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Supplement Article

Is 'Health for All' synonymous with 'antibiotics for all': changes in antibiotic prescribing in a performance-based financing pilot in Zanzibar

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Abstract

Universal Health Coverage, to meet the Sustainable Development Goal of 'Health for All', aims to increase the access of preventative and curative care services, particularly to the poor and vulnerable. However, the very provision of curative services by health providers in the primary care setting in low-income countries is considered one of the major drivers of antimicrobial resistance. The Zanzibar Ministry of Health introduced performance-based financing (PBF) in 2 of 10 Health Districts in July 2013. Payments to health facilities and staff were on a fee-for-service basis using 'direct quality indicators'. Results of an evaluation of secondary data of two indicators, 'treatment according to guidelines' and 'antibiotics prescribed according to guidelines' from 31 Primary Health Care Units in the two PBF pilot districts are compared with 28 in non-PBF districts. The proportion of patients treated with an antibiotic not in accordance with treatment guidelines after the introduction of PBF fell to 2%, 6% and 5% in 2014, 2015 and 2016, respectively, compared with an increase from 25% (2013) to 31% (2014) and 22% (2015, 2016) in non-PBF facilities. The key take-home messages from this evaluation are firstly that 'direct quality indicators' to improve the use of treatment guidelines, introduced into a national PBF reform that includes financial incentives and rigorous verification of register entries, have the potential to significantly reduce inappropriate use of antibiotics in high population density settings in Africa. Secondly, for a sustained reduction in the overall proportion of unnecessary antibiotic prescriptions rigorous monitoring of health worker behaviour is required to address changes in prescribing practice. A well-designed and monitored PBF with 'direct quality indicators' has the potential to ensure that 'Health for All', in terms of increased access to primary health services is not synonymous with 'antibiotics for all'.

Keywords: Antibiotic resistance, performance-based financing, health worker behaviour, Africa

Key Messages

- Performance-based financing (PBF) with direct quality indicators can reduce overprescription of antibiotics in the primary care setting.
- PBF design needs to evolve in response to identified changes in provider behaviour to sustain impact.
- To allow for efficient and effective monitoring of a PBF reform, densely populated or urban settings should be selected.

Introduction

Close to a century after the discovery of penicillin, antibiotics remain key to the treatment of infectious diseases, which are still responsible for over half of all premature deaths in low-income countries (World Health Organisation, 2017). However, resistance to antimicrobial treatments is now considered a major public health issue. Overprescription, incorrect dosage and indiscriminate sharing of antibiotics obtained in the formal health sector between family members and acquaintances are considered as the main drivers of antibiotic resistance in low-income countries (Uppal *et al.*, 1993; Bosu and Ofori-Adjei, 1997; Larsson *et al.*, 2000; Kristiansson *et al.*, 2009; Bennish and Khan, 2010; Hadley, 2011). Provider beliefs, norms and values of society are exacerbated by the value patients attribute to antibiotics (World Health Organisation, 2001; Sirinavin and Dowell, 2004), putting pressure on overstretched health workers to ignore treatment guidelines (Gani *et al.*,1991; Wolff, 1993; Paredes *et al.*, 1996; Radyowijati and Haak, 2003; Mohan *et al.*, 2004; Hadley, 2011; Reardon, 2014). Efforts made to curb overuse of antimicrobials in the public primary healthcare setting, to date, have focused on instruction of providers (Bexell *et al.*, 1996; Perez-Cuevas *et al.*, 1996). The motives of health providers to prescribe antibiotics, driven by the context in which they are living and working, compromised long-term success of these efforts (Sterky *et al.*, 1991).

However, Universal Health Coverage promotes prompt access to diagnosis and treatment for everyone. This begs the question whether 'Health for All', in the current context of overprescription by health providers, drives the upward trend of antibiotic resistance.

Zanzibar is a semi-autonomous archipelago of the Republic of Tanzania[1] with approximately 1.3 million inhabitants and a population density of 450 per square kilometre. Administratively, Zanzibar consists of two zones, Unguja and Pemba, the two main islands that make up the archipelago, divided into 10 districts.

