Costs of healthcare acquired infections due to inadequate water, sanitation and hygiene (WASH) in healthcare facilities in Ghana

Summary

The number of healthcare associated infections (HAI) in Ghana (population: 33 million) is conservatively estimated at 303,000 cases in 2022, with 31,360 excess deaths a year. The increasing rate of antimicrobial resistance causes worse health outcomes and higher costs of treating HAIs. Monetary estimates were aggregated from the healthcare costs, the productivity losses and the premature deaths associated with HAIs, including antimicrobial resistance. The total economic costs of healthcare associated infections (HAI) in Ghana in 2022 is US$ 1.57 billion. This equates with 1.98% of Gross Domestic Product in 2022. The financial cost of providing healthcare to treat HAIs is US$ 144 million in 2022, or 4.6% of total health expenditure. When comparing the medical costs per capita in Ghana of US$ 4.30 per year with the cost per capita needed to provide basic water, sanitation and hygiene (WASH), waste management and environmental cleaning in healthcare facilities in low-income countries (US$ 0.3 per capita for capital cost and starting at US$ 0.7 recurrent cost) it is likely that the spending will be more than covered by the savings in medical costs.

In addition to HAIs, cleanliness, availability of drinking water and a clean toilet are key determinants of patient satisfaction. These aspects are particularly important to people when they are at their most vulnerable, such as during surgery, during labour and delivery, and neonates in the first moments of their lives. Experiences of poor quality of care and inconvenience can impact future treatment-seeking behaviour and they also impact healthcare worker job satisfaction and absenteeism. WASH and infection prevention and control (IPC) should be essential interventions implemented by the health sector in Ghana to reduce HAIs and improve the quality of healthcare and patient satisfaction across the country.

Key messages

- The total economic cost of healthcare associated infections (HAI) in Ghana in 2022 was US$ 1.57 billion.
- This equates with 1.98% of Gross Domestic Product.
- The financial costs of providing healthcare to treat HAIs was US$ 144 million in 2022, or 4.6% of total health expenditure.
- It is feasible that the spending to provide basic WASH, waste management and environmental cleaning in healthcare facilities in Ghana (less than US$ 1 per capita) will be more than covered by the savings in medical costs of US$ 2.15 per capita per year, if the HAI rate can be halved.

This methodology was developed by the World Bank with support from Global Water Security and Sanitation Partnership as published in policy research working paper: Hutton,Guy; Chase,Claire; Kennedy-Walker,Ruth Jane. Costs of Health Care Associated Infections from Inadequate Water and Sanitation in Health Care Facilities in Eastern and Southern Africa (English). Policy Research working paper ; no. WPS 10708; PLANET Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/099428002212438578/IDU1fd9af37311cfe143471843c1e9de76a93d7e

WaterAid

Introduction

The lack of adequate water, sanitation and hygiene (WASH), waste management and environmental cleanliness in healthcare facilities poses a significant health risk to patients and healthcare workers in Ghana, and it seriously impacts quality of care and satisfaction with health services.

In Ghana there are hundreds of thousands of healthcare associated infections (HAI)[1] each year, and tens of thousands of resulting deaths. These infections impact patients, their families and healthcare facilities by causing illness, prolonged hospital stays, potential disability, excess costs and sometimes death. Furthermore, HAIs affect people when they are at their most vulnerable – during surgery, women during pregnancy, labor and delivery, and neonates in the first moments of their lives.

The problem caused by HAIs has been recognised by the Ministry of Health in Ghana, which has taken steps to improve infection prevention and control (IPC) by introducing National IPC Guidelines in 2015, as well as manuals and protocols to improve the quality of care (Escribano-Ferrer et al., 2017; Sunkwa-Mills et al, 2020). The IPC guidelines provide information to health providers on standard precautions including hand hygiene, use of personal protective equipment (PPE), environmental cleanliness and waste management.

