Title: How much healthcare is wasted? A cross-sectional study of outpatient overprovision in private-for-profit and faith-based health facilities in Tanzania

Abstract

Overprovision - healthcare whose harm exceeds its benefit - is of increasing concern in LMICs, where the growth of the private-for-profit sector may amplify incentives for providing unnecessary care, and achieving universal health coverage will require efficient resource use. Measurement of overprovision has conceptual and practical challenges. We present a framework to conceptualise and measure overprovision, comparing for-profit and not-for-profit private outpatient facilities across 18 of mainland Tanzania's 22 regions. We developed a novel conceptualisation of three harms of overprovision: economic (waste of resources), public health (unnecessary use of antimicrobial agents risking development of resistant organisms) and clinical (high risk of harm to individual patients). Standardised patients (SPs) visited 227 health facilities (99 for-profit and 128 not-for-profit) between May 3 and June 12, 2018, completing 909 visits and presenting four cases: asthma, non-malarial febrile illness, TB and upper respiratory tract infection. Tests and treatments prescribed were categorised as necessary or unnecessary, and unnecessary care classified by type of harm(s). 53% of 1995 drugs prescribed and 43% of 891 tests ordered were unnecessary. At the patient-visit level, 81% of SPs received unnecessary care, 67% received care harmful to public health (prescription of unnecessary antibiotics or antimalarials) and 6% received clinically harmful care. 13% of SPs were prescribed an antibiotic defined by WHO as 'Watch' (high priority for antimicrobial stewardship). Although overprovision was common in all sectors and geographical regions, clinically harmful care was more likely in for-profit than faith-based facilities, and less common in urban than rural areas. Overprovision was widespread in both for-profit and not-for-profit facilities, suggesting considerable waste in the private sector, not solely driven by profit. Unnecessary antibiotic or antimalarial prescriptions are of concern for the development of antimicrobial resistance. Option for policymakers to address overprovision include the use of strategic purchasing arrangements, provider training, and patient education.

Introduction

Addressing inefficiency is crucial if governments are to free up scarce resources needed to strengthen comprehensive health service delivery towards the attainment of the sustainable development goals [1]. One way to reduce inefficiency is to tackle waste. WHO estimate that 20-40% of spending on health is wasted, and that an important component is overprovision of healthcare [2]. Overprovision has been defined as provision of medical services for which the potential for harm exceeds the potential for benefit [3]. It includes unnecessary testing, procedures, medication, referral or inpatient admissions [4], and frequently co-exists with under-provision [5].

There are numerous negative consequences of overprovision. First, there are the risks of unnecessary adverse events, without any corresponding health benefits. In addition to physical side-effects, overprovision may cause patients anxiety when waiting for test results, or if inconclusive or false positive results lead to unnecessary investigations or diagnosis of a disease they do not have or that is not causing them harm [6, 7]. Overprovision is also wasteful. It results in substantial costs for publicly funded and insurance-based health systems, reducing resources available for effective care [8]. While such inefficiency is a major concern in all health systems [9], it is of particular importance for low and middle income countries (LMICs) striving to move towards Universal Health Coverage in a context of tight fiscal constraints, which could become even more strained with the global slowdown of the economy in light of Covid-19 [10, 11]. Overprovision can also result in substantial unnecessary expenditures for households, in the form of out-of-pocket payments for user fees or insurance co-payments [12]. Patients may also incur the opportunity costs of lost time and wages from receiving unnecessary care or from adverse events [7]. Finally, overprovision can have broader public health consequences; a commonly highlighted type of overprovision is unnecessary use of antibiotics and antimalarials, which contribute to antimicrobial resistance (AMR) [13, 14]. It is estimated that drug resistant infections will account for 10 million deaths annually by 2050 [15], with inappropriate antimicrobial use recognised as a primary driver of AMR [14].

Overprovision is commonly highlighted in high income countries [4], with documentation of tests, treatments and procedures for which the risks outweigh the benefits for all patients or certain patient groups [16]. In LMICs, however, the focus has typically been on under-provision, driven by poor access to healthcare and lack of resources within the health system [17], while the question of overprovision has received little attention.

