarily lead to sales revenues large enough to sum up to a fair reward.<sup>i</sup> The value of exclusive rights as an emblem for recognition of efforts only reflects market demand, which may be very distinct to social demand – an issue scholars working on access to medicines and neglected diseases have discussed at great length (Hassoun 2020). Under ideal conditions the size of the reward innovators deserve would be aligned to the social utility of the contribution. In the real world, any correlation between complexity and social utility is accidental. We may recall that perhaps the single most important “invention” to prevent bacterial infections is handwashing.

The inventor is said to have a strong property claim on the fruits of innovative research, since she mixed considerable labour – something she owns as it originates from her body and mind – over a previously unowned resource (i.e. a compound that has antibiotic characteristics). This reasoning borrows from John Locke’s theory on material property and translates it into the realm of intangibles. In this theory, built on reflections related to land improvements, mixing labour over something previously unowned entitles ownership (Drahos 1996). Appropriation under a Lockean doctrine is however subject to three further provisos. There needs to be “enough, and as good, left in common for others”, enclosure is subject to “non-wastage” and the most disputed proviso arguing for charity, which should allow others to meet their subsistence needs (Widerquist 2010).

The first Lockean proviso, requiring that the object has no previous owner, is often not relevant for intellectual property. Inventions are seen as creations of the mind, the inventor mixes labour with something intangible (i.e. ideas) without diminishing them (Child 1990). Different is the case for patents that involve tangible components, such as genes and antibiotic compounds (cf. Safrin 2004). Here the inventor takes first possession of a resource others have competing claims due to their uniqueness. This has major implications for the management of antibiotic substances. As Jeremy Waldron (2003) keenly notes “refusing to modify a holding based on First Occupancy in response to demographic or other changes in circumstances is an injustice”. By filing a patent on an antibiotic substance, one appeals to the First Occupancy principle – an act of claiming something as property that was previously unowned. According to the Lockean tradition one does not harm others by being the first to occupy a resource, making everyone’s consent mandatory would make it impossible to claim ownership thus leaving assets unimproved.<sup>ii</sup> However the First Occupancy principle still allows to condemn owners for careless stewardship of their property. Use that does not lead to improvements makes it more difficult for newcomers to recognize the multiple benefits of prior property arrangements (cf. Schmidtz 2002).

Most representatives of this tradition have worried about ascertaining limitations on continuous appropriation only after an overwhelming proportion of the resource in question has already been seized.<sup>iii</sup> Ownership is something that is generally welcomed, as it is believed that property rights motivate people to conserve and improve the owned resources (Soto 2000). The Lockean tradition generally assumes that property owners have a stark incentive to further improve their owned assets and thus create additional riches that will come to everyone’s benefit (Strauss 1952). Conservation is important, but difficult to justify on Lockean

grounds, since the estate (i.e. antibiotic effectiveness) cannot be improved (or even maintained) by the very act that justifies entitlement: labour. The evolutionary arms race against nature has to be continuously fought by discovering new active ingredients (Outterson 2005). While good management can reduce the rate at which antibiotic resistance develops, it cannot completely halt it (Ponce de León-Rosales *et al.* 2015).

Moreover, while long-term ownership (i.e. extended patent terms) may create an incentive for good stewardship, it is disputed whether such arrangements respect the “enough and as good” proviso. Exclusive ownership may have little benefits for those who are excluded, in particular for the global poor and future generations. Temporary exclusivity and competitive markets create the incentive to exploit antibiotic effectiveness as much as possible during the period of exclusivity (So *et al.* 2012). Especially when acquiring ownership over an antibiotic substance that does not leave *enough and as good* alternatives, exclusive rights lead to the most lucrative profits. Another line of argument claims that we should not focus on the abuses of individual property holders, but judge the property system as an institution. When we give full credit to the institution of property, we realize that it encourages making substantial investments in improving assets leading to multiple advantages that benefit far more people than the original owners (Schmidtz 1994). While some may end up without *enough* of a particular antibiotic, technological development facilitated by property rights provides *enough and as good* in the form of better diagnostic tools and new treatments.

As knowledge itself does not spoil, few have discussed the non-wastage proviso in relation to intellectual property (Hull 2009). One interpretation sees wastage as underuse, for example when “wasting” opportunities to help the global poor by impeding wider access to medicines (Sterckx 2005). At the very least, the non-wastage proviso applied to antibiotics would require to refrain from inadequate uses (e.g. for viral infections). A broader interpretation could even require to abstain from suboptimal uses, such as a growth enhancer for livestock.