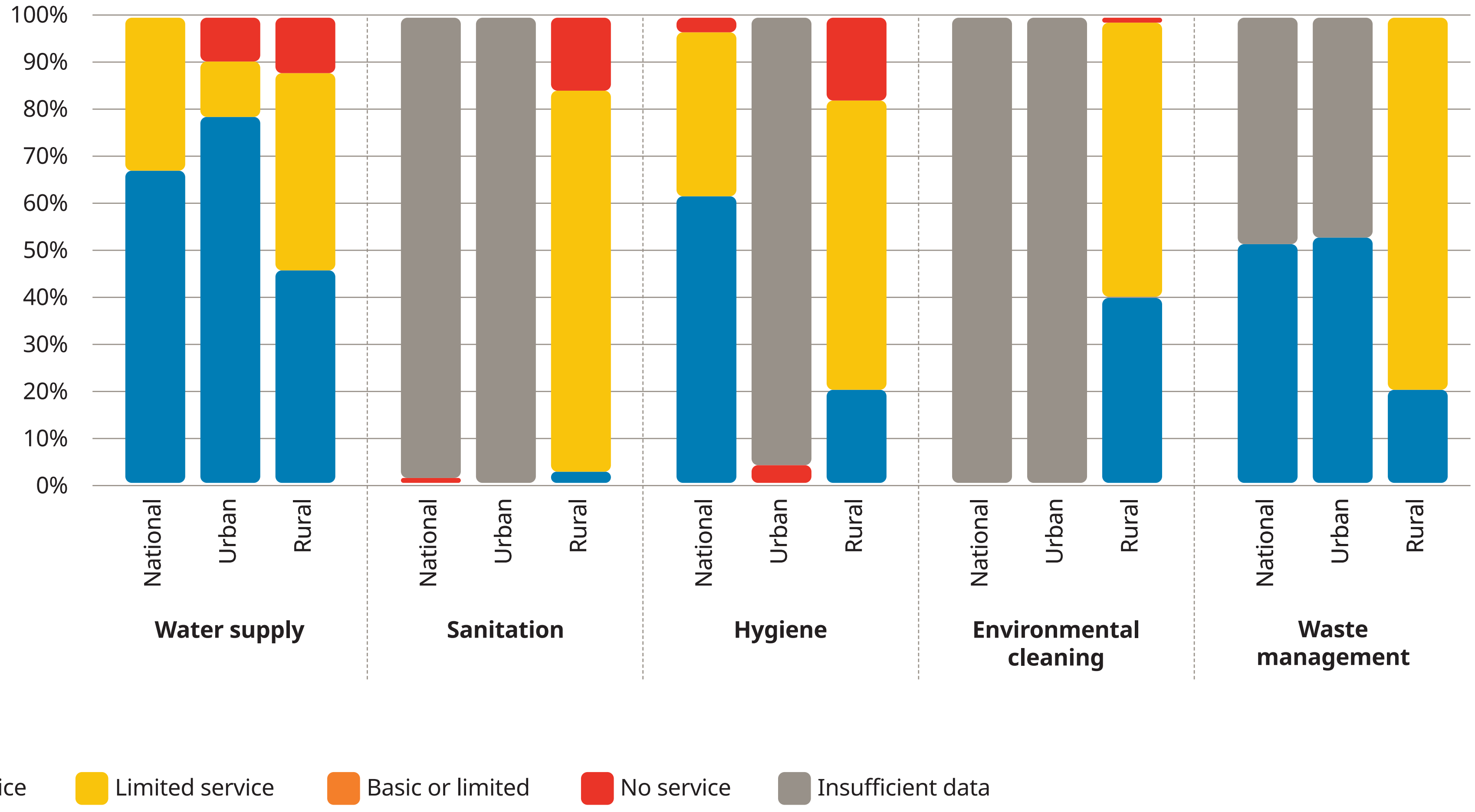
A growing proportion of HAIs are resistant to antimicrobials, leading to a worse health outcome for the patient and making them more costly to treat and requiring longer to recover and restart normal life, including productive activities. Antimicrobial resistance (AMR) rates vary across drugs and across settings within Ghana, but available estimates suggest that the majority of HAIs will be resistant to first-line drugs. As a response, Ghana has issued a National Action Plan for Antimicrobial Use and Resistance (Republic of Ghana, 2017).

The major transmission pathway for HAIs is a lack of cleanliness and hygiene measures provided during medical care and recovery time. The most common HAIs are surgical site infections, bloodstream infections, and respiratory tract infections, including pneumonia. The highest rates are found in intensive care units (ICUs), neonatal wards or ICUs, and pediatric medical wards. Some HAIs originate in the endogenous native microflora of the patients themselves, and hence cause infection following surgery or catheter-associated urinary tract infections.

Figure 1 shows data compiled by the WHO/UNICEF Joint Monitoring Programme (JMP) for WASH in healthcare facilities in Ghana. There is insufficient data for national estimates for sanitation and for environmental cleaning. Basic water services are available in 67% of healthcare facilities nationally (46% of rural healthcare facilities and 79% of urban). In rural areas, 84% of healthcare facilities have at least limited sanitation services, whilst in urban areas there is insufficient data Basic hygiene services, with handwashing facilities at points of care and near toilets, are available in 62% of Ghanaian healthcare facilities. Coverage stands at 20% in rural healthcare facilities, whilst there is a lack of data for urban.

