OECD-WHO Briefing Paper
on Infection Prevention and Control

ADDRESSING THE BURDEN OF INFECTIONS AND ANTIMICROBIAL RESISTANCE ASSOCIATED WITH HEALTH CARE

Focus on G7 countries

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BETTER POLICIES FOR BETTER LIVES

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Key findings

- Health care-associated infections (HAIs) pose a significant threat to population health across the globe, including in G7 countries. On average, 7% of patients in acute health care facilities in high-income countries develop HAIs, with the same risk being more than twice in low and middle-income countries (i.e., 15%).
- Microorganisms typically causing HAIs are very frequently resistant to available treatments. 68% of the total burden on antimicrobial resistance (AMR) is caused by four resistant microorganisms mostly acquired in health care, namely *Escherichia coli* and *Klebsiella pneumoniae* resistant to third-generation cephalosporins, meticillin-resistant *Staphylococcus aureus* (MRSA), and *Pseudomonas aeruginosa* resistant to carbapenems. It was also estimated that 63.5% (426 277 of 671 689) of cases of infections with antibiotic-resistant bacteria were associated with health care, resulting in 72.4% (23 976 of 33 110) of antibiotic resistance attributable deaths, according to 2015 data from European Union (EU) and European Economic Area (EEA) members.
- Without a robust policy implementation, the average resistance proportions across eight antibiotic–bacterium combinations are projected to approximate to 20% in G7 and EU27 countries by 2030. Even more worryingly, resistance to second-line antibiotics – the backup options for infections that are difficult to treat – will nearly double among G7 countries by 2030 compared to 2005.
- If AMR continues to follow the expected growth rates, G7 countries will spend more than 4 billion USD purchasing power parity (PPP) annually on average between 2015 and 2050 (i.e., around 5 USD PPP per capita) for treating resistant infections. In effect, this means that G7 countries are expected to spend on AMR each year around 2.5 times the amount of the average health expenditure they incurred on HIV/AIDS in 2015.
- Compelling evidence demonstrates that IPC interventions can achieve a significant reduction in the rates of HAIs in the range of 35–70%. In 2016, WHO issued a set of recommendations on the core components of effective infection prevention and control (IPC) programmes. The six core components recommended at the national level are: 1) IPC programmes; 2) IPC guidelines; 3) IPC training and education; 4) HAI surveillance; 5) multimodal strategies for IPC interventions; and 6) IPC monitoring and evaluation. These core components also apply at the facility level, along with an additional two core components: 7) appropriate workload, staffing and bed occupancy; and 8) the built environment, materials, and equipment.
- The 2021–2022 WHO global survey on the minimum requirements for national IPC programmes showed that only 54.7% (58/106) of countries had an active IPC programme. However, only four countries (none among the G7) reported meeting all minimum requirements for IPC at the national level.
- With regard to the assessments of G7 countries, the IPC minimum requirements related to the core components of the general IPC programme and IPC guidelines were the requirements that were most frequently met. In terms of individual minimum requirements, the ones least frequently met were those related to: having a national system and schedule of monitoring and evaluation in place to check on the effectiveness of training and education at least annually; having a national IPC curriculum for in-service training of health care workers; the expertise of the national IPC focal point in implementation science and multimodal improvement strategies and their application to IPC; having a strategic plan for IPC monitoring in place, including an integrated system for collection and analysis of data; hand hygiene compliance monitoring and feedback identified as a key national indicator.

- Strengthening investments in IPC interventions can achieve a significant reduction in the rates of HAIs in the range of 35–70%, irrespective of the level of income of a country. Analysis by the Organisation for Economic Co-operation and Development (OECD) show that improving hand hygiene and enhancing environmental hygiene can be important components of comprehensive approaches to reduce the HAI and AMR burden in G7 and EU27 members. This analysis suggests that, between 2015 and 2050, improving hand hygiene will prevent more than 30 000 deaths each year across all the G7 countries and around 19 000 across EU/EEA members, whereas 28 000 deaths each year can be avoided through enhanced environmental hygiene practices and around 18 000 across the EU/EEA members. Across 33 OECD countries, each 1 USD allocated to investments on these two interventions would yield 1.1–11.3 USD in savings in healthcare expenditure, depending on the type of intervention and setting.
- Enhancing IPC would provide a significant contribution to tackling AMR, particularly in the longer term, but additional actions to promote prudent use of antibiotics are needed. OECD analyses show that investing in a policy package that combines improved hand hygiene, enhanced environmental hygiene, and stewardship programmes would provide greater benefits.
- Based on their current level of progress of their IPC programmes, the following strategic directions can be identified for G7 countries: 1) strengthen IPC programmes and infrastructures at national and facility level; 2) improve IPC training and education; 3) strengthen monitoring and surveillance; and 4) use data for action.

Context and scope

This brief has been prepared by the World Health Organization (WHO) and the Organisation for Economic Co-operation and Development (OECD) pursuant to a request by the 2022 German Presidency to develop an analysis of the landscape of infection prevention and control (IPC) programmes and activities, recognizing the importance of strengthening IPC capacity in health care facilities to reduce the spread of antimicrobial resistance (AMR) and health care-associated infections (HAIs), including in the context of outbreaks and pandemics. This document, as well as any data and map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area. The opinions expressed and arguments employed herein do not necessarily reflect the official views of the OECD member countries or the World Health Organization.

To date, WHO and OECD have published a range of technical analyses that shed light on the state of IPC capacity and that have informed the development of the business case for investing in IPC measures. In May 2022, WHO issued the first global report on IPC[1] which provided a situation analysis of IPC programmes and activities worldwide. This report was followed by another technical analysis on different indicators, published in August 2022 by the WHO/UNICEF Joint Monitoring Programme for Water, Sanitation and Hygiene (WASH) and IPC in health care facilities.[2] Further, in 2018, OECD produced an economic analysis[3] using data from 33 OECD countries that quantified the effectiveness and cost-effectiveness of a range of interventions, including IPC measures such as improving hand hygiene and enhancing environmental hygiene to reduce the spread of AMR. Findings of the OECD analysis have been crucial in highlighting the business case for IPC.