Although without reference to a Lockean charity proviso, intellectual property law reserves a provision that allows governments to seek compulsory licenses of inventions to address urgent public health needs when no reasonable agreement can be sought.<sup>iv</sup> Public health interests limit the patent holders’ ability to maximize rent-seeking. In the specific case of antibiotics, the charity proviso allows non-owners to claim access to the enclosed good when this is essential to meet subsistence needs.

### *Incentives to innovate and market*

Perhaps the most widely asserted advantage of intellectual property rights in law and economics is their role as incentives. It is claimed that inventors will not engage in intellectual work, spending scarce resources if it would not be for the opportunity to recoup research and development costs and to gain some profits by making use of exclusive rights. Applied to antibiotics: researchers would not develop new medicines if they are not entitled to harvest the benefits of owning antibiotic effectiveness. In today’s world, the wide use and enforcement of patents has created the legitimate expectation among patent holders that they can exploit their invention as long as they abide by established rules. To make sure people are confident in investing in research, particularly economists argue that governments should not change regulations that may negatively affect the plans of innovators. But here and in other cases, creating an adequate incentive does not necessarily have to be linked to the product itself: any sufficiently large prize may serve as an effective incentive (for a number of alternative proposals, see Outterson 2014). The main hurdle for inventors is to get funding for research and development costs; the fact that others may benefit from their intellectual work may even

function as an incentive if we assume a minimum level of altruism (Wilson 2010). We need to recall that penicillin itself was refined without relying on patents (Quinn 2013).

A major problem of using intellectual property as an incentive is that the highest financial rewards innovators may harvest may not be in areas that would benefit the public the most. Markets direct research attention towards the richest markets, thereby underserving the interests of the poor and prioritizing therapeutic over preventive measures (Reiss and Kitcher 2009). Therefore, an alternate reward system that compensates inventors through prizes that are proportional to their health impact could work as a much better proxy to redeem effort in relation to social utility (Outterson *et al.* 2011). Here it needs to be noted that some public health efforts are more tedious than complex, but nevertheless have an enormous social utility. For example, if our goal is to improve public health, on a global level we may have more impact by focussing on sewage systems rather than biotechnology (Mackenbach 2007). It is however easier to patent inventions in the latter field than in the former.

Incentive arguments allow exceptions from patentability. Society may prohibit mixing labour with the object at stake or agree on not awarding property titles over modifications. These limitations are generally known in advance. In other cases, common sense would suggest that such prohibitions would follow by analogy, comparing other moral or legal prohibitions (especially under common law systems). It also has happened that lawmakers decide to prohibit ownership after an increased awareness of the negative effects.

Recognizing temporary exclusive rights as a tool to incentivize the disclosure of private knowledge would undermine its social purpose if we simultaneously concede a right to destroy. Destruction has the same effect as permanent exclusion (Goodin 1990). It is feared that we are drawing from a finite pool of antibiotic substances (Outterson 2005). In this scenario, if someone contributes significantly to the destruction of antibiotic effectiveness, it would leave others worse off, as another more responsible person could have developed the same antibiotic at a later stage. In case the reservoir of possible alternatives to develop antibiotics is endless, the scenario is different, as the incentive speeded up innovation providing a temporarily valuable invention.

Central for utilitarian justifications of intellectual property is whether these rights indeed promote overall welfare (Lemley 2015). Here we should not assess property rights on basis of individual practices, but compare the whole property system to the counterfactual situation where these rights are not recognized (Schmidtz 1994). To truly settle this question, we would have to provide both evidence on that the current levels of intellectual property protection are indeed better than alternatives, and that we are better off with a system that applies the same rules all over the world (James 2012). While we do not have the evidence to settle this debate, we can still refer to the impact ruthless profit-maximization has had on the institution of property rights in relation to access to medicines (Hassoun 2020). For intellectual property to be an institution that promotes overall welfare, intellectual property holders would have to refrain from engaging in practices that erode the overall trust in the system and invite to widescale boycotts and piracy. Public health requires that people do not look for unregulated alternatives to medicines and trust pharmaceutical companies when it comes to application of vaccines.