1. An HAI is a condition resulting from an adverse reaction to an infectious agent or its toxins acquired from healthcare settings that was not incubating or symptomatic at the time of admission.

Figure 1. Coverage of WASH, waste management and environmental cleaning in healthcare facilities in Ghana in 2021



Source: WHO/UNICEF Joint Monitoring Programme (2021): https://washdata.org

Methods

This study uses a cost-of-illness methodology developed for a recent World Bank study on the costs of healthcare associated infections in nine countries of Eastern and Southern Africa. See Hutton et al, (2023) where full methods and data sources are available. A quantitative model was constructed to estimate (1) healthcare costs, (2) patients' productivity losses, and (3) mortality costs due to HAIs in Ghana, including additional costs of treating antimicrobial resistant infections. Variables and data inputs are summarised in Table 1. The calculations are as follows:

- **Healthcare costs:** the number of HAIs across three health facility levels (health centre, district hospital and higher-level hospital such as regional, referral or teaching hospital), multiplied by the average cost per inpatient day at each level, multiplied by the average length of stay, and with the total drug cost per HAI added.
- **Productivity costs:** (a) the number of HAIs multiplied by the proportion of adults working multiplied by the daily opportunity cost of time (proxied by the agricultural wage), plus (b) the number of HAIs multiplied by the proportion of patients not working (including children) multiplied by the daily opportunity cost of time for non-working people (30% of the daily GDP per capita). All calculations are made separately for male and female.
- **Mortality costs:** the number of deaths due to HAIs (= the number of HAIs multiplied by the excess case fatality rate due to HAIs) multiplied by the value of life.

Table 1. Variables, data needs and sources for damage cost estimation of HAIs

Cost variable	Data needs	Ghana data value (in brackets range used in sensitivity analysis)	Data source
		Healthcare cost	
Annual healthcare associated infections (HAIs)	Average % of admissions infected with HAI	12.8% (10.3% to 15.2%) [a]	Labi et al (2019)
	Proportion of anti-microbial resistance in HAIs	50% (25% to 75%) [b]	Kariuki et al (2022), Murray et al (2022)
	No. of annual hospital admissions	5.6 admissions per 100 population	Ministry of Health (2014)
Additional cost of treating a patient with an HAI [c]	Average hospital cost per day ('hotel' cost)	US$ 17.6 health centre, US$ 37.6 district hospital, US$ 72.8 higher hospital [d]	IHME (2015)
	Cost of drugs and laboratory tests per HAI	US$ 29.8 health centre, US$ 71.4 district hospital, US$ 327.8 higher hospital[e]. Double for AMR	Aerts et al (2022), Gidey et al (2023), Bocoum et al (2019)
	Additional length of stay	5 days [f] (10 days AMR) [g]	Fenny et al (2020) Otieku et al (2023

Cost variable	Data needs	Ghana data value (in brackets range used in sensitivity analysis)	Data source
Productivity cost			
Annual HAIs	Same as Healthcare cost		
Additional days for recovery after HAI	Additional recovery time	2 days (2 days AMR)	Assumption
Loss in value-added of workers	Productivity loss (value-added in agriculture)	US$ 18.2 per day (US$47 per day in industry)	World Bank statistics
	Proportion of adult HAI patients	60%	Assumption
	Labour force participation rate	69.5% (female) 73.4% (male)	ILOSTAT (2023)
	Proportion of HAIs suffered by women	60%	Assumption
Loss of time spent in non-productive activities (opportunity cost	Average daily value	30% of the agricultural value-added	Hutton (2012)
Mortality cost			
Annual HAIs	Same as Healthcare cost		
Case fatality rate	HAI case fatality rate	6.9% (4% to 15%) [h] 13.8% (AMR)	7 studies
Value of a premature death	Value of a statistical life	US$ 43,296 (high value US$ 122,964)[i]	Calculation based on Banzhaf (2022)

Notes: See Annex 1.

Several impacts were excluded due to lack of data and lack of methods to quantify in monetary values[2]. Hence, the estimates presented in this study will significantly underestimate the true economic and social costs of HAIs in Ghana[3].