There are substantial methodological challenges in measuring overprovision in all settings. Some empirical work identifies overprovision in an indirect way by comparing prescription rates or use of healthcare (e.g. caesarean sections) across groups or against an established benchmark. Such indirect

measures allow identification of facilities, geographical areas or patient groups with relatively high rates of certain practices or which exceed established norms. For example, a Brazilian birth cohort study found that 81% of private sector patients underwent a caesarean section, compared to 36% of public sector patients [18]. Indirect measures are also frequently used as an indication of antibiotic overprovision. For example, global consumption of antibiotics is estimated to have increased by 39% between 2000 and 2015, driven mainly by LMICs [19]. However, such aggregate measures do not provide a measure of actual overprovision; they can only suggest that overprovision may exist, as there is no indication of what appropriate rates of provision should be. They also ignore case-mix variation, and may fail to identify overprovision if rates are universally inappropriately high.

Direct measures of overprovision tackle these issues by using individual patient level data, comparing care provided to pre-defined treatment guidelines for a specific clinical scenario. In practice such measures can be challenging to implement, as much medical care falls into a 'grey zone' where there is considerable scope for clinical judgement in reference to the individual case confronting the provider, and an incomplete evidence base means it is not always possible to classify care as definitively necessary or unnecessary [4]. Even where appropriate care is clearly defined, direct measurement is rarely possible from routine medical records, which can only ever reveal the clinician's actions and judgements, not the true condition. Moreover, in LMICs, record availability is very patchy, and where present they generally contain insufficient details on clinical presentation and history for an assessment of appropriateness of diagnosis and care to be made [20]. As a result, the limited number of LMIC studies using direct measures based on medical records have small sample sizes from middle income settings [21-26], with only two from a sub-Saharan African context.

Standardised patients (SPs) are an alternative tool for direct measurement of overprovision. They are increasingly used for measuring clinical quality of care in large studies, in order to assess deficits in care [27] and evaluate quality improvement strategies [28]. SPs have particular strengths for direct measurement of overprovision as it is possible to define what care is necessary for the case presented, they control for patient-mix, and providers are blinded to measurement [29, 30]. While SP studies do not typically have a primary objective of measuring overprovision, a small number of studies report on some aspects of overprovision. A study of informal providers in India found that 70% of SPs (with symptoms of asthma, angina or an absent child with diarrhoea) were given some unnecessary or harmful care [31], while a similar study of angina and asthma SPs visiting public and private Indian health facilities found 80% were given unnecessary care [32]. In rural health facilities in China, 64% of SPs (with symptoms of angina or an absent child with diarrhoea) were prescribed an unnecessary or harmful drug [33], and 42% of SPs (with symptoms of TB, angina or an absent child with diarrhoea) were prescribed inappropriate antibiotics [34]. A study of SPs with symptoms of

angina, asthma, TB or an absent child with diarrhoea visiting public and private health facilities in Nairobi, Kenya, found that 50% were prescribed an unnecessary antibiotic [35]. Analysis of several studies using SPs with TB symptoms found that between 8% and 97% of SPs were given some kind of unnecessary care, dependent on country, setting and provider type [36].

There is concern that overprovision may be a particular problem in private for-profit facilities [37], because information problems, and fee-for service payment or reimbursement systems combine to incentivise providers to induce demand beyond that which an informed patient would choose [38]. The private healthcare sector is expanding rapidly in LMICs. Analysis of Demographic and Health Surveys in 70 LMICs suggests that the private sector provides around 63-67% of care for sick children, and 30-39% of maternal health care, when averaged across countries [39]. While the private sector category in such surveys also includes faith-based facilities which are important in some contexts, it is the for-profit facilities that are growing most rapidly [40]. There is therefore increasing interest in ensuring that care delivered by private for-profit facilities is appropriate.

