# Supplementary Appendix

The author has provided this appendix containing additional information about her work.

Supplement to: Meagher KM. Why we should reexamine the “golden age” of antibiotics. *AMA J Ethics*. 2024;26(5):E418-E428. doi: 10.1001/amajethics.2024.418.

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**Figure.** A Primer of Economic Concepts for Identifying Goods and Losses Related to Antibiotic Resistance

**Public or common goods**

Nonexcludable: access to or use of benefit cannot be restricted by pay structures

- Absence of and lower rates of resistant infections are nonexcludable benefits because any community benefits from a lesser risk of exposure.

Non-rivalrous: access to or use of benefit doesn't affect whether others in the community can also benefit

- Absence of and lower rates of resistant infections are non-rival goods, as all members of the community share in the community health benefit of lower exposure and treatability if exposed. A One Health approach emphasizes how freedom from resistant disease comes about from interconnected causes and results in interconnected experiences, even across species.[1]
- However, the benefits of having effective antibiotics *are* rivalrous: one member's use can be beneficial to that individual in the short-term while reducing effectiveness in the long-term, including for the same individual and for others.[2]

Tragedy of the commons: access to or use of benefit by individual consumers from their own self-interest will deplete the shared resource

- Antibiotic effectiveness can exhibit similar features to a tragedy of the commons in that the short-term benefits of treatment gradually increase the likelihood of, in the long-term, losing the common good of effective treatment for infections. The rise of antimicrobial resistance is a sign of such a "tragedy."

**Market barriers to pharmaceutical innovation**

Undermined pricing strategies: broadly speaking, pharmaceuticals generate high margins when they are sold at low volume and high price, or at high volume and low price

- A profitable pricing strategy is difficult to achieve for antibiotics because the existential nature of infections renders antibiotics lifesaving, which supports a global health rationale for *keeping antibiotic prices low*.
- Additionally, from a stewardship perspective, resistance is mitigated and treatment effectiveness conserved when antibiotics are prescribed only when necessary and, when prescribed, for as short a duration as effectively treats or prevents infection. Conserving drug effectiveness is also economically pragmatic: high volume antibiotic sales are self-defeating, as doctors and hospitals will need to purchase a different drug to treat patients infected with resistant strains. Both factors provide a rationale for *keeping sales volume low*.

**Social cost of antibiotic market failures**

Allocative deadweight loss: the cost to society when desires of consumers go unmet due to inadequate competition

- Due the multifaceted complexities, few pharmaceutical companies are currently motivated to invest in the research and development of novel antibiotics. Consolidation and high market entry costs are 2 economic factors that contribute to low pharmaceutical industry competition. From this economic perspective, rising antimicrobial resistance is an example of allocative deadweight loss, or the social cost of a failed antibiotic market.

## References

1. Meagher KM. Can One Health policy help us expand an ethics of interconnection and interdependence? *AMA J Ethics.* 2024;26(2):E162-E170.
2. Giubilini A, Savulescu J. Moral responsibility and the justification of policies to preserve antimicrobial effectiveness. In: Jamrozik E, Selgelid M, eds. *Ethics and Drug Resistance: Collective Responsibility for Global Public Health*. Springer; 2020:141-154.