2. For example, unoccupied beds due to isolation (loss of capacity and revenue), extended length of stay in an intensive care unit (ICU), non-standard surgical prophylaxis in infected patients, infection prevention and control interventions such as screening at hospital admission or before surgery, long-term consequences of AMR infection, training of healthcare professionals and communication, HAIs of healthcare workers. Out-of-pocket expenditures by patients and their carers were also excluded. Financial burden on the government such as disability benefits were excluded.

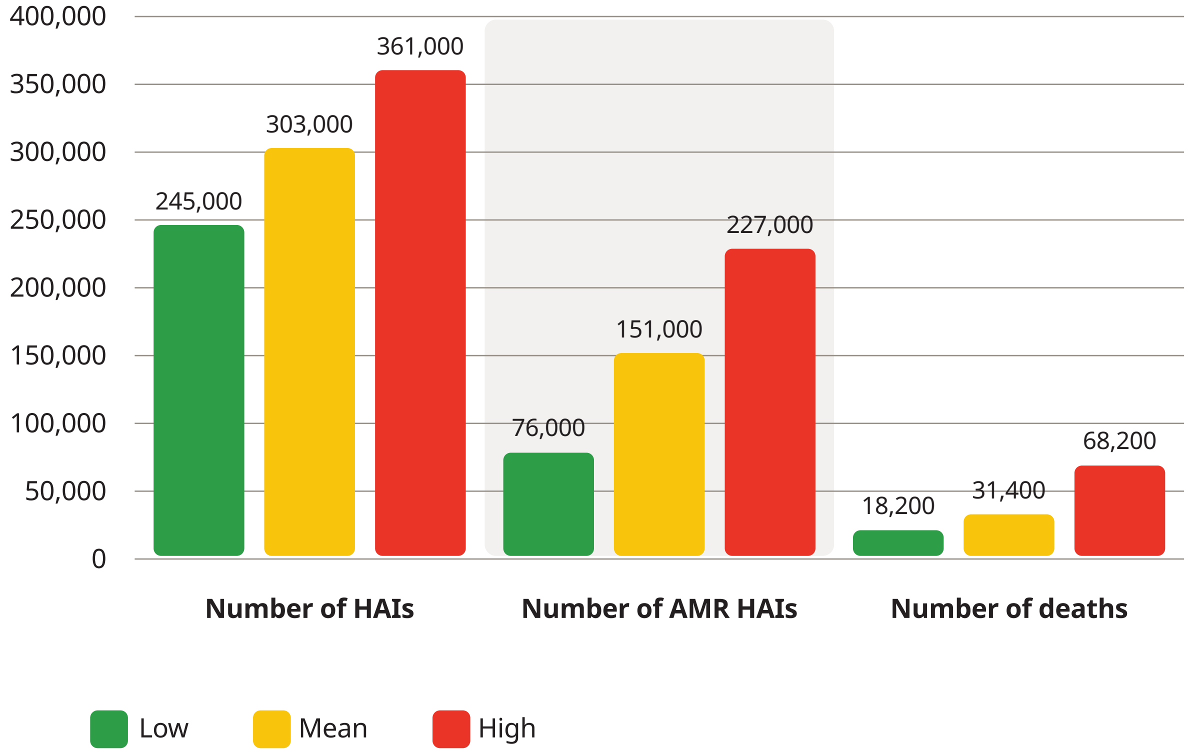
3. No comprehensive study of the economic and financial costs of HAIs has been conducted anywhere in the world, so it is not possible to conclude by how much this current study underestimates the true costs of HAIs.

Results

Disease burden due to healthcare associated infections

In total, the average number of HAIs in Ghana is estimated to be 303,000 in 2022 (Figure 2), of which half are predicted to be antimicrobial resistant (Berhe et al. 2021; Murray et al. 2022). The number of fatalities resulting from these HAIs is estimated to be 31,400 deaths.

Figure 2. Estimated number of healthcare associated infections and related deaths in Ghana

