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

Summary

The number of healthcare associated infections (HAI) in Nigeria (population: 218 million) is conservatively estimated at 848,000 cases in 2022, with 93,600 excess deaths in 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 HAI in Nigeria in 2022 was US$ 4.5 billion. This equates with 0.94% of Gross Domestic Product in 2022. The financial costs of providing healthcare to treat HAIs is US$ 606 million in 2022, or 3.8% of total health expenditure. When comparing the medical costs per capita in Nigeria of US$ 2.76 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 highly 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 Nigeria to reduce HAIs and improve the quality of healthcare and patient satisfaction across the country.

Key messages

- The total economic costs of healthcare associated infections (HAI) in Nigeria in 2022 was US$ 4.5 billion.
- This equates with 0.94% of Gross Domestic Product.
- The financial costs of providing healthcare to treat HAIs is US$ 606 million in 2022, or 3.8% of total health expenditure.
- It is feasible that the spending to provide basic WASH, waste management and environmental cleaning in healthcare facilities in Nigeria (less than US$ 1 per capita) will be more than covered by the savings in medical costs of US$ 1.38 per capita per year, if the HAI rate is 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 drinking-water, sanitation and hygiene (WASH), waste management and environmental cleanliness in healthcare facilities poses a significant health risk to patients and healthcare workers in Nigeria, and it seriously impacts quality of care and satisfaction with health services.

In Nigeria 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.

Infection prevention and control (IPC) has been reported to be poor in Nigeria. In Kaduna State, 30.5% and 10.1% of health workers do not use face masks and eye goggles, respectively, when conducting procedures likely to generate splash of body fluids (Sunday et al, 2021). The same study reported that the proportion of healthcare staff practising IPC correctly was 51.6%. IPC practices have also been shown to be better in private than in public health facilities. Private health workers were 3 times more likely to implement IPC interventions compared to public HF workers (Sunday et al, 2021).

The problem caused by HAIs has been recognised by the Federal Ministry of Health (2021), with the publication of the Nigerian Manual of Infection Prevention and Control, building on the National Policy on Infection Prevention and Control issued in 2013 and disease-specific IPC strategies such as monkeypox, viral haemorrhagic fever, tuberculosis and injection safety. The generic and prescriptive policies contained within the manual are mandatory and collectively represent the fundamental irreducible minimum infection prevention and control processes, procedures and practices. The facility-specific policies should be adapted to fit the scope, nature and level of services provided by the particular facility.

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 Nigeria, but available estimates suggest that the majority of HAIs will be resistant to first-line drugs (Federal Ministries of Agriculture, Environment and Health, 2017a). As a response, Nigeria has issued a National Action Plan for Antimicrobial Resistance in 2017 (Federal Ministries of Agriculture, Environment and Health, 2017b).

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 Nigeria. Basic water supply was available in 52% of healthcare facilities nationally, varying 44% in rural areas to 72% in urban areas. Basic sanitation coverage is significantly lower at 14%. Basic handwashing coverage is 36% nationally, varying from 29% in rural areas to 53% in urban areas. These rates have minimal variation when compared to the WASH Norms Survey (2021) which found basic water supply at 59%, basic sanitation at 12% and 30% basic hygiene services (Federal Ministry of Water Resources and others, 2022).

