Molly Ghinn

Template 1: Generating an impactful idea

1. *What is a change you want to see in the world?*

The threat of antimicrobial resistance is a significant and mounting global problem. Specifically, antibiotic resistance results in 33,000 deaths per year in Europe alone [1]. Antibiotics are critical in preventing and treating bacterial infections in humans and animals, however as antibiotic use increases across the world, antibiotic resistance is also increasing - meaning these medicines are becoming less effective. In low-income and developing countries, antibacterial resistance is particularly dangerous due to lack of diagnostic tools in health care settings, poor sanitation and minimal access to vaccinations. It is of great importance to protect future generations from living in a post-antibiotic era where something as simple as food poisoning could kill. I wish to see collective responsibility being taken at an individual, health care system and societal level to address the global threat of antibacterial resistance.

2. *What are three key bottlenecks to achieving this?*

1st Why: Why is antibacterial resistance a problem in the first place?

- Because people are failing to act and address the issue, allowing it to worsen exponentially.

2nd Why: Why are people not addressing the problem of antibacterial resistance?

- Overconsumption of antibiotics in healthcare is the norm.
- There are no alternative medicine options.
- There are extremely high rates of bacterial infections.

3rd Why?

- Why is overconsumption of antibiotics in healthcare the norm?
    - Doctors prescribe antibiotics unnecessarily
    - Patients do not understand when they should and should not be using antibiotics, and are unnecessarily requesting medicine.
- Why are there no alternative medicine options?
    - No incentives to develop new antibiotics in place, or existing incentives are too far in the future
    - No regulation or government policy
    - No competition
- Why are there extremely high rates of bacterial infections?
    - Poor infection prevention and control (e.g. hand washing)
    - Lack of access to preventative health (e.g. vaccinations)

3. *Pick one bottleneck. What do you think are the key reasons this bottleneck exists?*

Selected bottleneck: **overconsumption of antibiotics in healthcare is the norm**

The key reasons underlying overconsumption of antibiotics are diverse, but can be broadly categorized into three different levels: individual/patient level, health care practitioner (HCP) level and regulatory level.

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Individual/patient level:

- Patients do not understand when and why they should use antibiotics (e.g. requesting antibiotics for mild illnesses or conversely failing to treat bacterial infections in early-stages, leaving them until antibiotics are necessary)

HCP level:

- Doctors prescribe antibiotics unnecessarily (potentially due to: uncertainty of illness cause, patient pressure, as a preventative measure to avoid being accused of under-treating patients or simply incorrectly)
    - Additional explanation: patients presenting with an illness of unspecified cause are difficult to treat. Antibacterial infections are fairly common causes of illness, leading HCPs to often prescribe antibiotics in case they might be effective (with the attitude of 'no harm done'). However, the root cause of illness may not be bacterial at all, meaning antibiotics have been used unnecessarily.

Regulatory level:

- There is a lack of consistent guidelines on antibiotic use and prescription, as well as failure to promote infection prevention and control measures.

4. What are five ways one could overcome this bottleneck?

- Empower and educate patients: help patients to better understand when antibiotics are really necessary and how to use and dispose of them responsibly. Improve science communications through public education.
- Overcome diagnostic uncertainty: help HCPs to more rapidly identify underlying illness cause, enabling prescription of the most efficacious antibiotics only when necessary.
- Increase HCP awareness of unnecessary antibiotic prescription: this could be at a global scale (most distal), within the practice they work at or their own prescription rates (most proximal to the individual).
- Relieve HCPs from perceived patient-pressure: help to reduce HCP concerns about patient satisfaction and under-treatment which lead them to feel pressured to prescribe antibiotics.
- Restrict prescriptions: prohibit over the counter (OTC) access to antibiotics and further limit access to courses of antibiotics to patients who have been seen by at least two HCPs who both agree that antibiotics are a suitable treatment option.

5. Rank your options using a weighted factor model (model template will be provided on Thursday)

- 1. Empower and educate patients
- 2. Increase HCP awareness of unnecessary antibiotic prescription
- 3. Overcome diagnostic uncertainty

Weighted Factor Model for Ideas

Factor	Factor Weight	Empower and educate patients	Overcome diagnostic uncertainty	Increase HCP awareness of unnecessary antibiotic prescription	Relieve HCPs from perceived HCP pressure	Restrict prescriptions:
Impact Potential	0,17	0,5	0,75	0,75	0,5	1
Risk negative effect	0,17	0,75	0,5	0,5	0,25	0
Pilotability	0,17	1	0	0,75	0,25	0,25
Feasibility	0,17	0,75	0,25	0,75	0,25	0,25
Profitability	0,17	0	0,75	0	0	0,25
Personal Fit	0,17	1	1	0,5	0,25	0
Total score		**0,500**	**0,375**	**0,458**	**0,208**	**0,292**
Grade		1	3	2	5	4

6. List any weaknesses you can think of for your top 3 ideas. Then choose the idea you find the most promising.

- **1. Empower and educate patients** - *help patients to better understand when antibiotics are really necessary and how to use and dispose of them responsibly. Improve science communications through omnichannel public education. Short messaging campaigns in doctors' offices, hospitals and on patient communication tools (e.g. NHS website) should highlight concrete examples of when to use and when **not** to use antibiotics. Placing these messages in locations in close proximity to where patient-HCP contact is occurring is likely to ensure the knowledge is at the forefront of patients' minds.*