The evidence, strategic directions and conclusions emerging from these works informed a new resolution on IPC which was approved at the Seventy-fifth World Health Assembly in May 2022. This resolution[4] is in line with the G7 commitment to strengthening and assessing the implementation of IPC programmes across the One Health spectrum, particularly for health care facilities. This brief is based on the evidence included in these and other sources and builds upon the recommendations included in the World Health Assembly resolution WHA75.13.[4] his brief refers to the definition of IPC included in the resolution - i.e. that IPC is a clinical and public health discipline based on a scientific approach, providing proactive, responsive

[1] Global report on infection prevention and control. Geneva: World Health Organization; 2022 (https://www.who.int/publications/i/item/9789240051164, accessed 24 September 2022).

[2] Progress on WASH in health care facilities 2000–2021: special focus on WASH and infection prevention and control (IPC). Geneva and New York (NY): World Health Organization and United Nations Children's Fund; 2022 (https://washdata.org/sites/default/files/2022-08/jmp-2022-wash-hcf-launch.pdf, accessed 24 September 2022).

[3] Stemming the superbug tide: just a few dollars more. Paris: Organisation for Economic Co-operation and Development; 2018 (https://www.oecd.org/health/stemming-the-superbug-tide-9789264307599-en.htm, accessed 24 September 2022).

[4] Resolution WHA75.13. Global strategy on infection prevention and control. Seventy-fifth World Health Assembly. Geneva: World Health Organization; 2022 (https://apps.who.int/gb/ebwha/pdf_files/WHA75/A75_R13-en.pdf, accessed 25 September 2022).

and practical preventive and control measures grounded in infectious diseases, epidemiology, social engineering, implementation science and health systems strengthening that requires a dedicated specialized health workforce.[1,4] It protects patients, health workers and visitors at health care facilities by preventing avoidable infections, including those caused by emerging and antimicrobial-resistant pathogens, acquired during the provision of health services.[1] IPC is foundational to strong, resilient health systems. Public health emergencies such as the COVID-19 pandemic, have demonstrated that IPC, together with core capacities required by the International Health Regulations (2005),[5] play a critical role in preventing and responding timely and effectively to public health risks and emergencies of national and international concern.[1,4] IPC action is also acknowledged as playing a prominent role in curbing ongoing threats in health-related activities ranging from WASH and health worker and patient safety to preventing specific conditions, such as AMR and sepsis, and health care-associated transmission of infectious diseases such as hepatitis, tuberculosis and HIV.

The brief aims to:

- provide a global overview on the problem of infections acquired in health care, including those caused by emerging and antimicrobial resistant pathogens;
- present evidence of the effectiveness and cost-effectiveness of IPC interventions, including hand hygiene and environmental hygiene, and
- indicate key strategic directions with special emphasis on G7 countries.

[5] International health regulations (2005), 2nd ed. Geneva: World Health Organization; 2008 (https://apps.who.int/iris/handle/10665/43883, accessed 11 May 2022).

IPC: a global perspective

The burden of HAIs

HAIs pose a significant threat to population health across the globe, including in countries that are able to offer technologically advanced treatments.

HAIs are avoidable and yet they often present severe and deadly threats to patients, health workers and visitors that can occur during the provision of care in any health care settings where health care services are delivered – including intensive care units (ICUs), primary care and community settings, as well as long-term care facilities (LTCFs).

HAIs are among the most frequent adverse events that occur in the context of health service delivery in countries across the socioeconomic development spectrum. HAIs are usually a consequence of poor-quality care and lack of proper safety programmes, but can also be linked to technologically advanced and invasive treatments.[1] Globally, in high-income countries (HICs), HAIs strike, on average, 7% of patients in acute health care facilities.[6] The risk of HAIs in low- and middle-income countries (LMICs) is estimated to be more than double the risk in HICs – on average 15% but sometimes up to 20 times higher.[6] Neonates in LMICs in particular, are at a higher risk of acquiring HAIs, with the estimated infection rates ranging from 3 to 20 times the rates in HICs.[7] According to 2017 data, approximately 8.9 million episodes of HAIs are estimated to occur every year in European Union (EU) and European Economic Area (EEA) members, of which 4.4 million are in LTCFs.[8]

To date, it has been shown that the most common HAIs are respiratory tract infections, surgical site infections (SSI), gastrointestinal infections (including *Clostridioides difficile* infections), urinary tract and bloodstream infections.[8,9,10] However, in LMICs SSI is the most frequently reported HAI.[6] The presence of devices, such as central venous or urinary catheters, and invasive mechanical ventilation, increase the risk of developing an HAI. For instance, in ICU settings, where catheters and respirators are more frequently used, as many as 30% of patients can be at the risk of acquiring an infection. Importantly,

[6] Allegranzi B, Bagheri NS, Combescure C, Graafmans W, Attar H, Donaldson L et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2011;377(9761):228–41.

[7] Zaidi AK, Huskins WC, Thaver D, Bhutta ZA, Abbas Z, Goldmann DA. Hospital-acquired neonatal infections in developing countries. Lancet. 2005;365(9465):1175-1188.

[8] Suetens C, Latour K, Kärki T, Ricchizzi E, Kinross P, Moro ML, et al. Prevalence of healthcare-associated infections, estimated incidence and composite antimicrobial resistance index in acute care hospitals and long-term care facilities: results from two European point prevalence surveys, 2016 to 2017. Eurosurveillance: Eur Comm Dis Bul. 2018;23(46).

[9] Alothman A, Al Thaqafi A, Al Ansary A, Zikri A, Fayed A, Khamis F, et al. Prevalence of infections and antimicrobial use in the acute-care hospital setting in the Middle East: Results from the first point-prevalence survey in the region. Int J Infect Dis. 2020;101:249-58.

