Right care 2

Evidence for underuse of effective medical services around the world

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Underuse—the failure to use effective and affordable medical interventions—is common and responsible for substantial suffering, disability, and loss of life worldwide. Underuse occurs at every point along the treatment continuum, from populations lacking access to health care to inadequate supply of medical resources and labour, slow or partial uptake of innovations, and patients not accessing or declining them. The extent of underuse for different interventions varies by country, and is documented in countries of high, middle, and low-income, and across different types of health-care systems, payment models, and health services. Most research into underuse has focused on measuring solutions to the problem, with considerably less attention paid to its global prevalence or its consequences for patients and populations. Although focused effort and resources can overcome specific underuse problems, comparatively little is spent on work to better understand and overcome the barriers to improved uptake of effective interventions, and methods to make them affordable.

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Introduction

Underuse—the failure to deliver a health service that is highly likely to improve the quality or quantity of life, which is affordable, and that the patient would have wanted—is responsible for considerable avoidable morbidity and mortality. For example, WHO estimated[1] that in 2015, 1·5 million children died of vaccine-preventable illnesses. The Born too Soon Preterm Action Group estimates that an 84% reduction in the more than 1 million annual deaths in preterm babies could be achieved through universal health coverage and use of selected interventions, such as antenatal corticosteroids (panel 1) and kangaroo mother care, which involves maintaining prolonged skin-to-skin contact between the baby and mother; however, the uptake of such interventions has been painfully slow.

Underuse varies substantially between and within countries. For example, high-income countries (HICs), which already have relatively low cervical cancer rates and well established screening programmes, have documented a 68% reduction in high-risk human papilloma virus (HPV) infection rates as a result of HPV

Key messages

- Underuse is responsible for substantial suffering, disability, and loss of life worldwide, in both high-income and low-income countries
- Underuse is prevalent across different types of health-care systems, payment models, and health services
- The causes of underuse are multi-layered: from inadequate access, health system failures, clinicians being unaware or unskilled to provide required interventions, and patients not accessing or declining them
- Underuse occurs alongside overuse, particularly in areas where there is competitive tension between profitable and low-cost interventions
- Policy makers, funders, clinicians, and civil society urgently need to recognise, invest, and resolve the slow uptake of effective, affordable, but non-promoted interventions

Panel 1: History of the slow uptake, and current underuse, of antenatal steroids to prevent mortality and morbidity in premature births

1972
First randomised control trial (RCT) shows antenatal corticosteroids hasten fetal maturation, reduce risks of respiratory distress syndrome, intraventricular hemorrhage, and neonatal death[2]

1981
Paper by Crowley consolidating the results of four RCTs[3]

1984
Collaborative Group on Antenatal Steroid Therapy finds no detectable growth or physical, motor, or developmental deficiencies[4]

1989
Systematic review of RCTs shows significant benefit from steroid therapy[5]

1995
National Institutes of Health Consensus Conference recommends steroids based on a meta-analysis[6]

2010
Meta-analysis shows greater benefit in low-income and middle-income countries[7]

2011
WHO's 29 Country Survey of Maternal and Newborn Health documented only 52% of women in preterm labour receive corticosteroids[8]