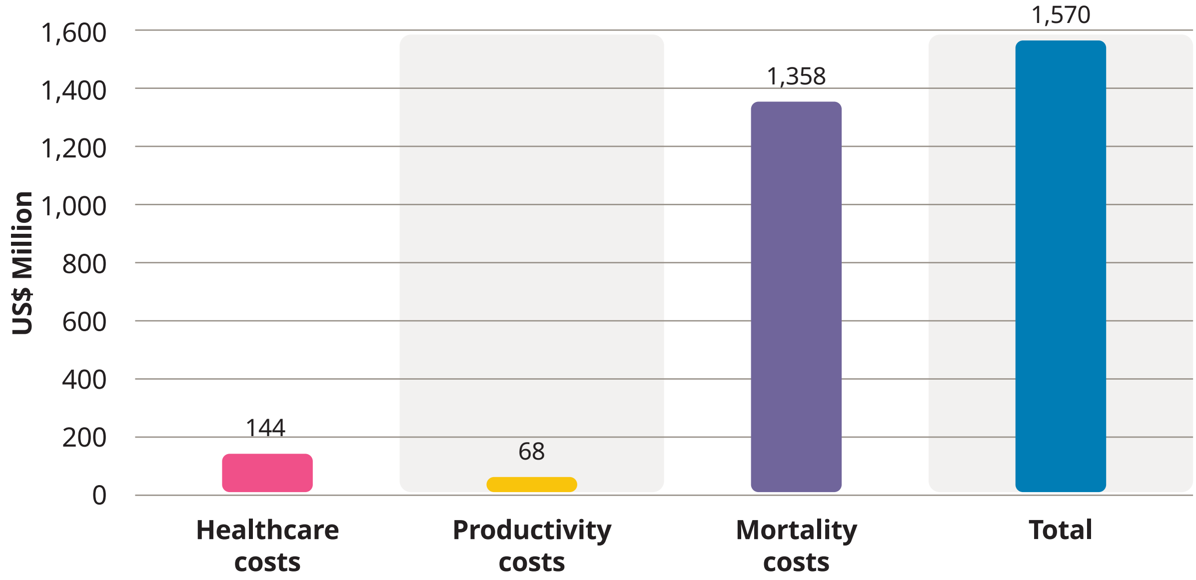


Estimates were made using different data inputs. When varying the HAI rate (baseline 12.8%) from 10.3% to 15.2%, the number of HAIs varied from 245,000 to 361,000. When varying the AMR rate (baseline 50%) from 25% to 75%, the number of HAIs that are anti-microbial resistant varies from 76,000 to 227,000. When varying the case fatality rate (baseline 6.9%) from 4% to 15%, the number of deaths varies from 18,200 to 68,200.

Monetary impacts due to HAIs

Costs of HAI are presented in Figure 3. Total costs exceed US$ 1.57 billion per year in Ghana.

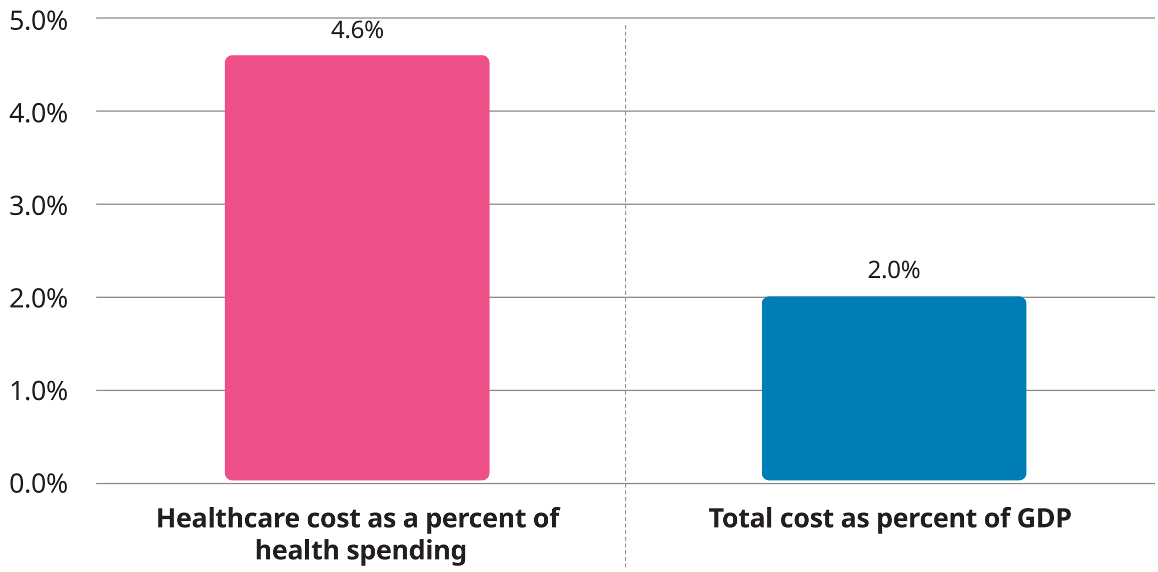
Figure 3. Estimated costs from HAIs in Ghana



Healthcare costs amount to US$ 144 million per year, with US$ 68 million in productivity losses and US$ 1,358 million in lost lives. The costs of premature death accounts for 86% of the total costs, due to the relatively high case fatality rate from HAIs. Total cost per HAI is US$ 5,180. Healthcare cost averaged US$ 475 per HAI episode.