[10] Magill SS, O'Leary E, Janelle SJ, Thompson DL, Dumyati G, Nadle J et al. Changes in prevalence of health care-associated infections in U.S. hospitals. N Engl J Med. 2018;379(18):1732–44.

infections in these patients can rapidly evolve to sepsis and organ dysfunction, a condition that is deadly in more than half of ICU patients. Approximately one in four (23.6%) of all hospital-treated sepsis cases are health care associated. Moreover, almost half (48.7%) of all cases of sepsis with organ dysfunction treated in adult ICUs are acquired in hospitals.[11]

HAIs are associated with an increased risk of death. According to a national study conducted in the United States in 2002, 5.8% of patients affected by HAI died due to an event associated with their infection.[12] Another study from EU and EEA members found that, in 2011, some 91 000 of 2.6 million patients who experienced an HAI lost their lives, representing about 3.5% of the study population.[13] The risk of death is exacerbated among patients who experience sepsis. One 2010 study found that about 24.4% of patients with health care-associated sepsis died. Alarmingly, mortality is estimated to increase to 52.3% among patients treated in ICUs.[11]

HAIs not only significantly increase the risk of premature death but also lead to long-term complications, disabilities, and suffering, resulting in social and psychological repercussions. For instance, across the EU/EEA countries, the burden of HAIs in 2011–2021 was estimated to account for twice the disability and premature mortality than 32 other infections combined[13,14] (Fig. 1). This finding indicates that HAIs represent the most significant challenge in terms of avoidable burden due to infections in EU/EEA members, and most probably in most other HICs, exceeding the burden of other infections such as influenza and tuberculosis[13,14] (Figure 1). Additionally, HAIs are associated with increases in the length of hospital stay, overloading health care management and significantly increasing the expenses of health care.[1]

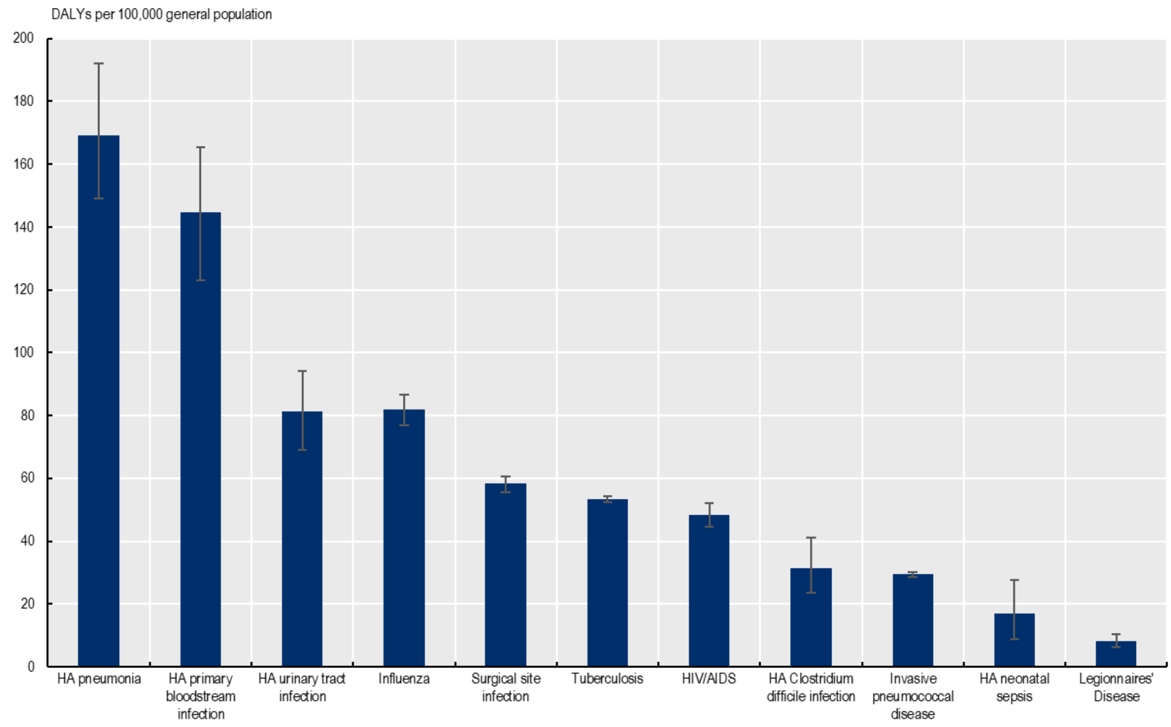
[11] Markwart R, Saito H, Harder T, Tomczyk S, Cassini A, Fleischmann-Struzek C et al. Epidemiology and burden of sepsis acquired in hospitals and intensive care units: a systematic review and meta-analysis. Intensive Care Med. 2020;46(8):1536–51.

[12] Klevens MR, Edwards JR, Richards CL, Horan TC, Gaynes RP, Pollock DA, et al. Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002. Public Health Rep. 2007; 122(2): 160–166.

[13] Cassini A, Plachouras D, Eckmanns T, Abu Sin M, Blank H-P, Ducomble T, et al. Burden of Six Healthcare-Associated Infections on European Population Health: Estimating Incidence-Based Disability-Adjusted Life Years through a Population Prevalence-Based Modelling Study. PLOS Medicine 2016; 13(10): e1002150.

[14] Cassini A, Colzani E, Pini A , Mangen M-JJ , Plass D , McDonald SA, et al. (2018). Impact of infectious diseases on population health using incidence-based disability-adjusted life years (DALYs): results from the Burden of Communicable Diseases in Europe study, European Union and European Economic Area countries, 2009 to 2013. Eurosurveillance 2016;23(16):17-00454.

Figure 1. In EU/EEA member states, HAIs represent a substantially greater threat to population health compared to other infectious diseases (2011–2012)



DALYs: disability-adjusted life-years, i.e., years of life lost due to premature mortality and years lived with a disability due to health care-acquired infection; HA: hospital- acquired; HIV/AIDS: human immunodeficiency virus/acquired immunodeficiency syndrome.
Source: Cassini A, Plachouras D, Eckmanns T, Abu Sin M, Blank H-P, Ducomble T, et al (2016). Burden of Six Healthcare-Associated Infections on European Population Health: Estimating Incidence-Based Disability-Adjusted Life Years through a Population Prevalence-Based Modelling Study. PLOS Medicine 13(10): e1002150.
Cassini A, Colzani E, Pini A , Mangen M-JJ , Plass D , McDonald SA, et al. (2018). Impact of infectious diseases on population health using incidence-based disability-adjusted life years (DALYs): results from the Burden of Communicable Diseases in Europe study, European Union and European Economic Area countries, 2009 to 2013. Eurosurveillance 2016;23(16):17-00454.