We set out to quantify the prevalence of overprovision to outpatients visiting private health facilities in Tanzania, and to investigate whether overprovision varied by profit status. We first provide a novel conceptualisation of overprovision, classifying care in terms of whether it causes an economic, clinical and/or public health harm, to define a set of overprovision indicators for both drugs and tests. Using undercover standardised patients, we measure overprovision for four cases of asthma, non-malarial febrile illness (NMFI), tuberculosis (TB) and upper respiratory tract infection (URTI), in a large sample of for-profit and not-for-profit facilities across Tanzania.

Methods

Conceptualising overprovision

We conceptualise the harms of overprovision as falling into three overlapping categories: economic, clinical, and public health harm (Figure 1). All overprovision is classified as an economic harm as any unnecessary care involves waste of resources for the patient, provider or the health system funder. In addition, some forms of overprovision are also considered to have a potential clinical harm, a public health harm, or both.

Drugs are classified as unnecessary (economic harm) if they are neither “required” nor “palliative” for a specific case. Required drugs are those recommended as correct treatment for the condition in the national standard treatment guidelines [41]. Palliative drugs are those not required but for which there is evidence or recommendation for control of symptoms. Unnecessary drugs can be further divided into clinical harm if there is a potential significant risk to patient health from short-term use (e.g. a non-steroidal anti-inflammatory medicine for asthma patients) or from delivery through a

high risk route (e.g. an IV drip); or as a public health harm if personal use has potential to increase antimicrobial resistance and thus indirectly affect the health of others (e.g. provision of antibiotics or antimalarials for a patient with an uncomplicated viral URTI, or an antimalarial for a patient with a negative malaria blood test). An example of a drug with an economic harm, but no clinical or public health harm, would be paracetamol for a patient with asthma: it will neither treat the condition nor alleviate their symptoms and is therefore wasteful. An example of a drug which may cause all three harms would be fluoroquinolone antibiotics for a patient with TB: this could mask the symptoms, delaying access to correct treatment and therefore causing clinical harm, as well as risking the development of antimicrobial resistance, and being wasteful.

Diagnostic tests are classified as unnecessary / an economic harm if they were neither "required" nor "appropriate" for a specific case. Required tests were those recommended as part of correct management of the condition or symptoms in the national standard treatment guidelines [41]. Appropriate tests were those not required but still considered potentially useful for making a diagnosis given the symptoms and setting. Unnecessary tests were further classified as clinically harmful if there was a potential significant health risk to the patient from the test, such as an unnecessary CT scan exposing a patient to a high dose of radiation. A test with an economic harm but no clinical harm would be urinalysis for a patient without symptoms of a urinary tract infection. A test which could cause public health harm might be a low-specificity antibody test for a highly transmissible virus: a false positive could encourage someone to risk exposure (and thus infection and onward transmission to others) because they believe themselves to be immune [42]. We acknowledge that there are grey areas is classifying diagnostic tests: some unnecessary tests may be clearly "inappropriate" (not helpful in making or ruling out a diagnosis), while others could be considered "rarely appropriate" (unlikely to be appropriate except in rare circumstances, for example a Widal test for typhoid in a patient with malaria symptoms). As rarely appropriate tests would not be considered typical good practice, we classify rarely appropriate tests as unnecessary.

Study facilities

Data were collected between 3rd May and 12th June 2018 as part of a wider evaluation of a quality improvement programme in 227 Tanzanian for-profit, faith-based and NGO private health facilities. The faith-based sector is closely tied to the public sector, often employing government salaried health workers [43]. Faith-based facilities normally charge fees (or invoice health insurance) to recuperate the costs of care, but may provide free care for certain conditions or to the poorest patients. More detail on facility selection is provided in the appendix. Potentially eligible facilities in the Northern, Eastern, Central, Southern and Southern Highlands zones of Tanzania were identified by the Association of Private Health Facilities in Tanzania (APHFTA) and the Christian Social Services

Commission (CSSC) from among their members. Facilities were ineligible if they refused consent, provided specific services only (e.g. mental health or maternity), or were tertiary hospitals. The sample included dispensaries (the lowest level of health facility, often staffed by a single clinical officer with three years of post-secondary clinical training), health centres (a larger facility with more staff and which may admit patients), and hospitals (which all have inpatient wards and usually have a fully qualified doctor on staff). Study facilities were widely dispersed across both urban and rural areas, in 18 of mainland Tanzania's 22 regions.