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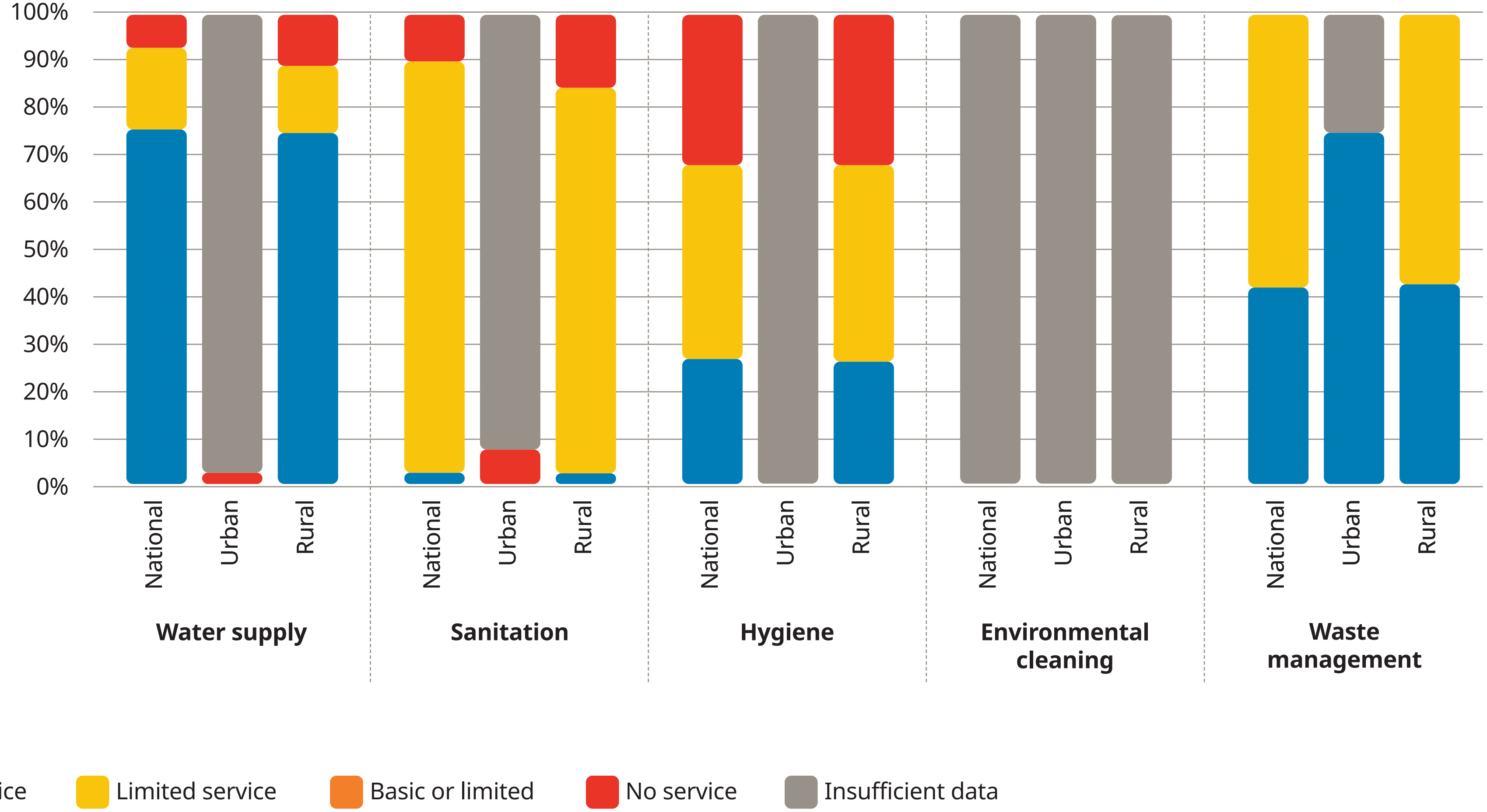
1. An HAI is a condition resulting from an adverse reaction to an infectious agent or its toxins acquired from healthcare settings that was not incubating or symptomatic at the time of admission.

Figure 1. Coverage of WASH, waste management and environmental cleaning in healthcare facilities in Nigeria 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 Nigeria, 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	Nigeria data value (in brackets range used in sensitivity analysis)	Data source
Healthcare cost			
Annual healthcare associated infections (HAIs)	Average % of admissions infected with HAI	18.2% (12.8% to 24%) [a]	10 studies
	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	2.13 admissions per 100 population [c]	DHIS2
Additional cost of treating a patient with an HAI [d]	Average hospital cost per day ('hotel' cost)	US$ 26.5 health centre, US$ 41.9 district hospital, US$ 78.2 higher hospital [e]	IHME (2015)
	Cost of drugs and laboratory tests per HAI	US$ 30.4 health centre, US$ 72.8 district hospital, US$ 334.3 higher hospital[f]. Double for AMR	Aerts et al (2022), Gidey et al (2023), Bocoum et al (2019)
	Additional length of stay	5 days [g] (10 days AMR) [h]	Fenny et al (2020) Otieku et al (2023)

Cost variable	Data needs	Nigeria 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$ 31.7 per day (US$ 78 per day in industry)	World Bank statistics
	Proportion of adult HAI patients	60%	Assumption
	Labour force participation rate	52.1% (female) 65.5% (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%) [i] 13.8% (AMR)	7 studies
Value of a premature death	Value of a statistical life	US$ 38,471 (high value US$ 111,873) [j]	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 Nigeria[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.