Outbreaks of infections such as SARS-CoV-2 also represent a major threat to the safety of patients, health workers and visitors in health care settings. During the first waves of the COVID-19 pandemic, it was found that up to 41% of inpatients were infected by SARS-CoV-2 in health care settings.[15] Furthermore, health workers have been at higher risk of infection throughout the pandemic, with the prevalence of SARS-CoV-2 infection up to 43.3%.[16]

The burden of AMR

AMR poses a significant threat to provision of health care as infections become more difficult to treat.

[15] Abbas M, Zhu NJ, Mookerjee S, Bolt F, Otter JA, Holmes AH et al. Hospital-onset COVID-19 infection surveillance systems: a systematic review. J Hosp Infect. 2021;115:44–50.
[16] Chou R, Dana T, Buckley DI, Selph S, Fu R, Totten AM. Epidemiology of and risk factors for coronavirus infection in health care workers: a living rapid review. Ann Intern Med. 2020 Jul 21;173(2):120-136. doi: 10.7326/M20-1632. Update in: Ann Intern Med. 2022 Jan;175(1):W8-W9.

Microorganisms typically causing HAIs very frequently carry resistance patterns. For example, in EU/EEA members, the four antibiotic-resistant microorganisms with the most impact (*Escherichia coli* [*E. coli*] resistant to third-generation cephalosporins, meticillin-resistant *Staphylococcus aureus* [MRSA], *Pseudomonas aeruginosa* resistant to carbapenems and *K. pneumoniae* resistant to third-generation cephalosporins) are typically acquired in health care settings.[17] Combined, these four microorganisms are estimated to cause 68% of the burden of antibiotic resistance in terms of disability and premature mortality.[17] The AMR threat is even more worrying since deaths due to carbapenem-resistant *K. pneumoniae* increased more than six-fold between 2007 and 2015 in EU/EEA countries.[17] It was also estimated that 63·5% of cases of infections with antibiotic-resistant bacteria were associated with health care, resulting in 72.4% of attributable deaths according to 2015 data from EU/EEA members. This finding suggests that the health effects of infections with antibiotic-resistant bacteria predominantly occur in hospitals and other health care settings.[17] Furthermore, the European Centre for Disease Prevention and Control (ECDC) has recently noted that the negative impact of the COVID-19 pandemic on AMR is emerging in EU/EEA members, in particular for typical health care-associated pathogens; for example, in 2020, carbapenem resistance in *Acinetobacter* spp was equal to or above 50% in 55% of countries, mostly in southern and eastern Europe.[18,19] Furthermore, a significant increase of the population-weighted carbapenem resistance mean in *E. coli* and *K. pneumoniae* and of the population-weighted vancomycin resistance mean in *E. faecium* was observed over time during 2016–2020. Similar increases of antibiotic resistance have been observed in the United States and other countries[1,20] during the first year of the pandemic (see Annex A).

A global survey conducted by WHO in 2014 reported that the prevalence of MRSA, *E. coli* resistant to third-generation cephalosporins, and carbapenem-resistant Enterobacteriaceae and *P. aeruginosa* from blood samples was significantly higher in LMICs than in HICs.[1] Very high resistance rates were also documented in the results of a surveillance study conducted by the International Nosocomial Infection Control Consortium in 664 ICUs in 45 countries from Africa, Latin America, Eastern Mediterranean, Europe, South-East Asia and Western Pacific between January 2013 and December 2018. The overall resistance proportions of *Pseudomonas* spp. to imipenem were 52.7%, and of *Klebsiella* spp. to ceftazidime and imipenem were 78.0% and 49.2% respectively, while *Enterococcus* spp. was resistant to vancomycin in 42.3% of the cases.[21] Patients infected with MRSA and carbapenem-resistant microorganisms have at least two to three times higher risk of death, health complications, septic shock,

[17] Cassini A, Högberg LD, Plachouras D, Quattrocchi A, Hoxha A, Simonsen GS et al. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. Lancet Infect Dis. 2019;19(1):56–66.

[18] WHO Regional Office for Europe/European Centre for Disease Prevention and Control. Antimicrobial resistance surveillance in Europe 2022 – 2020 data. Copenhagen: WHO Regional Office for Europe; 2022 (https://www.ecdc.europa.eu/sites/default/files/documents/ECDC-WHO-AMR-report.pdf, accessed 2 October 2022).

[19] Antimicrobial resistance in the EU/EEA (EARS-Net). Annual Epidemiological Report for 2020. Stockholm: European Centre for Disease Prevention and Control; 2022 (https://www.ecdc.europa.eu/sites/default/files/documents/AER-EARS-Net-2020.pdf, accessed 2 October 2022).

[20] 2022 Special Report Covid-19. U.S. Impact on Antimicrobial Resistance. Centers for Disease Control and Prevention 2022 (https://www.cdc.gov/drugresistance/pdf/covid19-impact-report-508.pdf, accessed 2 October 2022).

[21] Rosenthal et al. International Nosocomial Infection Control Consortium (INICC) report, data summary of 45 countries for 2013-2018, Adult and Pediatric Units, Device-associated Module. Am J Infect Control 2021;49(10): 1267-1274.

and longer length of stay in acute and long-term care compared to patients infected with susceptible strains.[22,23,24]

A recent study evaluated that antibiotic resistance was associated with almost 5 million deaths globally in 2019, (including 1.27 million attributable deaths) making it a leading cause of death worldwide. The highest burden was in western sub-Saharan Africa, and the lowest in Australasia. Among the leading AMR pathogens responsible for this burden, five out of six were mainly health care-associated.[25]

In terms of other HAI threats such as the increasing emergence of pan-resistant microorganisms (i.e. resistant to all relevant antimicrobial categories) such as *Candida auris*, it becomes clear that prevention of transmission through IPC measures should be a high priority for saving lives in all countries.