Zanzibar's Ministry of Health introduced performance-based financing (PBF) in 2 of its 10 health districts in 2013, one in each zone, primarily to address the perceived poor quality of services provided at the Primary Care level. The purpose of the pilot was to improve and refine the model The Zanzibar PBF was based on the World Bank PBF toolkit. In this model, payments were made to 31 health facilities and their staff for 18 pre-agreed services, 9 of which had additional 'direct quality indicators' attached. The Standard Treatment Guidelines for adults and children above 5 years and the Integrated Management of Childhood Illness (IMCI) guideline for children under 5 years were used to affirm compliance to the indicator 'diagnosis and treatment according to treatment guidelines'.

Payments were calculated on a fee-for-service basis. Data were uploaded into a database and performance payments to health staff within the health facilities were calculated and paid directly to the staff via the same bank accounts used for salaries. Payments were made through the Ministry of Health finance division. Payments to health facilities were initially through the District Health Management Team (DHMT) and later directly into the Community/Health facility bank accounts.

In the first 6 months, a payment of TZS 500 ($0.23) was made for each curative consultation, which was doubled if the diagnosis and treatment for the case were in adherence with the relevant treatment guidelines (the direct quality indicator). However, after 6 months, when adherence to guidelines had increased from an average of 24–85% the payment was revised to be TZS 1000 ($0.46) for a curative case that adhered to guidelines while cases not adhering to guidelines did not receive payments.

A 'remoteness' scale was applied with the intention of increasing performance payments to health facilities where staff were difficult to retain. We used five variables to determine the remoteness score. Distance in kilometres from specific key services (minimum score 0 maximum 15) that included town/bank, distance to a tarmac road, distance to a primary school. Additional indicators were availability of staff housing being situated on a small island and Zone (Pemba was difficult to retain staff in).

Health centre reports were verified by multidisciplinary teams on a monthly basis for the initial 3 months while verifiers and health facility staff became accustomed to the reform, thereafter on a quarterly basis for the 3 years from July 2013 with the exception of Unguja in 2016. The change from monthly to quarterly was made for logistic reasons. The teams leading the verification had other demands on their time and found monthly verification visits too disruptive. During the quarterly visits, verification was conducted for each of the 3 months separately using the same sampling tool. No registers were lost or damaged and entries remained unchanged with the exception of two registers in 2013, one on each zone.

As described above, the direct quality indicator, treatment according to treatment guidelines, monitored and provided a pre-agreed payment for the quality of each and every curative case. In addition, an indicator 'antibiotic prescriptions according to guidelines' was included in the quality checklist adapted from the existing Performance Assessment tool, conducted biannually (see Figure 1). This indicator 'antibiotic prescriptions according to guidelines' was included to complement the 'direct quality indicator', allowing antibiotic use to be tracked specifically, since irrational use of antibiotics was a major concern of the Ministry of Health. It was intended that the score from this quality checklist would be used to adjust the performance payments. However, the performance assessment was not routinely conducted and performance payments were not adjusted to reflect the quality score as anticipated.

Implementation of the PBF model was not fully realized as intended. During the fiscal years from July 2013 to June 2016, verification visits were made to all facilities, except for those in Unguja ($n = 16$) in 2016. Data were uploaded and performance payments to health staff working at the health facilities were paid. Payments directly to health facilities, amounting to 20% earnings, were delayed due to tardiness in opening bank accounts. Community verification was only conducted twice during the pilot period but did not show evidence of ghost entries in the registers.

Many factors contributed to the incomplete implementation of the PBF and the decision not to scale-up to the remaining eight districts. An evaluation of the most pertinent factors for this decision is underway. Key factors identified to date include poor understanding of the PBF reform in the Presidential office, a perception that the PBF was 'top-ups' to staff only (partly due to the delay in health

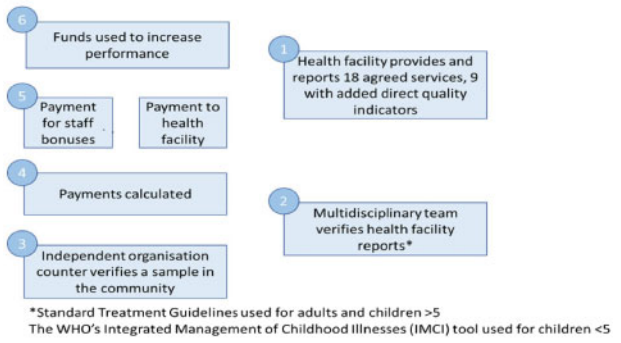

Figure 1 Zanzibar performance-based financing model.

facility payments) and therefore not sustainable, a perception that other ministries would also demand 'top-ups', the reluctance of District Basket contributors to make a decision to channel funds by performance rather than the traditional input approach and donor-driven priorities.