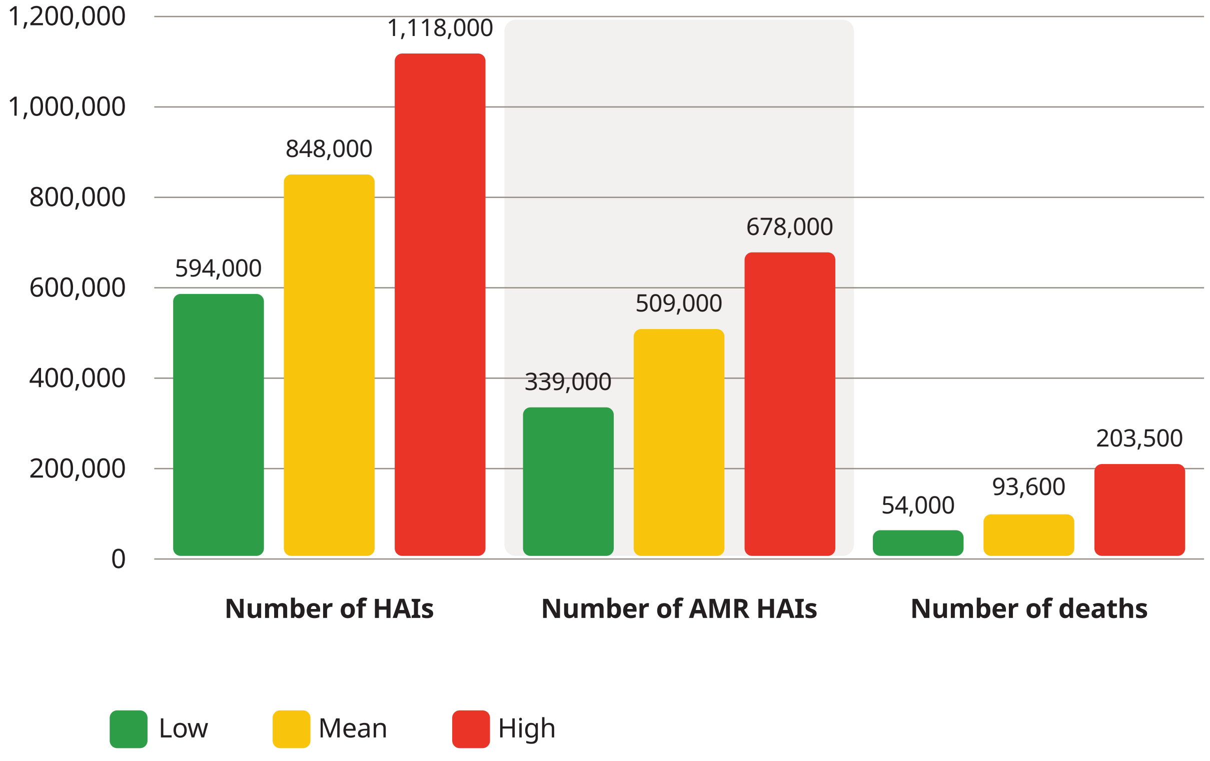
3. No comprehensive study of the economic and financial costs of HAIs has been conducted anywhere in the world, so it is not possible to conclude by how much this current study underestimates the true costs of HAIs.

Results

Disease burden due to healthcare associated infections

In total, the average number of HAIs in Nigeria is estimated to be 848,000 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 93,600 deaths.