HAI and AMR surveillance was disrupted in many countries during the first period of the pandemic. However, emerging data mostly suggest an alarming picture of significantly increased rates in several countries (see Annex A).

Effectiveness and economic advantage of strengthening IPC capacity

Strengthening IPC capacity can substantially reduce the burden of HAIs and AMR

Existing evidence suggests that IPC interventions, which are one of the key elements of the AMR Global Action Plan,[26] can achieve a significant reduction in the rates of HAIs (particularly of catheter-associated bloodstream infections, catheter-associated urinary tract infections, SSI and ventilator-associated pneumonia) in the range of 35–70%, irrespective of the level of income of a country.[1]

Whether implemented as a stand-alone intervention or integrated into multifaceted interventions, hand hygiene has been highlighted as the most effective single measure for reducing the transmission of microorganisms and infection in health care settings.[1]

One recent OECD analysis found that investments in IPC interventions offer a cost-effective means of tackling HAIs.[3] Across 33 OECD countries, investing less than 1 USD at purchasing power parity (PPP) per capita in improving hand hygiene will result in declines in health expenditure of nearly 2 USD PPP annually between 2015 and 2050. In the same period, investing 1 USD PPP per capita to enhance environmental hygiene practices in health care facilities will yield 1.1 USD PPP reduction in health expenditure each year.[3] Many of the practical actions included in these interventions – such as improving hand hygiene by ensuring access to hand hygiene facilities, training of health care personnel, regular audits and feedback, and enhancing environmental hygiene through more effective cleaning practices – are affordable in many countries, including those at lower levels of income.[3] Beyond their impact on AMR,

[22] Antimicrobial resistance: global report on surveillance. Geneva: World Health Organization; 2014 (https://apps.who.int/iris/handle/10665/112642, accessed 2 October 2022).

[23] Rapid risk assessment: carbapenem-resistant Enterobacteriaceae – 8 April 2016. Stockholm: European Centre for Disease Prevention and Control; 2016 (https://www.ecdc.europa.eu/sites/default/files/media/en/publications/Publications/carbapenem-resistant-enterobacteriaceaerisk-assessment-april-2016.pdf, accessed 2 October 2022).

[24] Stewardson AJ, Marimuthu K, Sengupta S, Allignol A, El-Bouseary M, Carvalho MJ, et al. Effect of carbapenem resistance on outcomes of bloodstream infection caused by Enterobacteriaceae in low-income and middle-income countries (PANORAMA): a multinational prospective cohort study. Lancet Infect Dis 2019;19(6):601-610.

[25] Murray CJL, Ikuta KS, Sharara F, Swetschinski L, Robles Aguilar G, Gray A, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet. 2022;399(10325):629-55.

[26] Global action plan on antimicrobial resistance. Geneva: World Health Organization; 2016 (https://www.who.int/publications/i/item/9789241509763, accessed 2 October 2022).

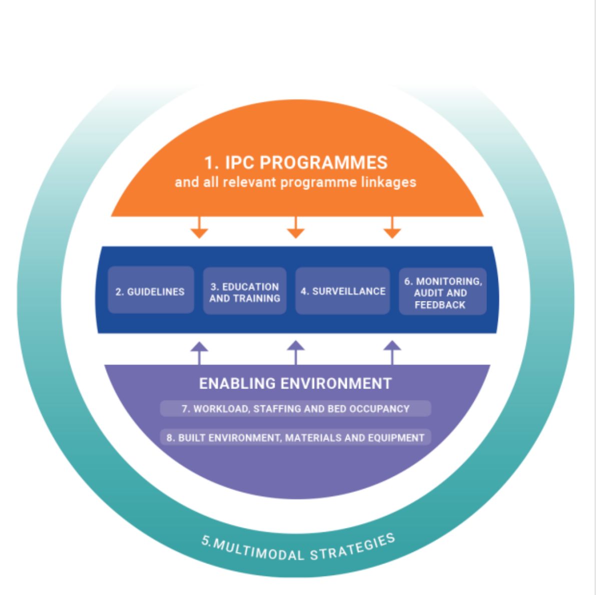
upscaling investments on such interventions would help advance other critical G7 priorities, including in prevention and control of other infectious diseases such as tuberculosis, HIV, malaria and neglected tropical diseases. In this respect, investments in IPC may also be instrumental in reducing silos in public health and supporting the adoption of a One Health approach.

Further, the OECD analysis suggests that both interventions offer favourable returns on investment in view of the balance between the cost of implementation and the savings generated in health expenditure.[3] For instance, across 33 OECD countries, each USD 1 allocated to investments to improve hand hygiene and environmental hygiene is expected to normally yield 1.1–11.3 USD in savings, depending on the type of intervention and setting.[3] Investments in IPC interventions are likely to offer great benefits beyond OECD countries. In particular, countries that face a higher burden of HAIs stand to make substantial gains on their investments in IPC capacity.

IPC programmes at national, subnational, and facility levels are essential to oversee the implementation of IPC measures and the allocation of resources and material support – such as hand hygiene supplies and personal protective equipment. To this end, in 2016, WHO issued a set of recommendations on the core components of effective IPC programmes for the national and acute care health facility levels.[27]

Six core components are recommended at the national level, namely: 1) IPC programmes; 2) IPC guidelines; 3) IPC training and education; 4) HAI surveillance; 5) multimodal strategies for IPC interventions; and 6) IPC monitoring and evaluation. These core components also apply at the facility level, along with an additional two core components, namely: 7) workload, staffing and bed occupancy; and 8) the built environment, materials, and equipment (Figure 2). These recommendations were built on scientific evidence, expert consensus, and country experiences, and were supported by many international partners.

Figure 2. The eight core components of IPC programmes



IPC: infection prevention and control.
Source: Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. Geneva: World Health Organization; 2016 (https://apps.who.int/iris/handle/10665/251730, accessed 29 September 2022).

[27] Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. Geneva: World Health Organization; 2016 (https://apps.who.int/iris/handle/10665/251730, accessed 29 September 2022).