Costs as a proportion of GDP and healthcare spending are shown in Figure 4. In terms of economic cost, HAIs cost an equivalent of 1.98% of GDP. The costs of treating HAIs (US$ 144 million per year) reflect 4.6% of overall healthcare spending from all sources. This is well below what was estimated in a tertiary hospital for surgical site infection, which was US$ 1,519 additional costs per patient, more than 3 times the US$ 475 estimated in this present study. However, HAIs will occur in a mix of tertiary, secondary and primary healthcare settings.

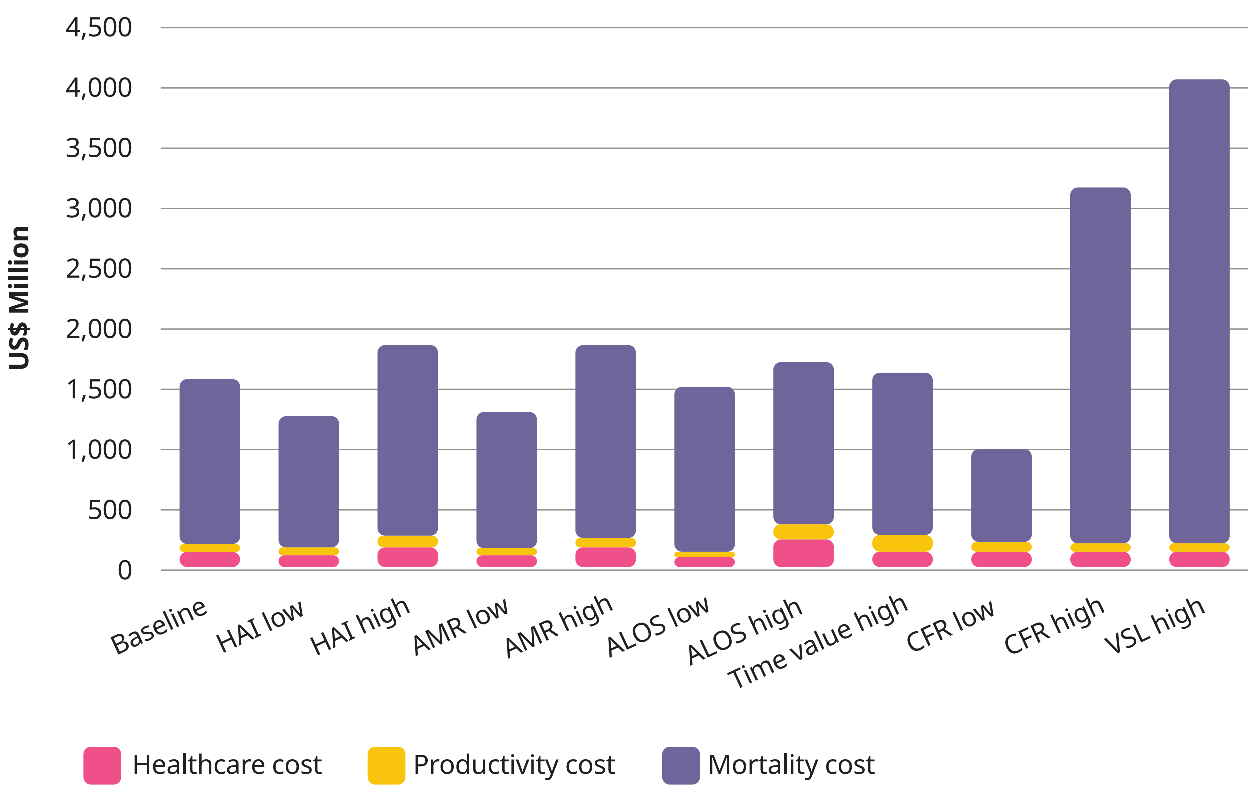
Figure 4. Costs as a proportion of GDP and healthcare spending



Sensitivity analysis

To better understand the impact of uncertain data inputs on the results, the values of selected variables were altered one at a time to assess what impact would be on the overall results in terms of economic impact. The variables selected include the HAI rate, the AMR rate, the average length of hospital stay, the value of time, the value of death, the case fatality rate. The results are shown in Figure 5. The biggest impact is the value of statistical life (VSL) which when a higher value was used it led to a total economic cost of US$ 4.1 billion in 2022. The results were also sensitive to the case fatality rate and the HAI rate. The resulting impact on costs as a percent of GDP were from 1.3% (low data value for CFR rate) to 5.1% (high value for VSL).