This evaluation is, therefore, only concerned with a potential benefit of a PBF reform using direct quality indicators for curative services to improve adherence to treatment guidelines resulting in a reduction in use of unneeded antibiotics. The evaluation is of one 'direct quality indicator', namely 'patients diagnosed and treated according to treatment guidelines' and the related indicator in the performance assessment quality tool, 'antibiotic prescriptions according to treatment guidelines'. This indicator was only concerned with prescription of an antibiotic when recommended. Unlike in 'treatment according to guidelines' other treatments prescribed to the patient were not considered. The reason for including the performance assessment tool indicator in the evaluation is to demonstrate the effect on antibiotic use using an existing tool for routine data collection.

Methods

This is an impact evaluation of two variables in the two districts of the Zanzibar PBF pilot. The variables are (1) patients treated according to guidelines ('direct quality indicator') and (2) patients prescribed antibiotics according to guidelines ('quality checklist indicator'). The evaluation was conducted on two similar indicators, however, the data on adherence to guidelines and antibiotic prescriptions in the same Primary Health Care Unit (PHCU) for the same month are not, and neither expected to be, identical. While prescription of antibiotics for illnesses such as common cold, cough and simple diarrhoea was commonplace, health providers also frequently prescribed other medicines not recommended in the treatment guidelines. An example frequently observed was vitamin B complex prescribed for many pathologies and an antihistamine for a diagnosis of a common cold. Such entries in the outpatient register would be considered 'not in accordance with treatment guidelines' but not involve an antibiotic.

The evaluation used secondary data. Routine data from all 31 PHCUs in the PBF pilot District were compared with health facilities in Districts where PBF was not introduced. Missing data were collected on a needs-basis when possible. Six months following the introduction of PBF the routine data were reviewed. It indicated that the pre–post results for adherence to guidelines were very positive. Following the first year of PBF implementation data were also collected from non-PBF facilities using the same sampling rules. A multidisciplinary team collected this data.

The choice of facilities in non-PBF districts was conducted through the propensity score matching (PSM) function in STATA (pscore). Routine data from the Health Information System (DHIS2) were selected as variables for this exercise. The PSM was conducted separately in Pemba and Unguja Zones and PHCUs size category. PHCUs in Zanzibar are similar in character, are divided into four categories for Human Resource planning and analysis based on population catchment. During 2016, data were collected from the same facilities to allow for comparison.

Data describing patients treated according to guidelines were collected routinely on, initially, a monthly and later a quarterly basis, including all months in that quarter, from the outpatient registers in the 31 pilot PHCUs. Data were collected for each of the 3 months separately during the quarterly visits. The registers were designated to one of the two age groups: under 5 years of age and 5 years of age and older. Verification teams examined a sample of outpatient cases for each health facility for each month, separately for those under 5 years old and those 5 years or older. Each sample size was chosen to ensure a 95% confidence that the true percentage treated according to guidelines would be within 15 percentage points of the observed value in the sample. The same strategy was applied in the comparison sites.

Adherence to treatment guidelines was determined by a correlation between the diagnosis and the treatment entered in the register for a patient with the treatment for the same diagnosis in the relevant treatment guidelines. Adherence to treatment guidelines required the description of the treatment to contain all first-line medications listed in the treatment guidelines, second-line medications if the first-line medications were out of stock, but no additional medications.[2] Dosages were not verified. The data verifying the reports prepared by the health centres were entered twice into a database.

'Antibiotic treatment according to guidelines' was determined by comparing the diagnosis and treatment with an antibiotic entered in the relevant, age-appropriate register with the Standard Treatment Guideline (STG) or IMCI guideline. Dosage was not taken into account. This indicator was only concerned with prescription of an antibiotic when recommended. Unlike in 'treatment according to guidelines' other treatments prescribed to the patient were not considered.