In 2019, WHO and its stakeholders further worked to extract "minimum requirements for IPC programmes"[28] from the recommended core components as a starting point for building strong and effective IPC programmes at the national and health care facility levels. At the very least, the minimum requirements for IPC programmes should be implemented consistently across health care services and their implementation should be demonstrated by monitoring key indicators for IPC and WASH. It should be noted that fulfilling the minimum requirements for IPC has become an essential parameter to be met within the 2021 edition of the State Party Self-Assessment Annual Reporting[29] (SPAR) (Annex B) and the Joint External Evaluation tool.[30] The minimum requirements for IPC *at the national level*[28] are detailed in Table 1 and they will be referred to in further sections of this brief and in Annex A.

Table 1. WHO minimum requirements for IPC at the national level

Indicator
Core component 1
An active infection prevention and control (IPC) programme exists at the national level
An appointed IPC focal point in charge of the programme can be identified
The appointed IPC focal points have undergone training in IPC in the prevention of health care associated infections (HAI)
The appointed IPC focal points have dedicated time for the tasks, at least one full time equivalent
There is an identified, protected and dedicated budget allocated to the IPC programme according to planned activity
Core component 2
The national IPC programme has a mandate to produce guidelines for preventing and controlling HAI
The guidelines are for national coverage, including all acute health care facilities, both public and private
The guidelines are reviewed at least once every five years and updated to reflect the current evidence base
The development of guidelines involves the use of evidence-based scientific knowledge and international national standards
The IPC programme actively addresses guideline adaptation and standardization of effective preventive practices, standard operating procedures and their implementation to reflect local conditions
Core component 3
The national IPC programme provides guidance and recommendations for in service IPC training at the facility level, for example, frequency, expertise required, requirements for new employee orientation, monitoring and evaluation approaches
The national IPC programme provides content and support for IPC training of health workers at the facility level
A national system and schedule of monitoring and evaluation is in place to check on the effectiveness of training and education at least annually
A national IPC curriculum for in service training of health-care workers has been developed in alignment with the national IPC guidelines approved and endorsed by an appropriate national body
Core component 4
The national IPC focal point team is trained in HAI surveillance concepts and methods
A multidisciplinary technical group for HAI surveillance is established at the national level by the national IPC focal point
A national strategic plan for HAI surveillance with a focus on priority infections based on the local context is developed by the multidisciplinary technical group
Core component 5
There is a trained national IPC focal point with knowledge of implementation science and multimodal improvement strategies and their application to IPC
Multimodal strategies are promoted through the inclusion of the approach in the development of IPC guidelines, education and training
The national IPC focal point coordinates and supports local implementation of IPC improvement interventions
Core component 6
A mechanism to train national and local auditors is in place
Hand hygiene compliance monitoring and feedback is identified as a key national indicator, at the very least for reference hospitals
A minimal set of core indicators for health care facilities in the country is defined
A multidisciplinary technical group for IPC monitoring is established at the national level by the national IPC focal point
A strategic plan for IPC monitoring is in place, including an integrated system for collection and analysis of data

[28] Minimum requirements for infection prevention and control programmes. Geneva: World Health Organization; 2019 (https://apps.who.int/iris/handle/10665/330080, accessed 29 September 2022).
[29] International health regulations (2005): state party self-assessment annual reporting tool, 2nd ed. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240040120, accessed 29 September 2022).

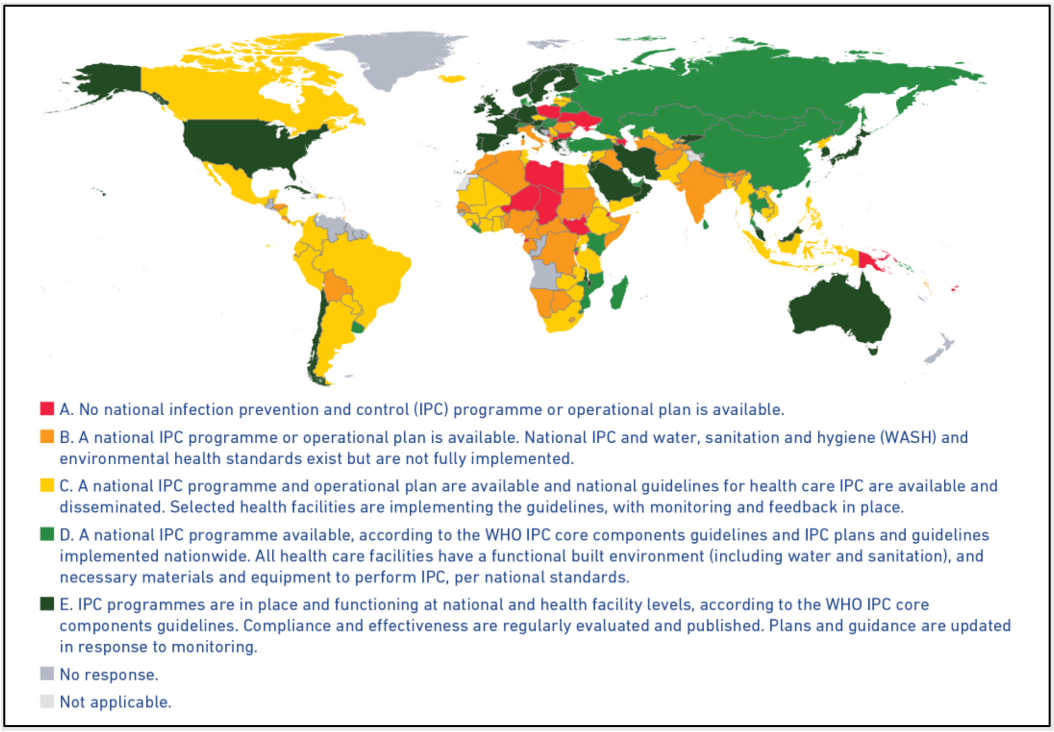
[30] Joint external evaluation tool: International Health Regulations (2005) - third edition. Geneva: World Health Organization; 2022 (https://www.who.int/publications/i/item/9789240051980, accessed 29 September 2022).