Figure 5. Results of sensitivity analysis



Cost-benefit analysis

The financial cost per capita to the health system due to HAIs across all the Ghanaian population is at least US$ 4.30 each year. Comparing this conservative figure with the cost per capita needed to provide basic WASH, waste management and environmental cleaning in healthcare facilities in low-income countries (US$ 0.3 per capita for capital cost and starting at US$ 0.7 recurrent cost) it is highly feasible that the spending will be covered by the savings in medical costs (Chaitkin et al, 2022).

Patient satisfaction as a key outcome of healthcare

Beyond the HAIs and additional costs to the health system and patients themselves, there will be several other negative consequences of inadequate WASH in healthcare facilities. Patient satisfaction has many determinants. Cleanliness, good housekeeping services and availability of drinking water and a clean toilet have been reported in the literature as key determinants of patient satisfaction.

Adequate WASH is particularly important to some population groups. For example, women attending antenatal clinic and choosing to have their child in a healthcare facility will consider the cleanliness of the facility and WASH services as essential, especially when they experience prolonged hospitalisations. Hygienic conditions for newborn health are vital and are therefore an important determinant of maternal and paternal satisfaction. A 2019 survey of over 1 million women and girls in 114 countries found that respectful and dignified maternity care was the most cited demand for quality reproductive and maternal healthcare, and this was closely followed by WASH services and facilities (White Ribbon Alliance, 2019).

Studies that assess the rates of HAI typically do not include infections to healthcare workers, which can seriously impact the health system's ability to provide quality healthcare. Healthcare worker job satisfaction influences their future career decisions and, if they do not feel safe in their working environment, they may leave their job. Furthermore, studies that measure HAIs focus on patients *admitted* to hospitals, while excluding the impact on outpatients of the lack of WASH facilities, cleaning, and waste management. Hence, there is a hidden burden of disease of ambulatory patients who pick up – and take home – a healthcare associated infection, with implications for the health of other family members. Furthermore, the lack of cleanliness and WASH facilities causes dissatisfaction of ambulatory patients with the quality of care and inconvenience, which might impact future treatment-seeking behaviour.

Conclusions

HAIs and other impacts of inadequate WASH are key challenges that need to be urgently addressed to achieve progress towards universal healthcare. Hospitals and health centres should be seen as safe environments where people can go to overcome illness and heal fully, and not places to get even sicker and stay for longer than necessary. At least 2.3% of healthcare expenditures could be saved if HAIs were minimised.

As has been found in richer nations, it is difficult to eliminate HAIs altogether, but significant reductions can be achieved through targeted interventions as well as improved general training and healthcare practices. Therefore, WASH and IPC measures should be essential interventions implemented by the health sector in Ghana to reduce HAIs and improve the quality of healthcare and patient satisfaction across the country.

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Annex 1: Notes to table 1

[a] Abubakar et al (2022) provides a pooled estimate for HAIs, estimating 12.76% (95% confidence interval 10.30– 15.23), based on 15 eligible Africa studies. It was found that surgical site infection was the most common HAI and accounted for 41.6% of all HAIs, followed by bloodstream infection and respiratory tract infections/ pneumonia. In Ghana, Labi et al (2020) surveyed ten hospitals that represented 33% of all acute care beds in government hospitals in Ghana. The prevalence values in hospitals ranged from 3.5% to 14.4%, with higher proportions of infections in secondary and tertiary care facilities. The most common HAIs were surgical site infections (32.6%), bloodstream infections (19.5%), urinary tract infections (18.5%) and respiratory tract infections (16.3%). Device-associated infections accounted for 7.1% of HAIs. Other studies include Fenny et al (2020) who found the prevalence rate for surgical site infection SSI was 11% of the total 446 cases sampled over 3 months in 2017. Newman (2009) found a rate of 6.7% in one teaching hospital in Accra. Onuzo et al found that 12.8% of women has an infection after caesarean section. According to the Ministry of Health, the HAI rate after surgery declined from 7.9% in 2020 to 4% in 2021. Based on this evidence, it is appropriate to use the pooled estimates reported in the meta-analysis by Abubakar et al (2022).