Data collection

SPs are undercover healthy fieldworkers, trained to present at health facilities reporting specific symptoms and history, and to record the care they receive. We describe the methods and the protocol for the safety of SPs in more detail in the appendix. Based on pre-defined selection criteria and a systematic review of the literature [44] we developed four SP cases: asthma, non-malarial febrile illness (NMFI), tuberculosis (TB) and upper respiratory tract infection (URTI). Symptoms and required drugs and tests for each case are described in Table 1. These cases were selected because there were clear clinical guidelines on their management, they were of clinical and/or public health significance, they were reasonably common in all study facilities, healthy SPs could falsify the symptoms, and they posed minimal risks to SPs, for example from invasive examinations.

We trained 17 SPs for two weeks, with extensive piloting and testing to ensure faithful presentation of case scripts and accurate recall of events. Facility managers were asked to consent to a visit from an undercover SP that would take place at an unspecified date over the next three months. Each facility received the four SP cases. SPs were organised into teams of four containing two male and two female SPs, each of whom were trained to portray two cases. For each facility, whether the case would be portrayed by the female or male SP was randomly assigned. Teams were allocated to facilities according to geographical region to ease logistics.

SPs completed a debriefing questionnaire on a smartphone using ODK Collect immediately after the visit, and fieldwork supervisors verified the information with the SP the same day. The questionnaire recorded history taking by the doctor, laboratory tests ordered and their results, diagnosis given by the doctor, treatments prescribed and dispensed, and any fees paid. For safety reasons, SPs refused venous blood draws, sputum tests, X-rays and HIV tests but did record them as ordered. If asked about their HIV status, SPs said they did not know. SPs carried out other laboratory tests including fingerprick tests for malaria and provided urine samples if requested by the clinician. They bought any drugs prescribed but did not buy treatments which would be administered at the facility (such as injections) or agree to any other type of treatment, such as receiving a saline drip. In a follow-up

telephone survey with facility managers, 5.3% of SP visits were categorised as detected; 0.5% of visits to for-profit facilities were detected, compared to 9.1% of those to not-for-profit facilities (appendix Table A4).

Analysis

We analysed the data at two levels: first, at the level of item provided (i.e. out of all drugs prescribed or all tests ordered); and second, at the level of the patient-visit. At the item level, we calculated the proportion of all drugs prescribed that fell into the categories: required, palliative, economic harm, clinical harm, and public health harm. Similarly tests were classified as: required, appropriate, economic harm, clinical harm and public health harm. Classification of care into harms was developed with a clinician experienced in working in low-resource settings and a pharmacist specialising in the rational use of medicines. A full categorisation of all drugs and tests is given in appendix Table A2.

We then carried out the analysis of overprovision at the patient-visit level. We defined an overall patient-visit level outcome for each of the three domains of harm (economic, clinical and public health), with additional outcomes of specific interest defined for economic and public health harms (Table 2). We calculated the prevalence of these outcomes overall and by case. These outcomes capture the presence of any overprovision within a consultation rather than the intensity of overprovision, which is measured by the drug and test level outcomes.

To examine the role of profit status in overprovision, facilities were categorised as not-for profit if faith-based or run by an NGO, and for-profit otherwise. Hospitals were excluded from this facility level analysis as all 36 hospitals in the sample were not-for-profit. Odds ratios for the relationship between the three overall patient-visit level outcomes and profit status were calculated for each of the four SP cases using logistic regression. In order to adjust for other facility characteristics associated with profit status, a multivariate analysis was then carried out combining the four cases. To assess the validity of pooling the four SP cases, likelihood ratio tests were performed to test for interaction between profit status and SP case for each of the three outcomes. We used multilevel logistic regression with profit status, facility level (dispensary or health centre), location type (urban, peri-urban or rural) and SP fieldworker fixed effects, and facility random effects, to calculate odds ratios for the association between the three outcomes and the facility characteristics.