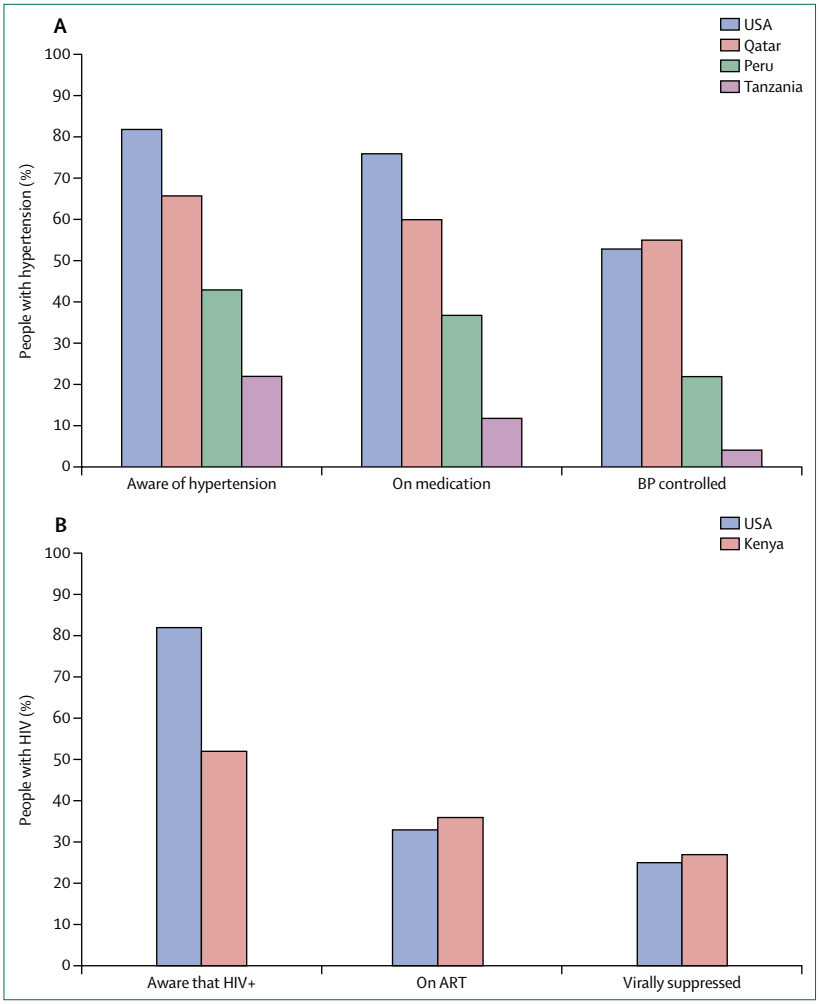

Figure 1: **Awareness, treatment, and control of hypertension[15,16] (A) and HIV[16,17] (B) between countries**
BP=blood pressure. ART=antiretroviral therapy.

immunisation programmes.[9] By contrast, in India, where more women die from cervical cancer than childbirth, access to HPV vaccination and even to low-technology screening, such as visual inspection of the cervix with acetic acid, is limited.[10]

Underuse and overuse can occur simultaneously. A common tragedy in both wealthy and poorer countries is the use of expensive, and sometimes ineffective, technology while low-cost effective interventions are neglected. For example, a 2013 study in Tanzania found a concurrent increase in maternal mortality and caesarean section in low-risk births;[11] at the same time, whether due to distance or financial barriers, only 50% of all deliveries were done by a skilled provider.[12]

In this paper we review what is known about the scope and consequences of underuse around the world. We undertook a literature search for primary resources and systematic reviews on underuse, supplemented with an iterative citation search of relevant articles. From this literature we offer a description of what is known about the prevalence of underuse and the harm it causes patients, populations, and health systems worldwide.

Measuring underuse

Although underuse is known to occur in all countries and health systems in which it has been studied, remarkably little research has focused on determining the global prevalence of underuse, or even the degree to which most medical services are underused in appropriate patients. Most studies of underuse have focused not on prevalence or harm, but rather on methods of remedying the underuse of specific services.

Studies of variations in practice, between and within countries, provide an indirect method of assessing possible underuse. Considerable variations occur in the use of many elective tests and treatments (eg, coronary bypass rates vary by more than three-fold across countries and by up to six-fold within countries; knee replacement rates vary by more than four-fold across countries and by more than five-fold within some countries).[13] Such studies suggest some degree of inappropriate use; however, there is usually no way to determine from variation per se that areas in which rates are high are experiencing overuse, or that areas in which rates are low are suffering from underuse.

Global burden of disease studies have focused on the prevalence of illness and risk factors rather than underuse of medical services; surveys in low-income and middle-income countries (LMICs), such as the Demographic and Health Surveys and UNICEF's Multiple Indicator Cluster Surveys, have included availability of some health services, such as antenatal and perinatal care, and vaccination, as markers to track the development of health-care systems.[14] However, such studies have generally not provided a full view of underuse of even those few services; even when a service is available in a system, the study might not measure the percentage of the population that does not access it. For example, in estimates of the underuse of corticosteroids to prevent preterm birth, studies focus on women who visit a clinic to see a health-care professional and do not receive appropriate steroid treatment, thus not capturing women who never attend a clinic, thereby producing an underestimate of underuse.

For a few conditions, population-based prevalence of underuse, including underdiagnosis and undertreatment, has been assessed directly via national surveys, which include questions about underuse before, during, and after clinical care. For example, in the USA, the National Health and Nutrition Examination Surveys[15] estimated that 31% of adults aged 18 years and older, and 70% of adults aged 65 years and older had hypertension (based on an average of three blood pressure measurements during the survey, and self-reported medication). Pharmacological treatment rates had improved modestly from 60% between 1999 and 2002, to 70% between 2005

and 2008, and the proportion of patients with controlled blood pressure increased from 33% to 46%. Although these figures still reflect considerable underdiagnosis and undertreatment of hypertension, they are very good compared with results from other countries[16] (figure 1), such as sub-Saharan Africa, where of those with hypertension, only between 7% and 56% (pooled prevalence 27%) were aware of their hypertensive status before the surveys; 18% of individuals with hypertension were receiving treatment; and only 7% had controlled blood pressure.[18] Surveys of HIV show similar gaps between awareness of virus status, treatment, and control of viral load (figure 1) for the USA[17] and Tanzania.[16] For most health conditions, however, similar population studies assessing underuse are uncommon, and thus we can draw only an incomplete picture of the global prevalence and effect of underuse.