Data were collected from the outpatient registers for all outpatient visits for the month of June in the years 2013–16. Healthcare providers in Zanzibar who diagnose patients and provide treatment have had a basic training. All staff are expected to use the Standard Treatment Guidelines and IMCI tools. The diagnosis should be taken from the available guideline and the linked treatment prescribed. There were some conditions that do not appear in the guidelines, e.g. trauma and wounds. These diagnoses were included as 'unable to ascertain' along with ineligible entries in a separate category. For the purpose of this evaluation, the diagnosis and treatment in the register are therefore accurate enough to provide insight into prescribing behaviour.

The teams involved in collecting the routine (PBF sites) and the comparison (non-PBF sites) data were multidisciplinary and led by the Health Sector Reforms Secretariat, Ministry of Health, Zanzibar. Analysis was conducted by Ministry of Health Senior Health Adviser with support from the Health Sector Reform Secretariat and an independent consultant using Microsoft Excel and STATA 14.1.

For the purposes of this evaluation, prescriptions were divided into three categories: those not adhering to treatment guidelines, those prescribed according to guidelines and diagnoses that were not able to be ascertained in either category. These included illegible entries and diagnoses that were not included in the 'STG' or 'IMCI' guideline. All antibiotic prescriptions during the month of June for each year were used. The month of June was chosen purposefully as the month immediately preceding the introduction of PBF.

Routine data were entered into three different databases over the period 2013–16. For evaluation purposes, all data were checked and analysed in Stata 14.1. The analysis was descriptive and performed by zone and by age group (below 5 years of age and 5 years and above). In the case of the treatment according to guidelines data, data were weighted to the actual number of cases seen in each facility.

During analysis, the number of cases with diagnosis of hypertension and diabetes mellitus only were removed from the total number

Table 1 Number of Primary Health Care Units from which data were collected for the indicators 'treatment according to guidelines' and 'antibiotics prescribed according to guidelines' per year

Year	PBF status	According to treatment guidelines	Antibiotic data
2013	PBF	28	19
	Non-PBF	26	19
2014	PBF	30	19
	Non-PBF	26	21
2015	PBF	30	17
	Non-PBF	20	18
2016	PBF	6	17
	Non-PBF	20	16
Any data	PBF	30	19
	Non-PBF	26	21
2013–16	PBF	6	17
	Non-PBF	12	11
Complete 2013–15	PBF	28	
	Non-PBF	13	

of cases. Neither condition warrants an antibiotic according to the treatment guidelines and the proportion of such cases varied between PHCUs depending on the professional interest of the health provider in management of non-communicable diseases.

Results

Data on patients' 'treatment according to guidelines' were collected from a total of 56 health facilities, 30 PBF and 26 non-PBF', with 302 entries. Data for 'antibiotics prescribed according to guidelines', were collected from 40 health facilities (21 PBF and 19 non-PBF) with 231 entries. However, data were not available (or collected) from all health facilities for all 4 years. Most notable is the absence of data for patients' 'treatment according to guidelines' in Unguja in 2016. Table 1 shows a breakdown of the source of data by year.

Outpatients treated in compliance with available guidelines

The proportion of patients clinically managed according to the available treatment guidelines increased from 25.5% (2013) to 85.7% (2016) in PHCUs where PBF had been introduced. Improvements of 58 percentage points were made in the initial year.

In comparison, a smaller increase in 'treatment according to guidelines' of 39.4% (2013) to 42.7% (2016) was found in PHCUs where PBF had not been introduced. Indeed, while improvements of 58 percentage points were observed in 'PBF facilities' in the first year of implementation a decrease of 6.5 percentage points was observed in non-PBF facilities (Figure 2). The range of improvements in the first year in the 30 PHCUs in the pilot Health Districts was 0.1–97.9 percentage points, compared with −32.4 to 17.7 in the PHCUs where PBF had not been introduced.