Global picture: the implementation of IPC programmes

Globally, around one in ten countries do not have a national IPC programme or an operational plan

Since 2016, WHO has been monitoring the status and implementation of national IPC programmes through the Tripartite AMR Country Self-assessment Surveys (TrACSS) (Annex B) as part of the AMR Global Action Plan.[26] The latest wave of the TrACSS (2020–2021) survey shows that 11% (18/162) of countries reported having no national IPC programme or operational plan (A) (Figure 3). Moreover, 22% (36/162) of countries reported having a national IPC programme or operational plan with national IPC, WASH and environmental health standards although these were not fully implemented (B). The same survey shows that 32% (52/162) of countries reported having an IPC programme implemented in selected health care facilities, with monitoring and feedback mechanisms in place (C), whereas 15% (25/162) reported having an IPC programme properly implemented in health care facilities nationwide (D). Finally, 19% (31/162) of countries reported that in addition to the previous levels scope and activities, they also monitored compliance with and the effectiveness of their IPC programmes[31] (E) (Figure 3).

Figure 3. Globally, only around 15% of countries report they have an IPC programme in place that is properly implemented in health care facilities nationwide



Note: The colours indicate the levels of IPC implementation at national level

Source: FAO, OIE, WHO. Global Database for the Tripartite Antimicrobial Resistance (AMR) 2020–2021 Country Self-assessment Survey (TrACSS) Indicator 8.1 [online database]. Geneva: World Health Organization; 2022 (http://amrcountryprogress.org/, accessed 29 September 2022).

[31] FAO, OIE, WHO. Global Database for the Tripartite Antimicrobial Resistance (AMR) Country Self-assessment Survey (TrACSS) [online database]. Geneva: World Health Organization; 2022 (http://amrcountryprogress.org/, accessed 29 September 2022).

Available evidence suggests a positive association between the level of socioeconomic development and the implementation of IPC at the national and facility levels.[1] An analysis of the 2020–2021 TrACSS data indicated that HICs were eight times more likely to have a more advanced IPC implementation status compared with low-income countries (LICs); compared with upper-middle-income countries, they were five times more likely to have a more advanced IPC implementation status.[1] Despite this, according to the results of TrACSS between 2018 and 2021, there has been little improvement in the implementation of IPC national programmes in LMICs. From 2018 to 2021, the only significant statistical association indicating IPC improvement over time was observed for HICs progressing to the most advanced level of implementation where monitoring of the effectiveness of a nationally implemented IPC programme is available.[1]

In 2021–2022, a detailed global survey on the minimum requirements for national IPC programmes carried out by WHO showed that an active IPC programme (i.e., a functioning programme with annual workplan and budget) existed in 54.7% (58/106) of countries.[1] However, only four of the participating countries (3.8%) reported meeting all minimum requirements for IPC, but they did not include any G7 country.[1] According to this survey, relevant gaps globally were limited availability of a budget specifically dedicated to IPC, limited support at the national level for IPC training roll-out and monitoring of its effectiveness, and lack of expertise to conduct IPC monitoring.[1]

There is substantial cross-country variation in the implementation of IPC programmes at the health-care facility level

According to a 2019 WHO global survey carried out in 4440 health care facilities in 81 countries across all six WHO regions and at all income levels, the level of implementation of IPC core components ranged from "inadequate" to "advanced", according to the use of the WHO IPC Assessment Framework (IPCAF).[32] The average score globally (605, IQR 450.4–705.0), was at the lowest level of the "advanced" (score range = 601–800) category, indicating implementation of the IPC core components according to the WHO recommendations and appropriate to the needs of the facility. However, significant differences in the levels of implementation of IPC programmes were observed according to the country's level of income, with significantly lower scores in LMICs compared with HICs. LICs scored on average at a "basic" level of IPC implementation (385, 279.7–442.9), indicating that some aspects of the IPC core components are in place, but not sufficiently implemented. HICs had more developed IPC in place for all core components, while lower- income countries had notably limited implementation of IPC guidelines, training and education, monitoring, audit, feedback and HAI surveillance. Only 15.2% of participating facilities – none of which were in LICs – met all indicators designated as minimum requirements for IPC, whereas 92.9% met at least half of these indicators.[32]

[32] Tomczyk S, Twyman A, de Kraker MEA, Coutinho Rehse AP, Tartari E, Toledo JP et al. The first WHO global survey on infection prevention and control in health-care facilities. Lancet Infect Dis. 2022; S1473-3099(21) (https://doi.org/10.1016/S1473-3099(21)00809-4, accessed 29 September 2022).

IPC: focus on G7 countries

The burden of AMR in G7 countries

Without effective policies, HAIs and AMR will remain a growing concern across G7 countries

One OECD analysis estimated, the average number of HAIs will exceed 700 per 100 000 across six of the G7 countries each year between 2015 and 2050.[3] The OECD analysis suggests notable cross-country variations in the burden of HAIs. The United Kingdom and Japan are expected to have the lowest number of HAIs per 100 000, whereas Italy and Germany are estimated to have the highest. As mentioned above, according to a 2017 analysis, approximately 9.9 million HAI episodes are estimated to occur each year in the EU/EEA countries.[8]

Since 2005, the average proportions of antibiotic resistance have been on the rise.[33] Across G7 countries, the average proportions of resistance across eight antibiotic–bacterium combinations[34] grew by about 10% from 2005 to 2015. In this period, G7 countries diverged in terms of their antibiotic resistance burden, with the antibiotic resistance proportions rising rapidly in France, Italy and the United States. In contrast, Japan and the United Kingdom saw more stable trends and, in some cases, even modest declines in average proportions of antibiotic resistance.