Independently of whether intellectual property is defended as a right or an incentive, there are strong arguments against the view that having the liberty to derive income from an invention is to be associated with an unlimited freedom to exploit. Ideas of what may constitute a fair reward, which influence expectations of patent holders, not only serve to claim property entitlements but also to draw limits on what one can reasonably claim as one's own. It has



been argued that about 90% of creative work is only possible due to social infrastructures and prior work done by others, therefore society is entitled to a significant “social return” on labour (Simon 2001). The large support offered by society to facilitate and make long-term creative endeavours possible should be compensated as the innovator makes profits. In the case of antibiotics, as with any medicine, society may make the ethical acceptability of risks associated with clinical trials only subject to reasonable sales practices that allow widespread access (cf. Macklin 2004).

Furthermore, there is a wide consensus that intellectual property rights would have to be temporary, as otherwise they would be overly restrictive on people’s freedom (Moore 1997). Particularly in the case of inventions, it is likely that we can obtain a similar invention by someone with more humanitarian licensing practices a few decades, years or days later. There seems to be a consensus in both traditions that we are all better off with rules that limit the duration of exclusive rights over inventions.

Additional investments in research and development could be gathered if the innovator has the right to alienate her inventions. This however raises some conflicts, as discussed in the next section.

### **Transferring rights and generating income**

Instrumental to the “right to derive income” is the “right to alienate”, especially in a society that values the benefits of free exchange. Not only the inventor, but also society has an interest in facilitating the conditions that make a division of labour possible. Society can expect more benefits, if the inventor concentrates on developing new products or on making her inventions more effective, rather than on acquiring marketing skills. However, the step from claiming a right to benefit from the fruits of one’s labour by making private use of one’s invention to claiming to have a right to transfer exclusive use is not a minor one and has substantial consequences for public health.

From a rights perspective, we can observe a firmly established tradition defending the freedom of contract (Sturm 2009). Researchers should be allowed to enter contractual agreements to license their inventions as long as these contracts do not cause harm to others. Opponents to these contracts need to demonstrate that an inadequate use of the resource “antibiotic effectiveness” does indeed cause harm to others. As mentioned, facilitating inadequate use of antibiotics could be perceived as harming others by contributing to genetic pollution (Anomaly 2010, 2017). While the potential harm caused to the overall population by the use of antibiotics by the inventors themselves is negligible, licensing indiscriminately others to do the same does indeed lead to genetic pollution.

The benefits of antibiotics cannot be gathered through a mere right to access the resource. The effective use of the resource requires consumption, which contributes to its destruction (i.e. the loss of its antibiotic effectiveness). To fully benefit from a right to transfer resources, the inventor would also need to have a right to destroy these resources. As the right to use the resource is transferred to more and more people, we have a substantial contribution towards its destruction. The right to use, if widely held, will necessarily require a right to destroy the resource. However, leaving antibiotics as an unused resource would mean to waste an opportunity to improve welfare – in order to benefit from the resource our generation or a future one will have to consume the good. Yet here we need to draw a normative distinction between an inevitable harm and an avoidable harm. A person that uses an antibiotic in the most socially responsible way to treat an infection that will not heal in a reasonable time is inevitably harming others. The person that is using antibiotics for non-

therapeutic reasons is harming others without a justifiable reason by contributing to the reduction of future treatment options (Littmann and Viens 2015), thus creating an avoidable harm (cf. Railton 1985). If we consider diminishing someone's prospects as a form of harm (Raz 1986) and translate this understanding to using antibiotics, we already assume that reducing the overall stock of remaining doses of antibiotics that can be used effectively to treat infections is in itself permissible and can therefore only condemn non-essential uses. A person living in the future can only claim that we are reducing her prospects by consuming antibiotics in the present if she herself would have been more entitled to use such a resource than we are. The same future person can however claim to be entitled to use a resource efficiently for a basic necessity and condemn prior wasteful uses of the resource (Hey and Kesselheim 2017), drawing a distinction between having a right to use, but not having a right to waste the resource of common interest (Risse 2010).