Antibiotic prescriptions in compliance with treatment guidelines

There was no difference in the proportion of patients treated according to guidelines in the month of June compared with other months of the year on either Zone, Pemba and Unguja. In 2013, before introduction of PBF in Zanzibar the proportion of patients treated with an antibiotic that was not consistent with the available treatment guidelines was 39% in PHCUs in Health Districts chosen for

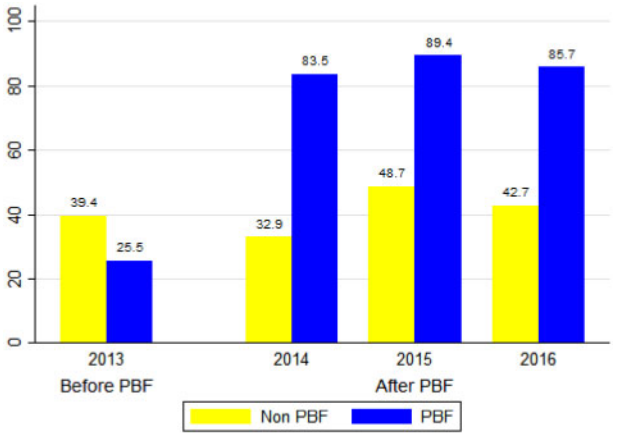

Figure 2 Percentage of patients clinically managed 'according to treatment guidelines' in Primary Health Care Units in Zanzibar (2013–16).

introduction of PBF. After introduction of PBF the proportion fell to 2%, 6% and 5% in 2014, 2015 and 2016, respectively, in these same PHCUs.

In adults and children 5 years of age and above, the proportion of patients prescribed antibiotics that were not in accordance with the treatment guidelines decreased from 33% (2013) to 2% (2014), 7% (2015) and 6% (2016) in the 30 PHCUs within the PBF pilot Health Districts. In 'non-PBF' PHCUs, the proportion of patients prescribed antibiotics not according to guidelines rose from 25% (2013) to 31% (2014) before decreasing slightly to 22% in both 2015 and 2016 (Figure 3).

In PHCUs in the PBF pilot Health Districts, children under 5 years of age prescribed antibiotics not in line with the IMCI diagnosis and treatment guideline decreased from 49% (2013) to 2% (2014) and 4% in 2015 and 2016. The same decrease was not evident in the 'non-PBF' PHCUs where a change from 40% (2013) to 43% (2014), 26% (2015) and 29% (2016) was found. The overall proportion of children prescribed an antibiotic decreased from 73% (2013) to 31% (2014), 40% (2015) and 32% (2016) in PHCUs in the PBF pilot Health Districts (Figure 4).

The decrease in prescription of antibiotics not in adherence to treatment guidelines was sustained throughout the pilot period in PBF Health Districts.

Discussion

In this section, we discuss the difference in results for the two indicators, changes in provider prescribing practices and comparison with strategies introduced to address overprescription of antibiotics by health providers in other low-income countries. Further implications of reduced prescription of antibiotics, including cost implications, are also discussed followed by the limitations of this evaluation. While the overall relevance and sustainability of the PBF reform are outside the scope of this evaluation a few key observations are made.

The evaluation was conducted on two similar indicators. However, the data on adherence to guidelines and antibiotic prescriptions in the same PHCU for the same month are not, and neither expected to be, identical. While prescription of antibiotics for illnesses such as common cold, cough and simple diarrhoea was commonplace, health providers also frequently prescribed other medicines not recommended in the treatment guidelines. An example frequently observed was vitamin B complex prescribed for many pathologies and an antihistamine for a diagnosis of a common cold. Such entries in the