To assess the available data for underuse at the population level, we divided the continuum of care into four stages, adapted from a previous model.[19,20] At each of the four stages, patients might not receive or use potentially beneficial treatment (figure 2). The four stages are: (A) a total or partial lack of access to health care (because the system does not offer coverage or patients are unable to reach or pay for available care, or both); (B) unavailability of effective services within the local health-care system; (C) a failure of clinicians to deliver or prescribe effective, affordable interventions; and (D) a failure of patients to commence or adhere to effective, affordable interventions. The effect of these four stages is cumulative, as illustrated in figure 2. Once the patient has accessed care, underuse at stages 3 and 4 might occur because of a lack of awareness, knowledge, or skills, in addition to other reasons such as habit, inertia, and inconvenience on the part of either clinician or patient.[23,24] Physicians and other health-care workers may not provide appropriate tests or treatments,[24] for various reasons including ignorance of the evidence, competing therapies promoted by financial interests, lack of confidence or technical skills, insufficient time, or implicit substitution of their own values and preferences for those of their patient. These problems can be compounded if clinicians are busy delivering unneeded or undesired care.[25] The potential for and prevalence of underuse can thus accumulate because of multiple problems at each stage of the health-care continuum.

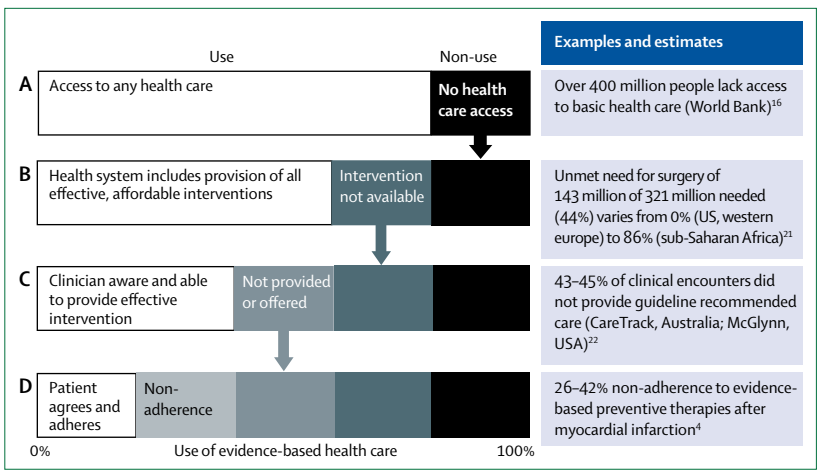

Figure 2: **Underuse can accumulate over four stages of care, from access to adherence**

Worldwide prevalence of underuse

The following section of this paper provides some estimates of underuse at each of the four stages shown in figure 2.

(A) Access to health care

Patients may have no, or little access to health care because of remoteness, poverty, lack of coverage, immigration status, or other factors. Poor access to medical care because of financial barriers occurs even in HICs. A recent survey of 11 Organisation for Economic Co-operation and Development countries found the percentage of the population unable to access medical care because of costs, as measured by prescriptions, tests, or health-care professional visits that patients did not attend, ranged from 4% in the UK, to 37% in the USA, with a median of 15% (Germany).[26]

The prevalence of underuse due to financial barriers in LMICs is likely to be substantially worse, but data are more scarce. To monitor global access to health care and ensure comparability between countries WHO and the World Bank have recommended eight core tracer health service indicators: family planning, antenatal care, skilled birth attendance, child immunisation (three doses of diphtheria, tetanus and pertussis [DTP]-containing vaccine), antiretroviral therapy, tuberculosis treatment, and improved water sources and sanitary facilities.[16] These health services are identified as essential and should be available universally in all countries, regardless of socioeconomic stage or epidemiological status. The report estimated that in 2013 more than 400 million people were still unable to access one or more of the following basic health services: women whose demand for family planning was not met, pregnant women who did not attend at least four antenatal visits (minus 38% to account for unintended pregnancies), infants who did not receive three doses of DTP-containing vaccine, HIV-positive adults and children not receiving HIV treatment, adults with new cases of tuberculosis not receiving tuberculosis treatment, and children aged 1–14 years not sleeping under an insecticide-treated bednet.[16]

(B) Availability in the health system

Even when a population has access to health care, some effective interventions are not available because of limited resources, regulatory control, or other factors. For example, a low per capita supply of physicians or hospital beds can mean that patients do not receive

For **dates and data from Hollows** see www.hollows.org.au/

Panel 2: **Fred Hollows' steps in reducing avoidable and treatable blindness in low-income countries, via low-cost cataract surgery**

Mid-1980s
Hollows initiated goal to reduce the cost of eye health care and treatment in low-income countries (training Ruit from Nepal and Desbele from Eritrea)

Late 1980s and early 1990s
Lens costs prohibitive, so Hollows, with Ruit and Desebele, build intraocular lens manufacturing facilities in Nepal and Eritrea

By 2010
The Fred Hollows laboratories in Nepal and Eritrea had manufactured over four million low-cost intraocular lenses, for both local use and global use

needed care. Excessive waiting times for elective surgery, such as cataracts or hip replacements, financial barriers to specific treatments (expensive cancer chemotherapy), and a paucity of practitioners (cognitive behavioural therapy [CBT]), are clear examples of limited availability even in countries with universal health-care coverage.