To secure long-term income the inventor may also want to claim the right to manage the resource. The right to manage is of special concern for antibiotics, as stimulating sustainable usage can prolong the effectiveness of antibiotics. The inventor could for instance use contracts to bind licensees to commit to sustainable usage of antibiotics. If an exclusive rights holder is able to grasp the benefits of efficient use of antibiotics, she will have an incentive to help maintain the effective life of this resource. However when she can reasonably expect that the antibiotic will retain its marketability beyond the period of exclusivity, she will have no financial incentive (at least under current market models) to promote efficient use (Outtersson 2014). In times where the pharmaceutical sector is immensely consolidated, it needs to be noted that companies may have a financial interest in the loss of effectiveness of antibiotics whose patents are about to expire when this obsolescence could increase the sales of other patented antibiotics they own. In many jurisdictions pharmaceutical companies have legal obligations to address the financial interests of stakeholders, which may conflict with their moral obligations toward future generations.

As antibiotics are as far as we currently know a unique resource, public interests in retaining antibiotic effectiveness can build a claim to have the right to manage the remaining stock of effective antibiotic doses. We turn now to this argument.

### **Limits on commercial exploitation**

In states that recognize the human right of everyone to the enjoyment of the highest attainable standard of physical and mental health, people can claim access to effective and authorized drugs for their treatment and to an institutional order that allows to live a healthy life. As this right is more an aspiration, than something that can be reasonably achieved (cf. Buchanan 1984), the right is usually interpreted as an obligation to control pollution and to make sure essential medicines are accessible to all who need them. Selling patents over antibiotics to the highest bidder will have the likely consequence that she needs to maximize profits to recoup investment without regard to public health needs. This may not only impede realizing the right to health, but also jeopardizes the sustainable stewardship of antibiotic effectiveness. Intelligent disease control strategies need to guarantee sufficient access to antibiotics to prevent bacterial propagation (Millar 2011). High prices on antibiotics may tempt people to break treatment to save any remaining doses for future eventualities without medical indication (Banerjee and Duflo 2011). There are thus limits to ethically exploiting this resource.

In terms of rights, this means that the right to exclude (in all its forms) can be considerably restricted if society decides to apportion the remaining antibiotic doses to meet specific public interests. Humanity may assert a strong claim on these resources on two

grounds (1) strong need, and (2) their uniqueness (cf. Goodin 1990). If these claims are recognized, it could have a strong effect on the liberty to derive income, manage and alienate these resources.

To guide policy there is no strict threshold to justify strong need. People may need antibiotics to speed up their recovery, so that they can be able to work again and thus secure their livelihood. This need is stronger in countries with insufficient or no social security (Giubilini and Savulescu 2020). A particularly strong case justifying need occurs when the bacterial infection will lead to severe disability or even death if not treated.

Even though we may treat a bacterial infection with more than one antibiotic, antibiotics as a whole are a unique resource (Littmann *et al.* 2015). While competing pharmaceutical companies may point to each other on who should offer their antibiotic, at least one of the possible suppliers has to cede to commit to humanitarian licensing, if we recognize something like a right to access essential medicines. Such a right can only be socially sustained, if we recognize some limitations on the exploitation of property rights (Gordon 2010). In our case this will come with both a limit on the right to derive income and constraints on the right to manage. In order to ensure sufficient access, there needs to be a limit on the price of antibiotics. Management needs to be in line with the principle of sustainable stewardship. Incentives that aim at maximizing market shares are ill set, and so are policies that do not go beyond price reductions. Good management involves substantial investments and global coordination (Rogers Van Katwyk, Weldon, et al. 2020). Here we may think about price-ceilings, government subventions, and obligations to engage in mass-production to reduce costs. Such efforts should make it easier for people to afford treatment. At the same time, the demand for antibiotics needs to be reduced, by developing educational programs, implementing policies that restrict agriculture uses and limits over-the-counter sales, and by enforcing sanitary measures that limit bacterial propagation. We need a set of incentives and policies that encourage proper diagnostic and prescription as well as secure compliance by patients, pharmacists and health personnel (Friedman 2013; So et al. 2012).

As mentioned, access and management constraints on property rights have been formulated very early on in natural rights theories. It is well-known that within this tradition people have to “leave enough and as good for others”, less-known are arguments that allow expropriation of what others own in abundance to cover essential needs, especially to secure self-preservation (Fitzmaurice 2015; Mancilla 2016). Bad management can lead to scarcity, which becomes unacceptable when it is preventable and jeopardizes human lives. Scarcity of an essential good as a consequence of bad management falls normatively in a different category than scarcity caused by misfortune or natural constraints.