Results

Of the 227 health facilities where SP visits were completed, 56.4% were not-for-profit facilities, and the remaining 43.6% private for-profit (Table 3). The majority (55.1%) were dispensaries, the rest being health centres (29.1%) and hospitals (15.9%). Dispensaries were more likely to be for-profit

and health centres not-for-profit. All 36 hospitals were not-for-profit. Most rural facilities were not-for-profit, while for-profit facilities dominated in peri-urban and urban areas.

909 SP visits were completed. 1955 drug items were prescribed to the 909 SPs. The mean number of drugs prescribed was 1.8 for asthma SPs, 1.7 for NMFI, 2.4 for TB and 2.7 for URTI. The minimum number of drugs prescribed was 0 and maximum was 7. Of all drugs prescribed, 41 could not be identified and were therefore not categorised. Of the 1914 drugs categorised, 46.2% were defined as required or palliative, and 53.8% as unnecessary (Figure 2). 3.0% of drugs were classed as clinically harmful, 35.3% as a public health harm, and 0.3% as both. SPs presenting with TB symptoms were most likely to be prescribed unnecessary drugs (60.2%), and those presenting with asthma least likely (46.6%).

891 tests were ordered for the 909 SPs. The mean number of tests ordered was 0.5 for asthma, 1.8 for NMFI, 0.9 for TB, and 0.8 for URTI. The minimum number of tests ordered was 0 and maximum was 6. Of all tests ordered, 56.7% were categorised as required or appropriate and 43.3% as unnecessary. No tests were classified as having public health or clinical harms (Figure 3). The percentage deemed unnecessary ranged from 26.5% for TB SPs to 85.0% for asthma SPs.

At the patient-visit level, the prevalence of economic and public health harms was generally high, while clinical harm measures were substantially lower (Table 4). In 81.4% of visits, SPs were ordered some kind of unnecessary care, with 72.8% prescribed unnecessary medication and 29.8% ordered an unnecessary test. Unnecessary care was almost universal among those with URTI symptoms, with 97.8% receiving some unnecessary care, mainly unnecessary medications (prescribed to 95.6%), though unnecessary tests were ordered for a substantial minority (25.6% of SPs). SPs with asthma symptoms were least likely to experience overprovision, though a majority still received some unnecessary care (62.1%), mainly unnecessary medications (52.4%). SPs presenting with NMFI symptoms were particularly likely (55.3%) to be ordered an unnecessary test, most frequently urinalysis (in 40.8% of NMFI SPs) and Widal testing (in 23.7%).

6.2% of SPs were prescribed a medication or IV fluids deemed clinically harmful; this was mainly driven by medications with only 0.2% of SPs ordered IV fluids. Provision of harmful medication was most common for SPs with TB symptoms (15.0%); in this case, steroids (prescribed to 12.3% of TB SPs) and fluoroquinolones (2.2% of TB SPs) were defined as clinically harmful due to their potential to supress TB symptoms (and therefore prevent diagnosis) without treating the disease. Non-steroidal anti-inflammatories were defined as harmful for the asthma case, and prescribed to 5.3% of asthma SPs. Diazepam and tramadol were defined as clinically harmful in all cases due to a high risk of habit-forming, and were prescribed to 0.7% and 0.6% of all SPs respectively.

Care likely to be harmful to public health was widespread, with 67.2% of SPs prescribed an unnecessary antibiotic or antimalarial. This was dominated by unnecessary antibiotic prescriptions (62.7% of SPs), rather than unnecessary antimalarials (8.9%). Unnecessary antimalarials were prescribed to 24.1% of SPs presenting with NMFI symptoms, who told the doctor that they thought they had malaria but were not actually parasitaemic. Unnecessary antibiotic prescriptions were especially common among those with TB symptoms (78.0%) and URTI symptoms (89.9%). Some particularly concerning practices were also observed, with 13.1% of SPs prescribed an antibiotic on the WHO Watch or Reserve lists of antibiotics which are designated as a high priority for antimicrobial stewardship. This was most frequent for SPs with NMFI symptoms, of whom 18.9% were prescribed a Watch antibiotic, most commonly ciprofloxacin. Among other case types the most common Watch antibiotics were azithromycin and erythromycin. 5.5% of SPs were prescribed two or more antibiotics in one visit, including 11.0% of SPs with TB symptoms.