The recent Cancer Atlas[27] reports that in HICs, most patients with terminal cancer have access to opioids for pain relief, whereas in LMICs as few as 11% do (57% average access for Africa; 69% in southeast Asia), despite opioids being on the WHO essential medicines list, having a low cost relative to many drugs, and strong evidence that they are the most effective treatment for severe pain due to cancer.

Human resource shortages are a persistent problem contributing to underuse in LMICs. For example, countries in sub-Saharan Africa (except for South Africa and Botswana) average less than two pathologists per million population,[27] compared with 15 per million in Taiwan, 26 per million in Canada, and 44 per million in the USA.[28] Lack of human resources can also afflict HICs. In 2004, the UK's National Institute for Health and Care Excellence issued guidelines recommending the use of psychological therapies—particularly CBT—in depression, anxiety, and other conditions; however, the UK workforce was insufficient to deliver the recommended treatments, and a training initiative, the Improving Access to Psychological Therapies programme,[29] was established. Access to mental health services is worse in LMICs than in HICs: a 2015 WHO report estimated that treatment coverage for depression was 41% in the HIC surveys, compared with only 18% in LMICs.[16]

The global unmet need for surgery, which is estimated to be over 320 million surgical procedures per year, is concentrated mostly in LMICs. A 2015 global analysis of the ratio of minimum procedures needed to procedures done, showed large deficits in southern and southeast Asia and most of sub-Saharan Africa, where less than half of the minimum needed procedures are done.[21] In some of the countries studied, failure to deliver needed surgery can occur at both stages A and B, because dependent patients do not have access to care, or there is limited capacity to perform surgery, or both.

There are no ideal solutions to these problems, but they can be solved. However, implementation will usually require persistence to overcome a series of barriers and bottlenecks. For example, avoidable and treatable blindness remains a global burden, with cataracts causing 10·8 million cases of blindness and 35·1 million cases of vision impairment in 2010.[30] The ophthalmologist Fred Hollows began doing cataract operations in Eritrea, and quickly recognised that it was better to train others to do the surgery than to do it himself. However, the cost of lenses meant that cataract surgery remained financially unviable for most poeple. Therefore, Hollows built a local factory to manufacture lenses at a fraction of the usual cost (panel 2). Since then, similar programmes have been established in many LMICs. Other solutions for underuse (and overuse) will be discussed in the fourth paper in this Series.

Particularly wasteful is the global failure to capitalise on effective non-pharmalogical therapies, which, although less intensively marketed, are in many cases equally or more effective than their pharmacological counterparts. For example, pulmonary rehabilitation, which involves progressive exercise and education, has been shown to reduce hospital re-admissions and deaths for patients with chronic obstructive pulmonary disease by 70%; daily application of sunscreen can cut invasive melanoma rates by 50%; and insecticide impregnated bednets can prevent 50% of malaria cases.[31] Unlike their pharmaceutical counterparts, non-drug treatments are less intensively studied, more poorly described in research, weakly regulated, and inadequately marketed, particularly when the treatment or prevention is cheap or free.

(C) Clinician uptake

Even when access and availability of services are not an issue, discrepanices can occur between best care, as suggested by evidence and guidelines, and what clinicians do in practice. For example, the CareTrack study[21] found that adult Australians received appropriate care in only 57% of 35 573 eligible health-care encounters. In the USA, a study published in 2003 found that patients received only 54·9% of recommended care.[32] Furthermore, Hackbarth and Berwick estimated between US$102 billion and $154 billion in wasteful spending in the USA in 2011, which resulted from the failure to deliver best care—ie, poor execution or lack of widespread adoption of known best care processes.[23]

The international interest in research translation and quality improvement reflects the growing recognition of the slow and inconsistent uptake of effective medical

services by clinicians worldwide. Evidence–practice gaps generally narrow with time, but uptake can be both slow and incomplete, resulting in avoidable suffering. The slow implementation of Semmelweis's demonstration of the importance of hand washing to prevent transmission of infections in delivery wards illustrates the problems of uptake. A century after his death, there is still chronic underuse of appropriate hand washing in both HICs and LMICs, resulting in avoidable morbidity and mortality.[33]

Clinicians also do not administer many evidence-based treatments to appropriate patients. For example, a review of 29 studies in several countries[34] found underuse of anticoagulation in patients with non-valvular atrial fibrillation (NVAF) who are at high risk of stroke; even for patients with a CHADS-2 (congestive heart failure, hypertension, age >75 years, diabetes mellitus, and previous stroke or transient ischaemic attack) score of 2 or more, seven of nine studies reported treatment levels below 70%. In a 2014 national registry study from China, only 19% of patients with NVAF and acute stroke were discharged on anticoagulation therapy, and physician's concern around bleeding risk was the most common reason for not prescribing it.[35] A study of nursing home patients in France found that less than 50% of those at high risk of stroke were on anticoagulation; physicians caring for these patients wrongly thought that paroxysmal atrial fibrillation causes fewer thromboembolic events than persistent atrial fibrillation.[36] Although stroke prevalence is low in Africa compared with the developed world, atrial fibrillation is a leading cause of stroke, and studies in various African countries have shown underuse of anticoagulation, ranging from 34% in Cameroon to 75% in South Africa.[37] These studies also show that those living in urban centres were more likely to receive anticoagulation than those in rural areas. Furthermore, access to new oral anticoagulants is limited in many countries.