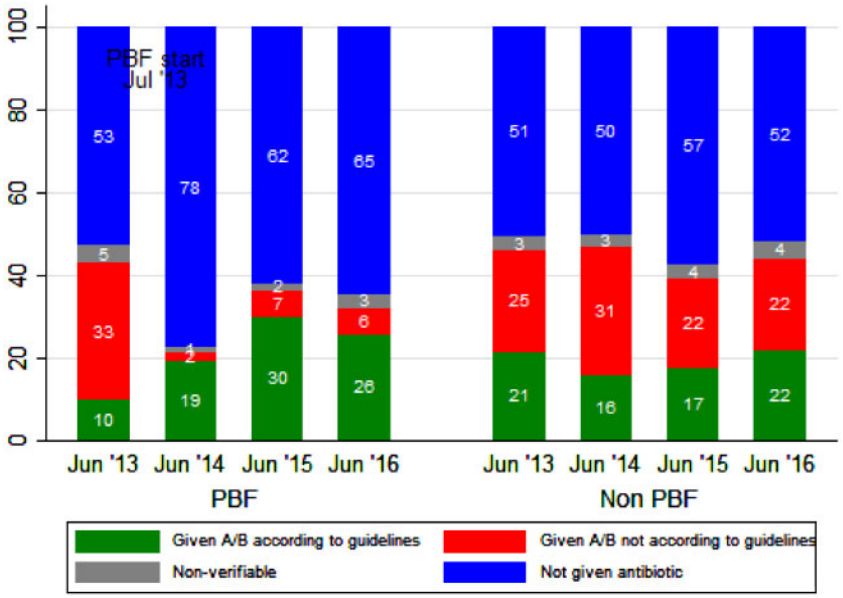

Figure 3 Antibiotic prescriptions in all adults and children aged 5 years and above in PBF and non-PBF facilities (June 2013–16).

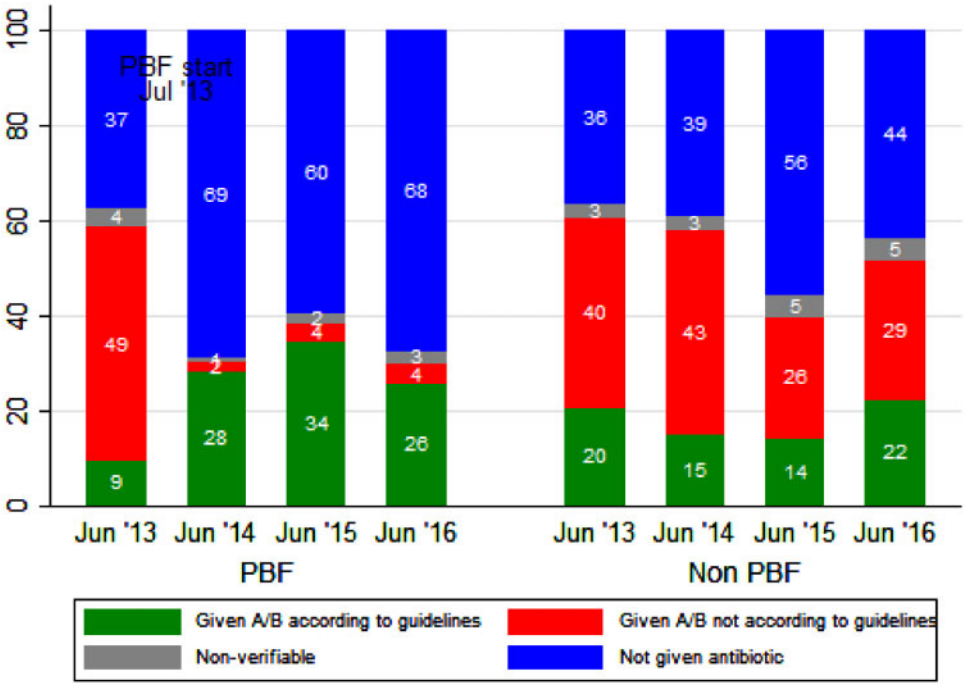

Figure 4 Antibiotic prescriptions in all children under 5 years of age in PBF pilot and non-PBF districts (June 2013–16).

outpatient register would be considered 'not in accordance with treatment guidelines' but not involve an antibiotic.

It became evident in the third year of the pilot that while adherence to guidelines for prescription of antibiotics remained high the total amount of antibiotics prescribed had increased. The verifiers noticed that the proportion of tonsillitis and pneumonia cases had increased and seemed to have 'replaced' diagnoses of common cold or upper respiratory tract infections. An email was sent to all DMOs, who had access to the PBF data, to closely monitor any PHCUs that showed a higher proportion of tonsillitis and pneumonia than cough, cold or upper respiratory tract infection and where diagnostic trends had changed. It was recommended that they use a mentoring approach and observe any prescribers suspected of increasing the number of diagnose of tonsillitis and pneumonia. Simultaneously verification teams recommended the insertion of a temperature reading and description of tonsils for all entries with diagnosis of tonsillitis and a respiration rate for diagnoses of pneumonia. While these measures were included in the draft PBF manual, there was no follow-up to ascertain if these had been put in place in all PBF and non-PBF facilities and data were not collected after these

corrective measures were made. However, the authors would like to emphasize that such manipulation of recordings in a PBF model with direct quality indicators for treatment of curative cases should be carefully monitored and corrective measures included in the PBF manual.