    - **Potential impact:** even the most informed patients cannot always change their HCP's decisions (e.g. antibiotics to try to treat an unknown infection may still be given), which limits the potential magnitude of impact. However, wider public awareness of the issue may be a catalyst for greater HCP engagement with better antibiotic prescriptive practices.
    - **Risk of negative effect:** Educational campaigns are fairly low risk, with the main concern being lack of engagement. However, backfire effects can occur for example people becoming more familiar with antibiotics may be more inclined to request them. It can also be hard to assess the right level of complexity, information should be clear and easy to understand but not patronising.
    - **Pilotability:** This idea can easily be piloted at small scales, for example in a randomized control trial of local advertising campaigns. Local health services can then be assessed against control services where the public have not received this empowerment and education.
    - **Feasibility:** This idea requires no new scientific development and only small adjustments to ensure educational materials are easy enough to engage with.
    - **Profitability:** This idea will be challenging to make profitable, investment could come from regulators and health care providers if framed as a way of saving money that will need to be invested in the future in antibacterial resistance.
    - **Personal fit:** As a behavioural scientist, this idea is super exciting to me! One of the crucial aspects of changing behavior is ensuring people have the knowledge and awareness of the problem, so are able to act on it, so this feels like an important early-stage solution.

- **2. Increase HCP awareness of unnecessary antibiotic prescription -** *for example by sharing data on unnecessary antibiotic prescription with them; this could be at a global scale (most distal), within the practice they work at, or their own prescription rates (most proximal). Using actual data from prescriptions could be a powerful way of demonstrating the impact an individual HCP could have on preventing antibacterial resistance and should be a significant trigger for behavior change.*

    - **Potential impact:** the impact of this idea could be really significant. Engaged and aware HCPs would be more hesitant to prescribe antibiotics when the threat of antibacterial resistance is prominent in their mind. Additionally, this information can be shared by HCPs with patients who are pushing for antibiotics, as they are often accepted as a source of authority by patients.
    - **Risk of negative effect:** there is a possibility that HCPs may feel attacked and uncomfortable with their prescription data being scrutinized. Informational

campaigns may feel condescending and overly obvious, and may have unintended backfire effects.
    - **Pilotability:** This idea can easily be piloted at small scales, for example in a randomized control trial in GP surgeries.
    - **Feasibility:** This idea requires some increased understanding of HCP prescription behaviour, but otherwise no major advances are required to make it possible.
    - **Profitability:** this idea is relatively low cost, but will have no tangible returns in the short term and only minimal returns in the longer term.
    - **Personal fit:** as a largely behavioral and communications problem, this idea is of some interest to me, though it is somewhat challenging as it requires re-education for individuals who are already significantly over-worked.
    - **Other:** this idea puts a lot of pressure and onus on HCPs who are already trying to provide the best care they can for their patients. They will have limited time and bandwidth to deliver care and it is likely to require more than some informational campaigns to significantly change their behaviour.

- **3. Overcome diagnostic uncertainty** - *help HCPs to more rapidly identify underlying illness cause, enabling prescription of the most efficacious antibiotics only when necessary. Currently, antibiotics are often used experimentally when the underlying cause of infection is unknown - this is an example of antibiotics being misused/used unnecessarily. If HCPs are better able to diagnose the cause of infection, the right course of antibiotics can be chosen first time. Currently, diagnostic tools are under-developed, untrusted and not used widely by health care systems.*

    - **Potential impact:** This idea could be very impactful, but only in cases where there is time for diagnostic tools to be used and where there is uncertainty surrounding the underlying infection. It also fails to address HCP concerns about under-treating patients.
    - **Risk of negative effect:** if the diagnostic tool is not developed to be rapid, accurate and fast-acting, patients could suffer considerable harm whilst awaiting treatment or receiving the wrong treatment. However, if the diagnostic tool is properly developed, there is low risk of negative effects:
    - **Pilotability:** given there are no readily-available diagnostics, attempting to pilot this on small scale would be impossible since it requires some further investment.
    - **Feasibility:** requires considerable development of new diagnostic tools to more rapidly diagnose infection at low-cost. Also requires buy-in from health care systems and HCPs.
    - **Profitability:** this test could turn significant profit given how prolifically it could be used.
    - **Personal fit**: This is the idea that excites me the most; if there is a technical solution that could help overcome human error and improve health outcomes. An infection diagnostic tool provides a tangible product for investors and stakeholders to run with as a solution to a problem that is currently being ignored.

7. *Prepare a 100-word pitch for your most promising idea: What problem are you trying to solve, what is your idea, what is its' theory of change (See template 2) – you don't need to have a complete TOC model*

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Despite being a significant global issue, the looming threat of antibacterial resistance is being ignored by governments, health care systems, health care professionals (HCPs) and individuals. One of the key bottlenecks to solving this issue is overconsumption of antibiotics, which occurs largely due to unnecessary or incorrect prescriptions, which are written as a result of HCP uncertainty of infection cause. Investing in research to advance and promote use of existing infection diagnostic tests could enable HCPs to select the most appropriate treatment. This diagnostic tool could play a vital role in reducing antibiotic misuse and slowing down antibacterial resistance.

References

[1] Cassini, A., Högberg, L. D., Plachouras, D., Quattrocchi, A., Hoxha, A., Simonsen, G. S., ... & Hopkins, S. (2019). Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. *The Lancet infectious diseases*, *19*(1), 56-66.