The slow and inconsistent uptake of β blockers for patients who have had a myocardial infarction illustrates the dynamic nature of underuse (figure 3). 8 years after the Beta-Blocker Heart Attack Trial,[38] only 34% of patients in the USA were treated at discharge, and even fewer had sustained adherence, according to hospital audit data. Subsequent improved uptake required support from national guidelines and inclusion in hospital accreditation standards.

The underuse of β blockers for more than a decade after publication of the original trial results, reinforces the fact that underuse of any given health service can occur at multiple stages along the continuum of care, even in HICs: health systems can fail to provide sufficient access to effective medication; physicians can fail to prescribe effective treatment; and patients might not adhere to effective treatment. It also highlights the important role of health system processes in addressing underuse through mechanisms such as quality improvement and accreditation processes to drive behavioural change.

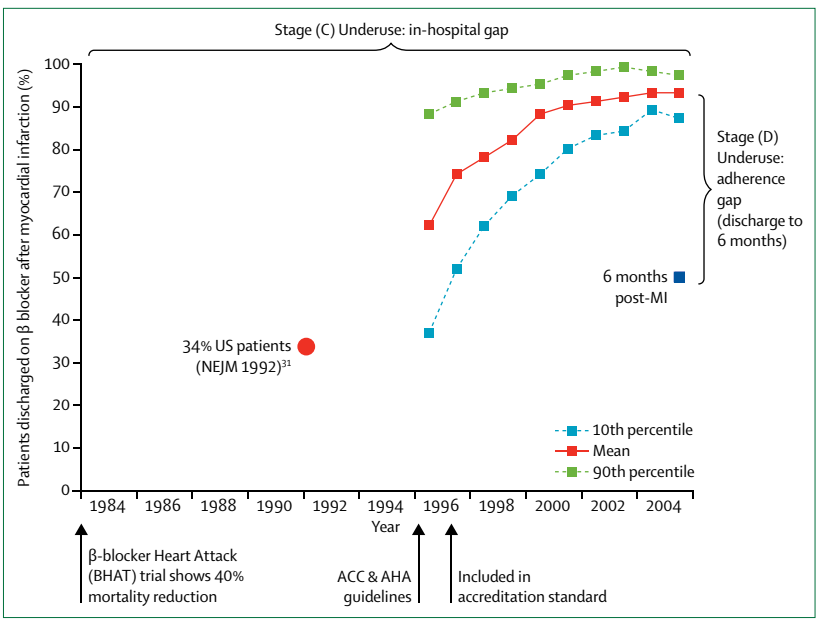

***Figure 3*: Timeline for adoption of β blockers after myocardial infarction**
Data extracted from Lee, 2007.[38] MI=myocardial infarction. ACC=American College of Cardiology. AHA=American Heart Association.

Slow, inconsistent, or stalled uptake by clinicians appears to be the standard rather than the exception, but with considerable variation across interventions. After angioplasty for the treatment of coronary artery disease was presented at an American Heart Assocation meeting in 1977, widespread adoption occurred in less than a decade in the USA and many other HICs. Subsequent evidence that transradial angioplasty reduces complications compared with the transfemoral technique has not led to comparably rapid uptake.[39] Some of the reasons for faster adoption, such as testability, ease of learning, relative advantage, and compatibility with the pre-existing system, were documented in the 1950s by Rogers in his seminal work on the diffusion of innovations;[40] however, these patterns do not always hold true for the uptake of medical interventions.

Underuse of a given effective intervention, even when affordable, is often greater in lower-income countries than in high-income countries, but not always. For example, the use of antenatal corticosteroids for preterm delivery (panel 1) varies considerably across countries. A recent survey of 29 countries[8] found that use ranges from 16% to over 90% (figure 4). While use appears to be higher in HICs, some LMICs, such as Palestine and Peru, have good uptake, whereas Japan and Brazil have low uptakes. However, a 2015 antenatal corticosteroid cluster-randomised trial,[41] which found an increase in neonatal deaths from antenatal corticosteroids, has suggested that transfer and scaling up of interventions requires caution, and sometimes additional evidence. Whether this increase arose as a result of unreliable dating of gestational age, increased sepsis, or other