Overprovision was often accompanied by underprovision, with 61.8% SPs receiving unnecessary care while not receiving the recommended treatment. Even among SPs who did receive the correct treatment (28.2%), additional unnecessary treatment was common, with only 8.6% overall receiving the correct treatment without any unnecessary care.

Univariate analysis of the association between profit status and overprovision harms among health centres and dispensaries is presented in Table 5. The results suggested no significant relationships between profit status and economic or clinical harms in any single SP case, but profit status was associated with public health harms. For SPs presenting with asthma symptoms, 50.5% of visits to for-profit facilities resulted in an unnecessary antibiotic or antimalarial prescription compared to 34.8% in not-for-profit facilities (OR=1.91, p=0.029). A similar relationship was observed among NMFI SPs, with 70.0% of those visiting for-profit facilities receiving care harmful to public health, compared to 53.3% at not-for-profit facilities (OR= 2.05, p=0.018). Although rates were also higher among TB and URTI SPs at for-profit facilities, the relationships were not significant. A pooled analysis across cases found strong evidence of increased public health harms in for-profit facilities (OR=1.64, p=0.009) but weaker evidence of increased clinical harm (OR= 1.92, p=0.060). Likelihood ratio tests showed no evidence of interaction between SP case and profit status (p=0.3586 for any unnecessary care, p= 0.5890 for any public health harm, and p=0.6910 for any clinical harm).

When combining SP cases and adjusting for facility level and location in multivariate models, different patterns emerged (Figure 4). Profit status was no longer a significant predictor of public health harms; the relationship appears to be confounded by facility level, with some evidence that health centres were less likely to provide care harmful to public health than dispensaries (OR=0.62,

p=0.078). For-profit status was a significant predictor of clinically harmful care in the multivariate model (OR 3.15, p=0.016). Univariate analysis had underestimated the relationship between profit status and clinically harmful care, perhaps due to negative confounding by location; urban facilities (which were most likely to be for-profit, see Table 3) were less likely to provide clinically harmful care than those in rural areas (OR= 0.36, p= 0.043). Full multivariate results are given in appendix Table A3.

Discussion

Overprovision of all types was high in this setting: over half of drugs prescribed and more than two-fifths of tests ordered were classified as unnecessary. Analysis at the patient-visit level revealed that four out of five SPs received some type of unnecessary care when visiting the outpatient department of private health facilities. Practices harmful to public health were also prevalent: nearly two-thirds were prescribed an unnecessary antibiotic, with more than one tenth prescribed an antibiotic labelled high priority for antimicrobial stewardship and over 5% prescribed multiple unnecessary antibiotics, while nearly 10% were prescribed an unnecessary antimalarial. It was also concerning that a minority of patients (6%) were prescribed a medicine which could cause clinical harm. Profit status was not as universally associated with overprovision as hypothesised: after adjusting for facility level and location, for-profit health centres and dispensaries were more likely to provide clinically harmful care, but not care that was harmful to public health, or unnecessary care as a whole.

An SP study in Nairobi with some similar cases (asthma, TB, child diarrhoea and unstable angina) found that 49% of SPs were prescribed unnecessary antibiotics, lower than in this work; while the Nairobi study included public facilities (unlike this one), public clinics were just as likely to give unnecessary antibiotics, so that alone does not explain the different practices [45]. Similarly, a study in India found no significant difference in the probability of prescribing unnecessary treatment when comparing public and private facilities [32]. Research in China found that 61% of SPs presenting with TB symptoms were prescribed an unnecessary antibiotic, 7% a fluoroquinolone and 5% a steroid [46]. They were less likely to be prescribed antibiotics (but not the clinically harmful steroids and fluoroquinolones) at higher level county hospitals than lower level township health centres or villages clinics, reflecting a similar relationship between level and overprovision to the one we found in Tanzania. Township health centres were less likely than village clinics to dispense unnecessary medications for SPs with child diarrhoea and unstable angina [33].