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

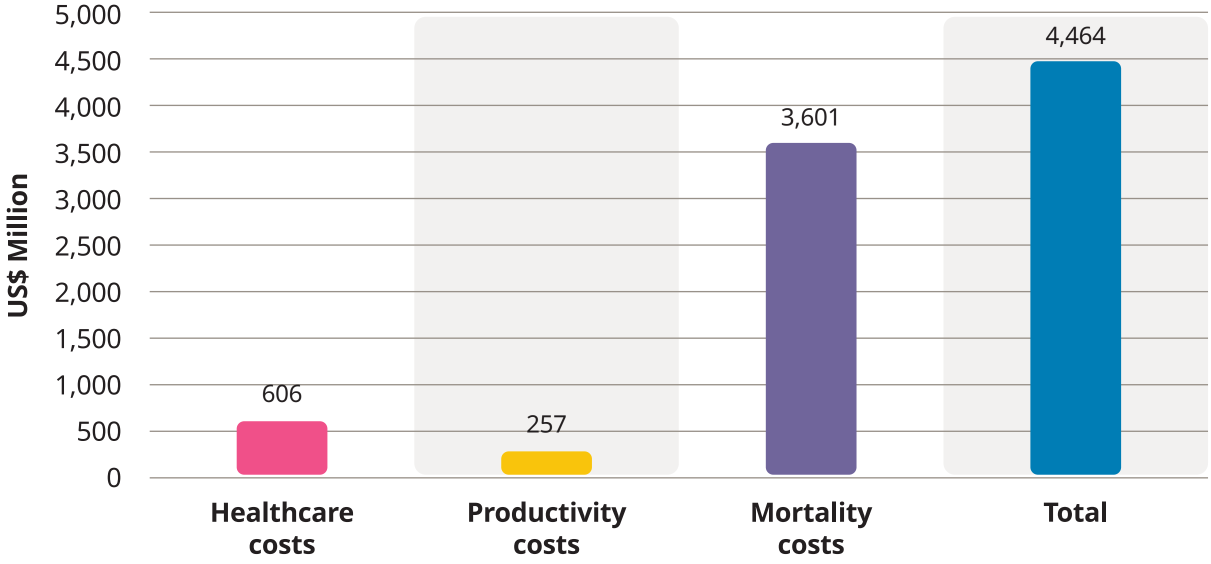


Estimates were made using different data inputs. When varying the baseline HAI rate of 18.2% from 12.8% to 24%, the number of HAIs varied from 594,000 to 1,118,000. When varying the AMR rate (baseline 60%) from 40% to 80%, the number of HAIs that are anti-microbial resistant varies from 339,000 to 678,000. When varying the case fatality rate (baseline 6.9%) from 4% to 15%, the number of deaths varies from 54,300 to 203,500.

Monetary impacts due to HAIs

Costs of HAI are presented in Figure 3. Total costs are US$ 4.5 billion per year in Nigeria.

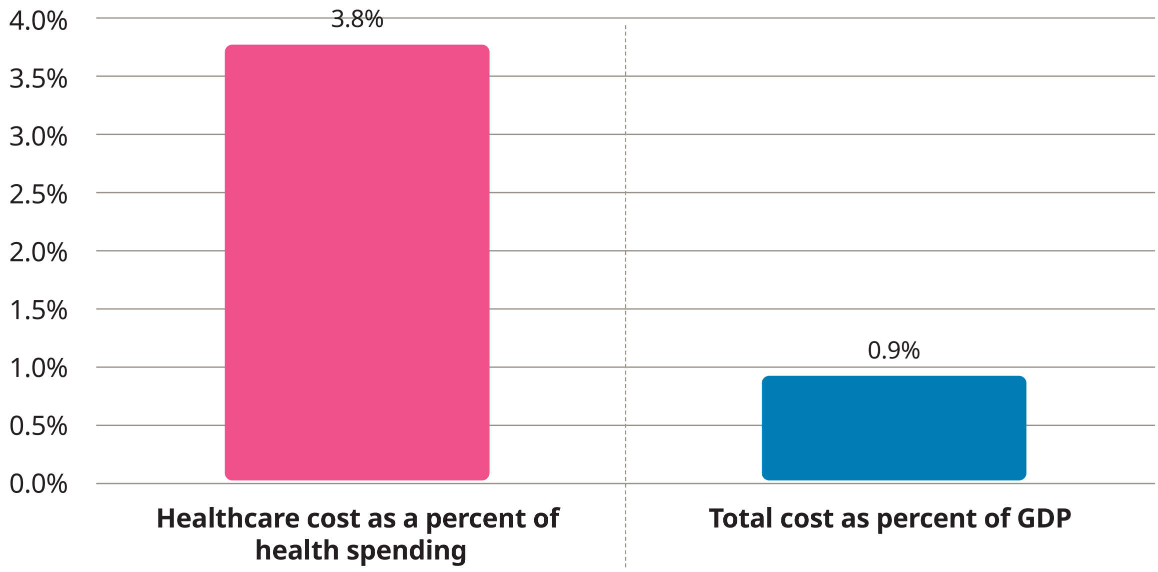
Figure 3. Estimated costs from HAIs in Nigeria