An additional problem is that an antibiotic class is a resource of rivalrous consumption. At one stage the antibiotic will not be effective to treat most common bacterial infections. As a vital exhaustible resource, antibiotic effectiveness has to be somehow divided among those who assert legitimate claims on it. Lockean property theories start with the statement that people are given in abundance and as stewards of the earth’s riches it is up to each generation to ensure they leave enough and as good to those who will follow (Wolf 1995). Yet how can we claim that everyone should have access to a resource and at the same time limit the right to use in view of future interests? An insufficient, but well defensible option is to address the interests of future generations by setting a tax on the use of this scarce and exhaustible resource to finance efforts to reduce resistance and prevent infections (cf. Dennis 2015). Future research could develop precise diagnostic tools that reduce the demand for antibiotics by improving targeted use (Kades 2005), compounds that boost the immune system, and new treatments, such as bacteriophage viruses (Anomaly 2020). Continuously relying on exclusive

rights would however deprive the poor from a resource they are entitled to if no subventions are provided.

The high costs of management and the enormous social importance in its success demand greater governmental involvement. We proceed with an approach that justifies wide public claims.

### **Antibiotics as common heritage of humankind**

The strong claims society has on antibiotic effectiveness can justify expropriating intellectual property from inventors and offer them financial compensation for their losses. This would respect their legitimate expectations to enjoy the fruits of their labour, but would delink the reward from commercial exploitation. Another argument goes even further. We may agree on the fact that the inventor made a valuable contribution to society by discovering the therapeutic use of a compound, but question whether this labour entitles to have exclusive rights over the compound itself. We could argue that the therapeutic characteristic of the compound is commonly owned by humanity, as it would not be reasonable for people to concede exclusive rights over such an essential resource. This position is compatible with the idea that society may want to encourage innovation and therefore concede certain rights over antibiotics, but at the same time establish clear boundaries on what constitutes fair rewards and adequate use in view of common interests (cf. Risse 2012). The idea of common heritage of humankind recognizes such common interests and cancels some or even all property rights traditionally associated with the resource, particularly the right to destroy. The strong need for antibiotics has led to the idea that antibiotic effectiveness should count as a resource everyone – now and in the future – should be entitled to (Carlet *et al.* 2014). Applying this concept severely restricts the antibiotic owner's right or even expropriates her in view of the fundamental interest humanity has in the object.

The idea behind the common heritage of humankind principle gained wide prominence in the 1960s when state leaders discussed the different claims on outer space and the seabed (Shackelford 2008). Human-made objects, such as work of arts and buildings, and improved objects, such as agricultural seeds, may also be considered humanity's common heritage (Turtinen 2000, Timmermann and Robaey 2016).

The idea implies not only inheriting a good, but also passing it on to future generations. There are four main principles attributed to the concept of common heritage of humankind (Chemillier–Gendreau 2002; Shackelford 2008):

- (1) common management
- (2) sharing benefits with all
- (3) scientific cooperation
- (4) prohibition of harmful uses

As it becomes immediately clear, applying these principles to antibiotic effectiveness place strong claims on this resource, restricting all conventional property sub-rights.

The first principle, common management, underlies the idea that the resource should be managed democratically in view of long-term sustainability. The current generation should not engage in practices that deteriorate the resource to such levels that it becomes useless for the next generations. According to empirical observations, common management has the advantage that it improves compliance, as participants can better relate to commonly reached decisions and commitments (cf. Hollis and Maybarduk 2015).

The second principle, demanding that everybody should derive benefits, sets some limits on how people can use the resource. Recognizing the exhaustibility and common good nature of antibiotic effectiveness demands to only use antibiotics for urgent needs, and abstain from usage when doing so is a small sacrifice (Giubilini and Savulescu 2020). This principle also eliminates the right to alienate, as alienation presupposes that either someone will not benefit (any more) of the resource or that someone will benefit from the resource who was previously not entitled to it. Therefore, under this principle the resource is inalienable in the sense that nobody ought to be excluded from its benefits.

The third principle – a commitment to scientific cooperation – would prohibit exclusivity when doing research on or with the antibiotic compound. It would also demand that data is shared. For this principle to be meaningful for all states, it requires scientific capacity-building to assist those countries which currently cannot meaningfully participate in common research efforts (Rhodes 2016).

The fourth principle, prohibiting harmful uses, is as discussed earlier somewhat tricky to apply to antibiotics. Non-compliance to dosage prescriptions and inappropriate use would in a strict sense qualify as harmful use, as it contributes to genetic pollution. Arguably it would also require to refrain from non-essential uses, such as using antibiotics as growth enhancers for animals (Anomaly 2020).