[b] Systematic reviews of antimicrobial drug resistance in sub-Saharan Africa show that antimicrobial resistance varies widely for different first- and second-line drugs and across geographies from 0% to over 80% (Leopold et al, 2014; Tadesse et al, 2017; Kariuki et al, 2021). Kariuki et al (2022) report AMR rates in Sub-Saharan Africa with four studies from Ghana. AMR of Clinical Diarrheagenic E. coli (DEC) are 100% for 5 drugs and 81% for a 6th drug in one study, and between 0% and 80% for 5 drugs in another study. AMR of Clinical Vibrio cholerae are 2.5%, 90%, and 95%. AMR of Clinical Acinetobacter baumannii are 60% to 76% for 6 drugs in one study, and from 8% to 67% in another study. AMR of Staphylococcus aureus are 3% to 97% for 7 drugs.

Murray et al (2022) report a systematic analysis of the global burden of bacterial antimicrobial resistance in 2019 and produce modelled estimates for resistance of several important pathogens to frontline drugs. The following figures are modelled data for Ghana:

- Meticillin-resistant Staphylococcus aureus is 20-30%.
- Isoniazid and rifampicin co-resistant (excluding XDR) Mycobacterium tuberculosis <5%.
- Third-generation cephalosporin-resistant Escherichia coli 50-60%.
- Carbapenem-resistant Acinetobacter baumannii 20-30%.
- Fluoroquinolone-resistant Escherichia coli 50-60%.
- Carbapenem-resistant Klebsiella pneumoniae <5%.
- Third-generation cephalosporin-resistant Klebsiella pneumoniae is 70-80%.

As stated in Ghana's National Action Plan for Antimicrobial Use and Resistance 2017-21 (Republic of Ghana, 2017): "Various studies carried out proved the existence of antibiotic resistance in Ghana. A study in 2 teaching, 7 regional and 2 district hospitals in Ghana revealed that very common microbes such as streptococci, salmonella, and E. coli showed very high levels of multiple drug resistance, some as high as 78.7%. In the various hospitals sampled, the prevalence of resistance to common and affordable antimicrobials like Tetracycline, Co-trimoxazole, Ampicillin and Nalidixic acid are significantly high (largely above 70%). In another 2007 study carried out in some key health facilities among in-patients and out-patients, specimens taken from various sources including wounds, urine, sputum and blood, showed a high prevalence of MRSA.

[c] Due to lack of published data available on the total costs of treating HAIs, it is necessary to construct the cost based on the cost per hospital bed day, the additional length of stay due to HAI, and the costs of drugs, procedures and laboratory tests related to the HAI. AMR will also lead to longer length of stay, and additional costs of drugs, procedures and laboratory tests.

[d] The cost per bed day in 2022 is estimated using the 2010 cost in Cedis (IHME, 2015), updating to current prices using the GDP deflator for Ghana for 12 years, and then applying the average Cedi:dollar exchange rate for 2022.

[e] Aerts et al (2022) for Mozambique, Gigey et al (2023) for Ethiopia and Bocoum et al (2019) for Mali, reflecting three ranges for different levels of care. Values in local currency were updated to 2022 costs and converted to Ghana cedi using PPP. The upper value is similar to the Fenny et al (2020) who found an average cost per day for excess days spent treating SSI to be US$ 330 per day. However, this was in a teaching hospital, and hence reflects the higher level of hospital.

[f] Based on Ghana data, as follows. Fenny et al (2020) found in a teaching hospital additional average length of stay (ALOS) of 4.6 days for patients with SSI. Otieku et al (2023) found ALOS was 3 days longer between the HAI (non-AMR) group and the control group.

[g] Otieku et al (2023) found patients in the AMR cohort stayed approximately 5 more days compared with HAI patients and 8 more days compared with uninfected cohorts.

[h] An exploratory literature review with a focus on the nine countries of the Hutton et al (2023) study found seven studies. Two studies presented case fatality of only HAI patients, while five compared HAI and non-HAI patients. Differences in case fatality ranged from 4.2% to 14.6%, with two studies from Ethiopia with a difference of 6.9%.

[i] US$ 8 million value of statistical life (VSL) from the USA (Banzhaf, 2022) converted to Ghana based on GDP per capita differential with the USA and using an income elasticity of 1.5. The high value is estimated using an income elasticity of 1.2.

WaterAid is an international not-for-profit, determined to make clean water, decent toilets and good hygiene normal for everyone, everywhere within a generation. Only by tackling these three essentials in ways that last can people change their lives for good.

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