The District Health Management Teams were provided (and had been provided for at least 6 years before the introduction of PBF) with sufficient funds, a vehicle and supervisory guidelines for monthly visits to each PHCU in their Districts. These supervisory visits were included in the annual workplan for each DHMT every month. These visits were not conducted as intended and prescriber adherence to treatment guidelines was on average 24% before the introduction of the PBF. In the PBF pilots, the verification teams systematically reviewed the outpatient registers using the sampling tool provided. There was pressure on the Health Sector Reform Secretariat, responsible for the PBF reform, from DHMT members and health facility staff to conduct verification visits because the performance payments could not be calculated and paid otherwise. It was, therefore, not possible to determine whether it was the verification visits or the payments that made the change in adherence rates but both of these activities were part of the PBF reform and had not happened without it. Interestingly, Figures 3 and 4 show there was a reduction in the antibiotics given that were not in accordance with treatment guidelines following the evaluation in the non-PBF sites, albeit not as marked as in the PBF pilot and not sustained in the subsequent year. This does suggest that attention from verifier/evaluator teams had an impact on the adherence to treatment guidelines. This was not sustained in the non-PBF districts. Further investigation is required to determine firstly the extent of the change being attributed to performance payments/verification visits and secondly how, when funding and annual plans were already promoting supervision by DHMTs, the same attention and importance can be placed on supervision without performance payments being the driving force.

As previously discussed, the majority of interventions designed to reduce 'over use' of antibiotics by health providers have centred on filling knowledge gaps (Bexell *et al.*, 1996; Perez-Cuevas *et al.*, 1996). In Zanzibar, the health workers attending the patients were diploma level 'Clinical Officers' or nurses, certificate level Public Health Nurses or untrained staff such as 'orderlies'. The majority, but not all, of the diploma and certificate level health workers had been trained in IMCI since their initial pre-service training. There were no further training sessions on either the STG nor the IMCI tool between June 2013 and 2016. During verification visits to the health facilities, there was no noticeable difference between those who had been trained in IMCI and those who had not. So, while knowledge of diagnostics and treatment is believed to determine adherence to treatment guidelines (Kunin *et al.*, 1987; Gouws *et al.*, 2004) this evaluation suggests that the level of knowledge is not necessarily the main contributing factor. Moreover, our results suggest that alternative approaches, other than training, refresher training or other interventions addressing knowledge levels alone, are required to have a long-lasting impact on antibiotic prescription practices (Gani *et al.*, 1991; Guyon *et al.*, 1994; Paredes *et al.*, 1996). The PBF reform has the potential to override existing prescribing preferences by offering alternative incentives to adhere to pre-agreed 'rational' use of antibiotics.

An estimation of the short- and long-term cost savings of reduced use of antibiotics was beyond the scope of this evaluation. A simple calculation of the cost of 'wasted' medicines was $20 432 per year in the in the two PBF districts in Zanzibar in June 2014–16 or $113 290 per year if the same results are achieved on scale-up to all districts.[3] However, the dangers of 'over' prescription of antimicrobials go beyond the waste of low-cost first-line antibiotics for treatment of individuals. Antibiotic-resistant strains move increasingly quickly across national borders as evident from the Feldgarden (2010) study on Dutch visitors to Indonesian. Reduction of prescription of unnecessary antibiotics in the long-term would have a positive effect on curbing global resistance to antimicrobials.

The cost for Zanzibar in terms of the need for increased laboratory capacity, a reduction in economic productivity as people stay incapacitated from infectious disease for longer while transmitting to those in contact with them and the global cost of maintaining the status quo requires a more complex analysis.

The limitations of this evaluation are a result of the circumstances under which the PBF pilot was introduced. The results presented are from a 'real life' setting not under strict research conditions. The intention of the PBF pilot was to test out and adapt a model provided by World Bank to the Zanzibar context before scaling up to other Districts. The Ministry of Health, Sector Reform Secretariat were responsible for the pilot, in addition to their already heavy workload. Not all the components of the model were fully implemented. There were missing data from two facilities because the facility was closed to routine outpatients due to a cholera outbreak, one in each Zone (2016) and another two facilities due to unavailability of outpatient registers, one in each Zone (2013). Data were not collected in 2016 in Unguja Zone (16 PHCUs) due to an administrative breakdown.