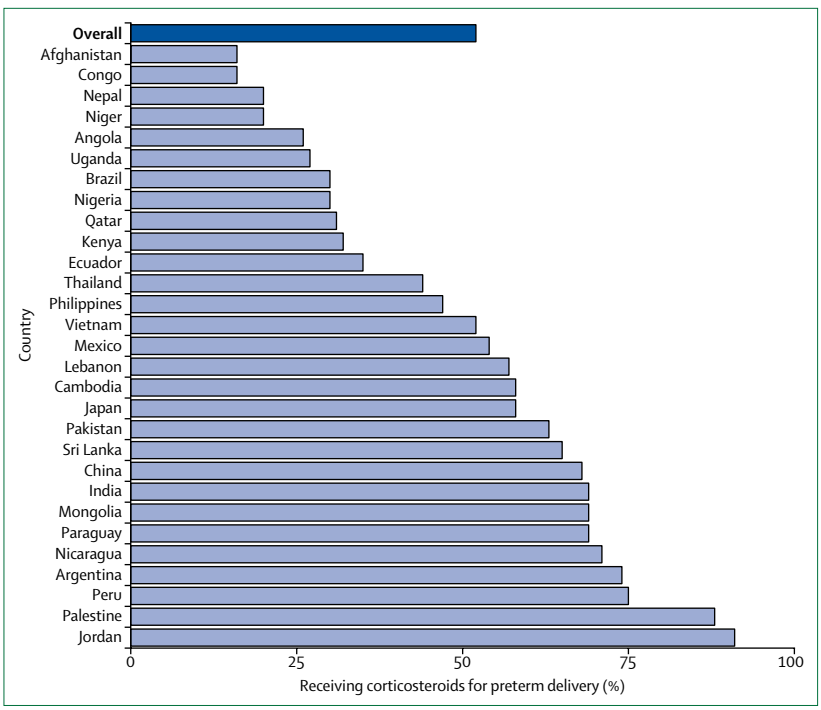

***Figure 4*: Use of antenatal corticosteroids for preterm delivery in 29 countries**
Underuse of antenatal corticosteroids remains prevelant 40 years after the first randomised controlled trial.[8]

problems is uncertain, but illustrates that interventions do not occur in isolation, but within a context of other diagnostic and supportive treatments.

(D) Patient use and adherence

Patients not attending scheduled visits or not accepting recommended care can occur as a result of barriers, including distance, affordability, culture, stigma, language, socio-economic status, and race. For example, in the Chinese registry study discussed previously, in 30% of non-use of warfarin cases, it was the patient who declined anticoagulation.[35] However, even when patients accept treatment recommendations adherence can be poor, hence diluting the effectiveness of a health-care system, that ensures that the first three stages on the treatment continuum do not pose a barrier to treatment. For example, secondary prevention with drugs and lifestyle changes following acute myocardial infarction has greatly improved outcomes, but a recent retrospective cohort analysis in the USA documented low adherence at 12 months after discharge for prescribed drugs: 66% of patients were taking their β blockers, 63% angiotensin-converting enzyme (ACE) inhibitors/angiotensin receptor blockers (ARBs), and 66% statins.[42] These findings are echoed in a multicountry survey of patients with a self-reported cardiovascular disease event in the past four years, where use of preventive medication was generally low. Adherence was highest in HICs (antiplatelet drugs 62%, β blockers 40%, ACE inhibitors or ARBs 50% and statins 66%), but much lower in low-income countries (8·8%, 9·7%, 5·2%, and 3·3%, respectively), and decreased with reduction of country economic status (p for trend <0·0001 for every drug type).[43]

The causes of non-adherence can be complex. Building on our previous example, underuse of warfarin in patients with NVAF at high risk of stroke is common, with less than 60% of people receiving optimum treatment.[34] As stated earlier, these care gaps may be in part due to the physician values and concerns, but can also result from poor assessment of patient values and concerns. In a study[44] of the maximum increased risk of bleeding (threshold risk) that people would tolerate to achieve a reduction of three strokes in 100 patients, the median threshold risk for both patients and physicians was ten additional bleeds, but with wider variability in patients than clinicians (patient range 0–100, physician range 0–50): one cluster of patients and physicians would tolerate fewer than ten bleeds and another cluster of patients, but not physicians, would accept more than 35. This example illustrates that when patients are poorly informed of treatment choices and potential outcomes, or their preference has been ignored or not elicited, the right treatment might not be delivered.

Harms to patients and health systems

What is the extent of harm caused by underuse? The most obvious and concerning harms are poor patient outcomes—unrelieved symptoms, serious disability, and deaths, including preventable maternal and perinatal deaths. Such adverse outcomes have been documented in both LMICs and HICs (figure 5), but there are also significant harms related to non-clinical outcomes, such as financial burdens for patients and families, spending precious remaining time in a hospital instead of at home, loss of patient autonomy, and diminished ability to participate in daily life.