The study had a number of strengths. Using SPs allows us to control for case-mix, which means our estimates are not biased by the different types of patients (and their conditions) which may attend different types of facilities. The Hawthorne effect is minimised, so it is unlikely that provider behaviour has changed in response to measurement. SPs also allow us to control exactly how patients present and define what care each case is meant to receive based on the national standard treatment guidelines, which means we can categorise what is necessary and unnecessary care to measure the rate of overprovision directly. This is one of few large scale studies that have used SPs to estimate the prevalence of overprovision, which is typically measured using indirect methods [4].

The univariate analysis results showing that for-profit facilities are more likely to provide unnecessary antibiotics or antimalarials for asthma and NMFI than not-for-profit facilities aligns with other studies comparing private and public sectors [18, 25, 48], and is consistent with the idea that providers may induce demand if they have a financial incentive to do so [49]. However, profit status is hard to untangle from other associated factors: for-profit facilities in this sample were more likely to be of a lower level and in urban or peri-urban areas, and these factors themselves are associated with public health harms. Lower level facilities are likely to have staff with fewer qualifications and limited diagnostic skills , which might lead to routine presumptive use of antimicrobials [13]. That overuse of antibiotics and antimalarials is less common in rural areas runs contrary to arguments that prescription of presumptive medicines is necessary when patients may live some distance from a health facility and would struggle to return if their condition deteriorated rather suggesting that overuse is a response to market conditions. When all factors are adjusted for together, only facility level has a weak relationship with public health harms, suggesting that provider skill is more important in preventing this kind of overprovision than changing incentives.

Clinically harmful care was associated with profit status when adjusting for facility level and location. However, it is notable that this relationship between profit status and overprovision does not hold when examining unnecessary care as a whole. This lack of a stronger relationship between profit and unnecessary care is surprising given the incentive for for-profit facilities to sell tests and drugs. It may be that not-for-profit facilities also face these incentives, as they also charge for most care, and are otherwise reliant on voluntary donations. It could also be that profit status does not capture the full variation in provider incentives across different mechanisms for facility reimbursement. The limited association with for-profit status may also suggest that overprovision is not only driven by financial incentives in our setting, but by ingrained clinical norms, learnt either through medical education or from colleagues in clinical practice. Cognitive bias may also explain why clinicians provide unnecessary care; at least 40 types of cognitive biases have been identified in medical

decision making [50]. One bias particularly pertinent to overprovision is commission bias, a preference for action over inaction because it appears better to do something than nothing, even if the action could have harmful consequences [51]. Clinicians aim to relieve suffering, and so may find it difficult not to take any action [52]. Patients themselves may play an important role in overprovision, whether through directly demanding unnecessary tests or treatments (though in our study SPs were trained not to do this), or through providers' perceptions of what patients understand to be 'good care'.

These findings have important implications for both public health and health systems financing. The widespread prescription of unnecessary antibiotics and antimalarials may contribute to the development of antimicrobial resistance in the community, reducing the effectiveness of existing drugs at treating infections. The prescription of fluoroquinolones and steroids to patients with TB symptoms risks those symptoms being masked and patients failing to receive the correct treatment, increasing the chances of onward transmission of TB. The use of habit-forming benzodiazepines and opioids (diazepam and tramadol in this setting) in outpatients with mild symptoms is concerning, especially give the widespread misuse of prescription drugs now observed in West Africa [53]. It is also clear that a large part of household expenditure on health costs, and likely the expenditure of social health insurance schemes which empanel private facilities, is on care which provides no benefit to the patient and could be put to better use. An analysis of the estimated value of unnecessary care will be presented in a separate paper. It is notable that many patients who receive unnecessary care did not receive the required or recommended treatment, that is, overprovision and underprovision coexist even within a single patient [54].