Healthcare costs amount to US$ 606 million per year, with US$ 257 million in productivity losses and US$ 3.6 billion in lost lives. The costs of premature death account for 81% of the total costs, due to the relatively high case fatality rate from HAIs. Total cost per HAI is US$ 5,265. Healthcare costs averaged US$ 715 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 0.94% of GDP. The costs of treating HAIs (US$ 606 million per year) reflect 3.8% of overall healthcare spending from all sources.

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$ 11.3 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 0.62% (low data value for HAI rate and for low CFR rate) to 2.4% (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 Nigerian population is at least US$ 2.76 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 clinics 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. Up to 1.9% 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 Nigeria 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] Ten studies are available from Nigeria on HAI rates, reported below. Abubakar (2020) surveyed three acute care hospitals in Northern Nigeria, finding a HAI point-prevalence of 14.3% among 321 patients. The most common HAIs were bloodstream infection (38.0%), surgical site infections (32.0%) and pneumonia (12.0%). Neonatal (53.0%), pediatric surgical (26.7%) and surgical (10.1%) specialties had the highest prevalence. Iliyasu et al (2018) conducted a 2-year surveillance survey in a tertiary hospital in Nigeria. 518 patients developed HAI out of 8216 patients giving an overall prevalence of 6.3%. UTI 223 (43.1%) was the most prevalent HAI. Overall, E. coli 207 (40.0%) was the most frequent isolates followed by P. aeruginosa 80 (15.4%). Ige et al (2011) conducted a retrospective survey of records from the infection control unit of the University College Hospital, Ibadan, for the years 2005-09. For the 5 years studied 22,941 in-patients were reviewed and the data of those who developed infections during admission were retrieved and analyzed. The prevalence of HAI over the 5-year period was 2.6% (95% CI: 2.4–2.8). Surgical and medical wards had the most infections (48.3%) and (20.5%) respectively. Urinary tract infection (UTI) and surgical site infection (30.7%) were the most prevalent (43.9%) HAI. Olowo-okere et al (2018) found 27.6% of patients developed SSIs at a Tertiary Healthcare Facility in Abuja, Nigeria. Bob-Manual et al (2023) found a 10% HAI prevalence among 100 patients from adult and paediatric medical and surgical wards, and neonatal intensive care unit (NICU) at Rivers State University Teaching Hospital (RSUTH), Port Harcourt, in 2021. Ameh et al (2009) surveyed 322 children who had surgery between 2001 and 2005, of whom 23.6% developed SSI. The SSI rate was 14.3% in clean incisions, 19.3% in clean-contaminated incisions, 27.3% in contaminated incisions, and 60% in dirty incisions. The infection rate was 25.8% in emergency procedures and 20.8% in elective procedures. Dayyab et al (2018) conducted a prospective study of hospital-acquired infections among adults in a tertiary hospital in north-western Nigeria, finding rates of HAIs to be 7.2%, 18.6% and 1.8% in the medical wards, ICU and surgical wards, respectively. The most common HAI was urinary tract infection caused by Escherichia coli. Kesah et al (2004) found an overall wound infection rate of 30.9% (245 out of 664 surgical patients). Iwuafor et al (2016) found a 45% HAI rate in the intensive care unit. Makanjuola et al (2018) found an overall prevalence of ICU infections was 30.9%. Of these, 12.9% were bloodstream infections, 31.5% urinary tract infections, 38.9% pneumonia, and 16.7% skin and soft tissue infections. Given the range in findings, from 2.6% to 45%, it is necessary to estimate an average; however, no meta-analysis has been done for HAIs in Nigeria. The simple average is 18.2% across all these studies is used in the analysis, with low range 12.8% and high range 24%.