Harms to patients

The substantial differences in life expectancy between countries suggest likely underuse of effective prevention and treatment, but precise quantification of the contribution of underuse to population-based health statistics is difficult. One study of declines in so-called amenable mortality—which would be attributable to underuse—found that it slowed for Americans younger than 65 years, relative to their peers in Europe. For example, from 1999 to 2007, amenable mortality rates in men fell by only 19% in the USA compared with 37% in the UK, and among women, the rates fell by 18% and 32%, respectively.[46] Deaths from circulatory conditions, such as cerebrovascular disease and hypertension, were considered the main reason that amenable death rates remained relatively high in the USA.[46] The authors point out several limitations in trying to estimate avoidable mortality, but suggest one reason might be the poor access for people who are uninsured. For example, insurance coverage reforms in Massachusetts (2001–2005 compared with 2007–2010) resulted in a significant decrease in all-cause mortality compared with

the control counties in other states (–2·9%; p=0·003, or an absolute decrease of 8·2 deaths/100 000 adults): deaths from causes amenable to health care also significantly decreased (–4·5%; p<0·001).[47] The number needed to treat was approximately 830 adults gaining health insurance to prevent one death per year. Similarly, a geographical regression discontinuity study in India found that government-funded health insurance for people below the poverty line had a positive effect on access to care and subsequently on health outcomes.[48] Removal of financial barriers is very likely to reduce underuse and improve health outcomes. This and other countermeasures for underuse (and overuse) will be discussed in greater detail in the fourth paper in this Series.

Maternal mortality is largely avoidable, and hence provides a clearer picture. Although maternal mortality has fallen globally by 47% between 1990 and 2010, the Millenium Development Goal (a 75% reduction) was not achieved by 2015. Of the estimated 287 000 maternal deaths in 2010, LMICs account for 99%, with the majority in sub-Saharan Africa (162 000) and southern Asia (83 000). The more than 100-fold differences in maternal mortality between countries suggest that most of these deaths are preventable, and figure 5 shows estimates of the potential effect of better access to services in Pakistan.

Some changes in practice are demonstrably feasible at low or no cost. In the Philippines, Maria Silvestre found that poor newborn care, such as no delayed clamping, was causing preventable morbidity and mortality. Maria Silverstre and colleagues developed a guideline and training programme[49]—Unang Yakap (the first embrace)—to overcome this, reducing admissions to the neonatal intensive care unit (NICU), neonatal sepsis rates, and maternal and newborn deaths in the 11 pilot hospitals. This example shows the negative effect of underuse of delayed clamping on both morbidity and mortality, and the health system, which pays for preventable NICU admissions.[50]

With constrained budgets, not all underused interventions are affordable. Hence the Disease Control Priorities in Developing Countries Report[51] has recommended four categories to describe the efficiency of interventions: (1) neglected opportunities (low coverage but high cost-effectiveness; (2) interventions to scale back (high coverage but low cost-effectiveness; (3) interventions for which scaling up is inefficient (low coverage and low cost-effectiveness); and (4) cost-effective interventions used widely (high coverage and high cost-effectiveness). The first of these is most relevant to underuse and the report highlights more than 25 low-cost opportunities that are neglected, which often have a cost of less than $100 per disability-adjusted life-year averted, such as: hygiene promotion for diarrheal disease; training volunteer paramedics with lay first responders; intermittent preventive malaria treatment in pregnancy; insecticide-treated bednets; acute management of myocardial infarction with aspirin and β blockers; and HIV/AIDS peer and education programmes for high-risk groups.