Policy interventions to curb overprovision may act at a system, provider, or patient level [55]. In this work, we were only able to measure overprovision to patients who paid out-of-pocket for their care. In reality, with the roll out of social health insurance, an increasing proportion of patients will be covered by insurance [11]. Social health insurance purchasers could use strategic purchasing arrangements such as capitation to limit incentives for overprovision on the supply side and co-payments on the patient side. Regulation could also play a role in tackling overprovision, for example on the degree to which clinicians are able to sell medicines, or whether they could only be dispensed by independent pharmacies. Strategies involving the education, training and support of health workers could also be used. Pre-service medical education, as well as ongoing professional development programmes, could place greater emphasis on the harms of unnecessary care, the importance of evidence-based decision making, and incorporate tools for "de-biasing" (cognitive methods for reframing decision making) [56]. Patient education programmes could also be used to

improve awareness of when clinicians might make errors in decision-making and encourage patients to be more active in making decisions about their health, as well as reducing demand for treatments such as antibiotics. The evidence base on the impact of these various strategies is very limited, with the exception of some antibiotic studies [57, 58], but given the extent of overprovision and consequences for individual patients and the health system, we urgently need to turn our attention to addressing this concern.

There are several key limitations of the SP method. First, SPs are not real patients. In practice, real patients may mitigate against overprovision by choosing not to undergo certain tests or buy certain medications, so overprovision recommended by clinicians may be greater than that actually obtained by patients. Second, only a limited number of cases are feasible with SPs. Our conceptualisation of the harms of overprovision was developed with outpatient curative care in mind. Further refinement would be required if the framework were to be extended to encompass preventative and inpatient care. Moreover, the use of healthy fieldworkers as standardized patients necessitates choosing relatively 'mild' cases and types of disease, where most care is defined as unnecessary. Taken together, it is possible that in genuine patients presenting at health facilities, more care is likely to be necessary, and our choice of SP cases leads to an overestimate of the true prevalence of overprovision. These SPs cannot measure the experience of HIV positive patients: the 10% of SPs asked their HIV status said they did not know, and the 6% ordered an HIV test declined them.

Other study limitations include the need for expert advisors to define which care is unnecessary, with some decisions open to legitimate debate. There are also harms which were not measured by this study, such as anxiety caused to patients through believing themselves to be unwell, and the opportunity cost of time spent visiting health facilities and receiving treatment. The study was conducted entirely in private health facilities, and, as already discussed, it is often assumed that the private-for-profit sector has a higher prevalence of overprovision than public health facilities [18], though widespread antibiotic overprovision has been documented in all sectors in Kenya for example [45]. The private sector focus does not make the findings unimportant for the Tanzanian health system as a whole: 30% of Tanzania's health facilities are non-governmental, approximately half of these being for-profit and half not-for-profit [47]. The private sector accounts for 31% of health expenditure in facilities, and approximately 27-30% of outpatient care-seeking when including private retailers [47]. Private health facilities are also increasingly likely to be empanelled in government-backed social health insurance schemes: 30% of real patients we surveyed in exit

interviews in study facilities reported that their care was paid for by social health insurance [unpublished data].

Conclusion

We developed a novel conceptualisation of the harms of overprovision, and used this to estimate the prevalence of different types overprovision in Tanzanian private health facilities. We found that unnecessary care that was wasteful, harmful to public health, and potentially dangerous to patients was widespread. After adjusting for facility level and location, we found that for-profit facilities were not more likely that not-for-profit facilities to provide unnecessary care, and conclude that overprovision cannot be explained by a motivation to increase profits, but may instead be more deeply ingrained in medical practice. We recommend policy makers tackle overprovision through medical education and in-service training including "di-biasing", as well as systems level interventions such as regulating the sale of medicines in health facilities and strategic purchasing arrangements.

Data Availability

The data used in this article and code required to reproduce tables and figures are available in [institutional repository] and can be accessed through [doi].

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