This legal construct has far-reaching effects on the incidents traditionally attached to property rights. While (previous) owners may retain some rights over what has been declared common heritage, strong constraints are implemented. While owners or stewards may derive some financial benefits, these need to be proportional to a fair return of effort. The right to derive income does not vanish, but is limited to what potential users are able to pay. Under no circumstances should this lead to an exploitation of a position of advantage harming the vulnerable. The right to destroy the resource, in the sense of allowing irresponsible use, is also cancelled for all. Everyone is entitled to the benefits; destruction leads to deprivation. As common heritage is everyone's concern, all are required to take steps to maintain this good, by refraining from non-essential uses, informing oneself about the need to conserve antibiotic effectiveness and educating others about the problem of antibiotic resistance. Common heritage comes with common responsibilities.

The idea of common heritage of humankind was developed in view of goods that already existed. New antibiotics need to continuously be identified and developed, which requires substantial research efforts. As countries vary enormously on how much resources they devote to research – even at similar industrial development stages – any attempt to globally distribute the fruits of research will clash with substantial opposition and difficult to settle questions of distributive justice (Timmermann 2020). The principle of common heritage requires a larger willingness to share costs.

Another major challenge for this normative framework is that antibiotics lose their effectiveness through use and people can only benefit from antibiotics when they are used. Even a right to responsible use ultimately implies a right to destroy. We only have a heritage that can be prolonged so that people born somewhat later on can enjoy it, but not a heritage that we can entirely save. The most we can do is to reduce the need for antibiotics and offer alternative therapies.

### **Conclusion: On the limits of property rights**

While we do recognize and defend the view that people should be entitled to the fruits of their labour (subject to the harm principle), we have to single out a maxim that restricts the

unsustainable exploitation of this exhaustible healthcare resource. Our normative goal is to maximize resources that benefit public health under principles of justice. This goal raises a dilemma when considering antibiotic effectiveness. On one side, society needs incentives to innovate. Reliance on underregulated markets comes at the price of inefficient use of antibiotics by creating incentives that stimulate the sales of antibiotics. Moreover, health care resources are limited everywhere, putting a ceiling on expected returns. Yet, we also saw intellectual property is not the only imaginable method to stimulate innovation. Implementing a different incentive system can detach the compensation of inventors from sales revenues. Distributive justice and pragmatic reasons demand that the public health systems gain and retain a reputation of fairness to secure international cooperation to maintain microbial control substances that benefit all (cf. Ruger 2015). Fair prices are not only important to facilitate access but also a prerequisite to identify the global antibiotic regime as fair and worthy to cooperate with. To maintain adequate incentives and do justice to the hard work of innovators, the government may need to subsidize research and antibiotics in the case low prices do not lead to sufficient income. Principles of justice and of epidemiology also demand that all people have access to antibiotic treatments when in need. To address this demand the right to derive income will have to be substantially limited, while taking adequate measures so that innovators receive a fair reward for their labour. In addition, antibiotic users need to be taught about the role they can play in maximizing the effective life of this resource and be aware that they are depleting a common resource over which everyone has claims, including future generations.

When prioritizing public health goals and intergenerational justice, it becomes clear that the right to use and therefore destroy the scarce resource of antibiotic effectiveness has to be curtailed. While in theory property owners can act as adequate stewards, it is unlikely that they will do so under non-ideal conditions when financial incentives and competition encourages them to sell antibiotics to people who do not really need them. The complexity of antibiotic stewardship, obliges the government to take a more central role in managing this resource, as efficient management requires international coordination, educational campaigns and extensive monitoring.

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<sup>i</sup> When incomes from sales are insufficient, prizes are frequently awarded to stimulate further creativity. The most prominent examples are literature prizes.

<sup>ii</sup> As Helga Varden interprets Locke: "If actual consent by all is required to make rightful property possible, then "Man had starved, notwithstanding the Plenty God had given him". (Varden 2012, quoting Locke (1689/1960), book II, chap V, §28)

<sup>iii</sup> Classically, John Locke argued that "... for he that leaves as much as another can make use of, does as good as take nothing at all" (1689/1960, book II, chap. V, §33).

<sup>iv</sup> See Agreement on Trade-Related Aspects of Intellectual Property Rights (1995), art. 31

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