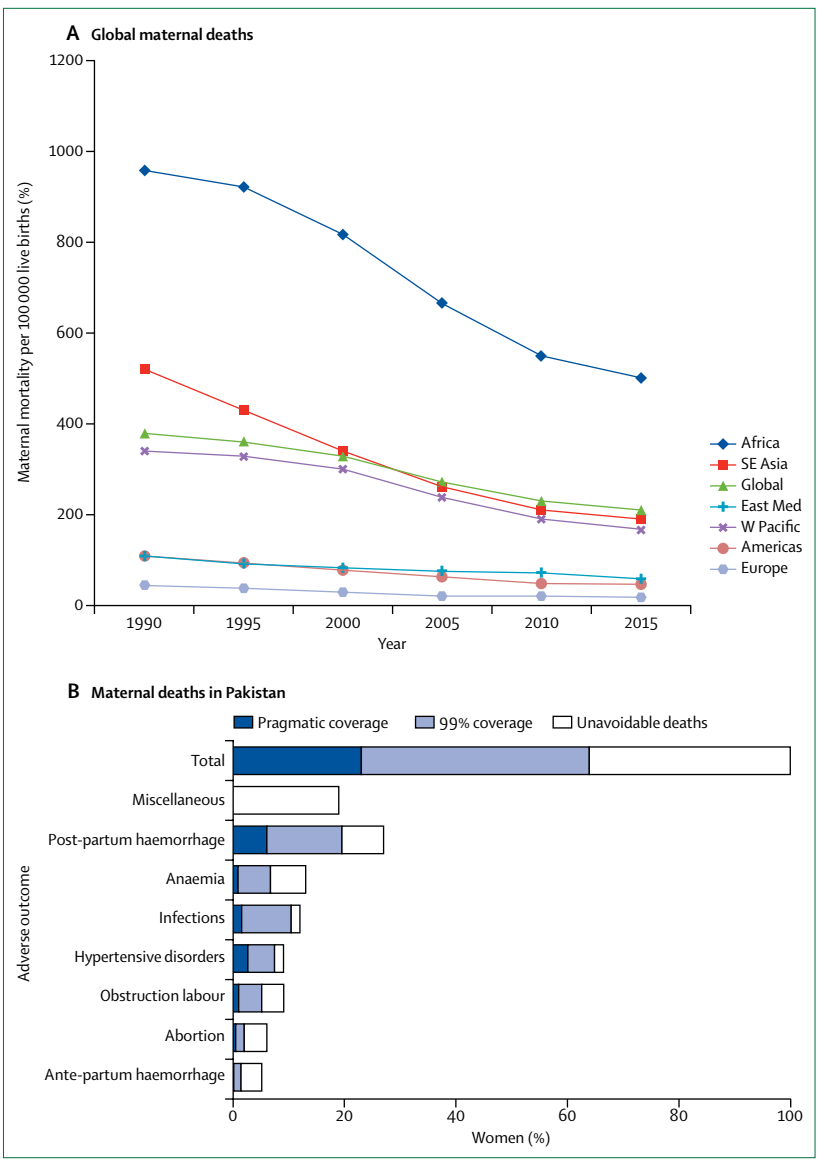

***Figure 5*: Adverse outcomes of underuse in both low-income and middle-income and high-income countries**
(A) International variation in maternal death rate. (B) Causes and preventability of maternal deaths in Pakistan from an improved range of maternal, newborn, and child health primary health-care services.[45] SE=southeast. W=western. Med=mediterranean.

Reducing underuse can apply to processes designed to improve care. For example, by a stepwise process improvement in the insertion of central lines in intensive care units, Pronovost was able to reduce infections leading to sepsis and death to zero.[52] When these processes were replicated across 103 intensive care units in Michigan, this improvement saved 1500 lives and around $175 million over an 18 month period, suggesting underuse of this quality improvement process has resulted in considerable mortality and cost. Similarly, the CRUSADE Quality Improvement Initiative tracked and improved coronary

care.[53] The failure to use such processes represents both unnecessary loss of lives and wasted resources. This example also illustrates a wider problem that the underuse of effective interventions is not limited to clinicians and patients; policy makers and managers also fail to implement processes based on evidence.[54–56]

Harms to health systems

Underuse often represents a misallocation of resources: opportunities to provide needed, effective, and cost-effective care are often competing with less effective services, which may be more heavily marketed and more expensive. Moreover, what might represent underuse in one country has to be considered in the proper context in another, according to resources and priorities. For example, the Department of Health in the Philippines has invested heavily in newer, expensive vaccines such as human papilloma virus, rotavirus, pneumococcal, and dengue vaccines, despite the fact that they have not yet achieved full coverage for more standard, cheaper vaccines such as DPT, measles, mumps and rubella, and polio, and consequently children are still dying of measles, diphtheria, and tetanus.[57]

In many countries, Health Technology Assessment processes have been established to control overuse, but this has had some drawbacks: new, expensive, high technology devices, services, and pharmaceuticals come under scrutiny, because they are expensive, often have an eager sponsor making the submission, and have an enthusiastic and influential clinical workforce (such as surgeons or specialists). Low-technology treatments might have high value but lack these three dimensions and thus avoid the re-imburser's scrutiny.[58]

Conclusion

Underuse occurs at all stages along the care continuum: from poor health-care access, to lack of availability, failure of providers to deliver service, and failure of patients to use it. Underuse also appears to occur across countries, regardless of payment model or health system, and in clinical settings ranging from rural clinics to tertiary hospitals. Despite the fact that underuse is frequently recognised as a problem around the world, obtaining good estimates of its extent is hampered by a lack of studies of many conditions and health services, the complexity of the problem, and the paucity of population monitoring. Furthermore, studies of the harms of underuse are in particularly short supply. Although global spending on health and medical research is about $200 billion per year, only a small fraction is aimed at better understanding and overcoming the barriers that prevent better uptake of effective interventions, and methods to make them affordable.

The estimates and examples of underuse in this paper indicate that it remains a serious problem in both HICs and LMICs. Underuse causes substantial harm to both patients and health systems, and is deserving of greater attention from the health care and research communities. A much more systematic approach for identifying important areas of underuse is needed if we are to address this serious problem.

The global health community must focus its attention and resourcing for health policy and health systems work at each of the stages we have outlined. Subsequent papers in this Series will look at the causes and drivers of underuse (and overuse) and possible solutions, but investment and action are urgently required.

Contributors

SB, VS, and PG drafted the outline; PG led the redrafting; all authors contributed to sections and examples in the paper, provided substantial revisions, and approved the final version of the manuscript.

Declaration of interests

We declare no competing interests.

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