A second limitation of this evaluation is the definition of 'treatment according to guidelines' and 'antibiotics prescriptions according to treatment guidelines'. Since historical data were used, the patients' true diagnoses were not known. The entry into the register of a diagnosis, test results and treatment prescribed were simply matched with the treatment guidelines by the verifier.

This is an evaluation of two indicators, one 'direct quality indicator' and another in the quality checklist. A conclusion on the effectiveness and sustainability of the PBF pilot in its entirety is beyond the scope of this analysis. However, within the context of the results it is worth noting that the Zanzibar PBF model included counter verification of reports by an independent body. This involved visits to patients in the community. This was only possible because of the short distances between the home and health facility (<5 km). This infers that introduction of this model of PBF in rural areas of low-density populations would be challenging and costly if not totally impractical. Studies comparing antibiotic resistance in urban and rural settings, however, have found a greater problem among urban residents than their rural counterparts (Lamikanra and Okeke, 1997; Mthwalo *et al.*, 1998; Quagliarello *et al.*, 2003; Nys *et al.*, 2004; Lee *et al.*, 2013). This implies that introduction of a 'direct quality indicator' 'treatment according to guidelines' into a PBF fee-for-service model in an urban area would have the potential to reverse the trend of increasing antibiotic resistance. However, inclusion of the private sector, a key provider of health services in urban areas (Mackintosh *et al.*, 2016), would be required to optimize impact.

Conclusion

The key take-home messages from this evaluation are, first and foremost, 'direct quality indicators' to improve the use of treatment guidelines, introduced into a national PBF reform, that includes financial incentives and rigorous verification of register entries, have the potential to significantly reduce inappropriate use of antibiotics

in an urban or high population density primary healthcare setting in Africa. The benefits are fewer first-line antibiotics required (immediate cost savings), reduced resistance of individuals to first-line antibiotics, fewer antibiotics 'circulating' in the community, reduced reliance on second- and third-line (costlier) antibiotics and less need for sophisticated laboratory resources to track antibiotic resistant strains of bacteria. In a community, a country and globally, less antibiotic resistance also translates into increased productivity as people fewer illness episodes (less spread of untreated resistant bacteria) and for shorter periods.

Secondly, a 'sustained' reduction in the overall proportion of unnecessary antibiotic prescriptions in a PBF reform requires several conditions to be considered. In order to curb changes in diagnostic behaviour by first-line health providers close monitoring is required. These could take the form of justification for specific diagnosis (e.g. tonsillitis and pneumonia), observation by those who oversee the functioning of the health facilities (e.g. District Medical Officers) and penalties reflected in reduced earnings from the PBF reform to reduce fraud and 'gaming'.

A well-designed and monitored PBF with 'direct quality indicators', therefore, has the potential to ensure that 'Health for All', in terms of increased access to primary health services is not synonymous with 'antibiotics for all'.

Further research would add to the body of existing knowledge related to the role of in-service training on adherence to treatment guidelines (particularly IMCI), the cost-effectiveness of using 'direct quality' indicators in a PBF reform to reduce overprescription of antibiotics, the effect of reduced antibiotic use on morbidity and mortality in the same population and the feasibility of direct quality indicators in a sparsely populated region of Africa.

Notes

1. The health sector is autonomous from Tanzania Mainland.
2. There was no difference in availability of antibiotics during the pilot period in PBF pilot and non-PBF sites. When the recommended antibiotic was out of stock at the time of diagnosis the prescription was made for another antibiotic and it was noted in the entry in the register that the first-line treatment was not available.
3. The cost was estimated by taking the proportion of children under 5 years of age decreased antibiotic use (6600) and children and adults over 5 years of age (40 596) of the pilot area population (350 000) and multiplying with the cost of the most commonly prescribed antibiotic for children (TZS 1239) and adults (TZS 904). The currency conversion rate was at the rate at the time of submission TZS 2200: 1USD. The same cost savings were then applied to the total population of Zanzibar (1 415 034) based on the Census projections for 2018.

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Conflict of interest statement. None declared.

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