[b] A number of studies on rates of AMR have been conducted in Nigeria. Iliyasu et al (2018) found a high prevalence of cloxacillin resistant S. aureus (67.9%) and gram-negative rods resistant to third-generation cephalosporins. Trimethoprimsulfamethoxazole resistance across the board was more than 90%. Stanley (2020) observed widespread multidrug resistance: Klebsiella pneumoniae, S. aureus, and E. coli isolated from urine were resistant to amoxicillin/clavulanate, cefuroxime, ceftazidime, ciprofloxacin, ampicillin, gentamycin, and ceftriaxone. Dayyab et al (2018) found high-level resistance to commonly prescribed antibiotics, especially ampicillin and ceftriaxone, was observed among causative bacteria. Nwafia et al (2019) found all the isolates were resistant to ampicillin, tetracycline and chloramphenicol while 68 (97.14%) of the 70 isolates were susceptible to imipenem. Orababa et al (2012) found 63.1% of the E faecium and 36.9% of the E faecalis were vancomycin resistant. Ayandele et al (2020) found E. coli exhibited high resistance against cloxacillin (96%), oxacillin (96%), erythromycin (88%), and most especially streptomycin (98%). Similarly, K. pneumoniae had presented a high resistance to streptomycin (88%), cloxacillin (92%), oxacillin (92%), and colistin (92%). Makanjuola et al (2018) found multidrug resistant organisms constituted 59.3% of the pathogens, MDR Klebsiella spp and MDR E. coli were 70.8% and 71.4% respectively. Resistance to Cefuroxime was the highest (92.9%) while Meropenem had the least resistance (21.4%).

Government of Nigeria (2017b) provides estimates of AMR. For example, 79-100% of Escherichia coli are resistant to penicillins, 68-80% to tetracycline, 90-100% to ampicillin, 76-100% to cotrimoxazole, 89% to nalixidic acid and 78% to chloramphenicol. Shigella in children is 100% resistance to penicillins, 44-100% resistance to gentamicin, 68-70% resistance to tetracyclines and 44-58% resistance to the quinolones. In South-West Nigeria, 90% resistance to ampicillin, 77% to chloramphenicol, 79% to tetracycline and 86% to cotrimoxazole. There is an increasing rate of Vibrio cholerae resistance to fluoroquinolones in Nigeria, with already 100% resistance to co-trimozaxole. The three most common causes of UTIs (E. coli, Staphylococcus and Klebsiella) in this review are listed by the WHO as organisms of concern with regards to AMR, with resistance 50% to 100% in Nigeria.

From Murray et al, 2022, rates of resistance are the following for Nigeria:

- Meticillin-resistant Staphylococcus aureus is 40-50%.
- Isoniazid and rifampicin co-resistant (excluding XDR) Mycobacterium tuberculosis is <5%.
- Third-generation cephalosporin-resistant Escherichia coli is 60-70%.
- Carbapenem-resistant Acinetobacter baumannii is 30-40%.
- Fluoroquinolone-resistant Escherichia coli is 60-70%.
- Carbapenem-resistant Klebsiella pneumoniae is 10-20%.
- Third-generation cephalosporin-resistant Klebsiella pneumoniae is >80%.

Due to the particularly high rates of AMR found, 60% AMR is used for Nigeria, with a range 40-80%.

[c] A figure of 4,658,641 hospital admissions is sourced from Demographics Health Information System.

[d] 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.

[e] The cost per bed day in 2022 is estimated using the 2011 cost in Uganda (IHME, 2014), updating to current prices using the GDP deflator for Uganda for 11 years, and then converting to Nigerian Naira using the average exchange rate for 2022.

[f] Aerts et al (2022) for Mozambique, Gigey et al (2023) for Ethiopia and Bocoum et al (2019) for Nigeria, reflecting three ranges for different levels of care. Values in local currency were updated to 2022 costs and converted to Nigeria Naira using PPP.

[g] Based on 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.

[h] 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.

[i] 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%.

[j] US$ 8 million value of statistical life (VSL) from the USA (Banzhaf, 2022) converted to Nigeria 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.

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