Without a robust policy response, AMR growth will continue to pose a great threat to the health of citizens in G7 countries. By 2030, the average resistance proportions across eight antibiotic–bacterium combinations are projected to approximate to 20% in G7 countries and 27 EU members (Figure 4)[3]. None of the G7 countries and 27 EU members are projected to achieve reductions in resistance proportions across all eight antibiotic–bacterium combinations by 2030. Among the 27 EU members, the average resistance proportions across eight antibiotic–bacterium combinations are generally expected to be the highest in countries in southern and central Eastern Europe and the lowest in Nordic countries by 2030.[3]

In G7 countries, resistance proportions are expected to grow for many of the eight antibiotic–bacterium combinations. The proportion of infections caused by carbapenem-resistant *P. aeruginosa* and fluoroquinolone-resistant *E. coli* are projected to grow between 2015 and 2030. In comparison, some declines are expected across G7 countries in the rates of proportions of resistance of penicillin-resistant *S. pneumoniae*, vancomycin-resistant *E. faecalis* and *E. faecium*. None of the G7 countries are projected

[33] Cravo Oliveira Hashiguchi T, Ouakrim DA, Padget M, CassiniA, Cecchini M. Resistance proportions for eight priority antibiotic-bacterium combinations in OECD, EU/EEA and G20 countries 2000 to 2030: a modelling study. Euro Surveill. 2019 May;24(20):1800445 (https://doi.org/10.2807/1560-7917.ES.2019.24.20.1800445, accessed 29 September 2022).

[34] Bug-drug combinations included in the OECD analysis are fluoroquinolone-resistant *E. coli*, vancomycin-resistant E. faecalis and *E. faecium*, third-generation cephalosporin-resistant *E. coli*, carbapenem-resistant *K. pneumoniae*, third-generation cephalosporin-resistant *K. pneumoniae*, carbapenem-resistant *P. aeruginosa*, meticillin-resistant *S. aureus*, and penicillin-resistant *S. pneumoniae*.

to achieve reductions in proportions of resistance across all eight of the antibiotic–bacterium combinations by 2030.[33]

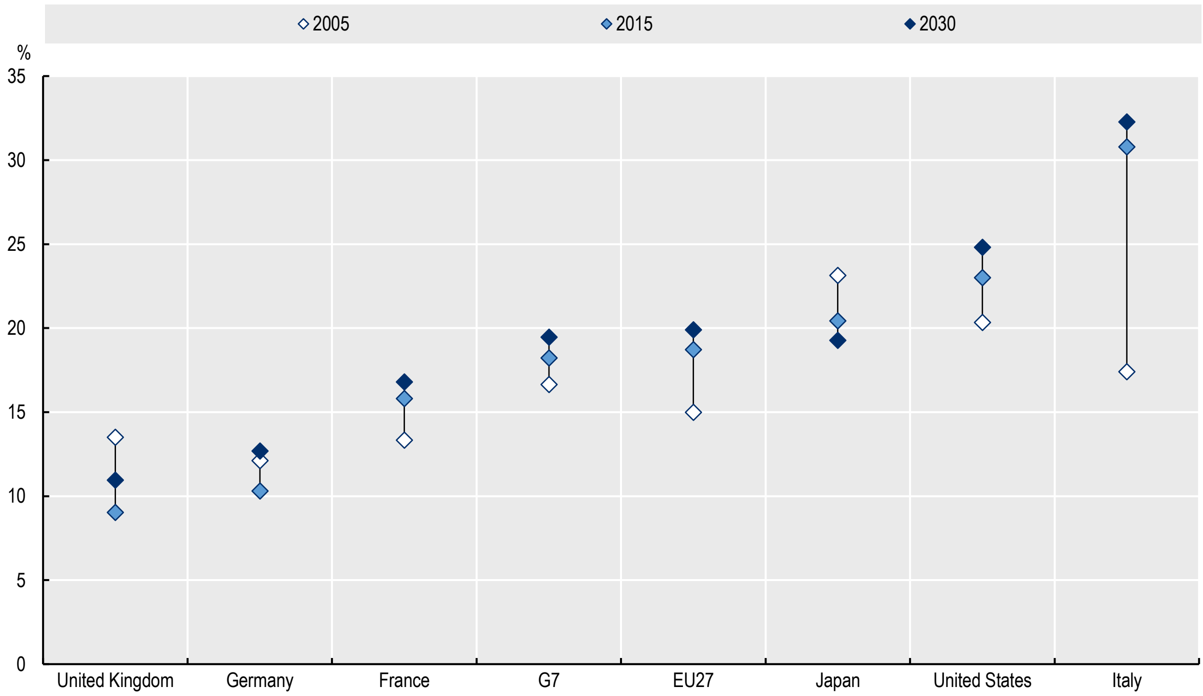
As it can be seen in Figure 4, forecasts based on an OECD ensemble model suggest that if trends continue growing as expected across G7 countries, around one in five of all infections expected to be caused by bacteria that are resistant to antibiotic treatment by 2030.[3] If current trends continue as expected until 2030, countries such as Italy and the United States will show greater proportions, while AMR proportions will grow at a slower pace in Germany. Similarly, Canada has reported increases in the incidence rate of resistant bloodstream infections among hospitalized patients for certain bug-drug combinations.[35]

Without effective policy action, antibiotic resistance to second-line antibiotics – the backup options for infections that are difficult to treat – will nearly double among G7 countries by 2030 compared to 2005. This rise in resistance to second-line antibiotics is expected to be more pronounced in France and Italy. Conversely, Japan will experience a decline in antibiotic resistance to second-line antibiotics. Among members of the EU and EEA, resistance to second-line antibiotics is expected rise substantially by 2030 compared to 2005[3] Other OECD countries are also experiencing increased resistance to first-line antibiotics. For instance, the Canadian Council of Academies Using used a methodology different from the OECD analysis for a different set of diseases and estimated that about 26% of bacterial infections were resistant to first-line antimicrobials in Canada in 2018.[36]

[35] Public Health Agency of Canada, Canadian (PHAC). Antimicrobial Resistance Surveillance System Report. Ottawa (ON): PHAC. 2021 (https://www.canada.ca/en/public-health/services/publications/drugs-health-products/canadian-antimicrobial-resistance-surveillance-system-report-2021.html, accessed 10 October 2022).

[36] When antibiotics fail - the expert panel on the potential socio-economic impacts of antimicrobial resistance in Canada. Ottawa: Council of Canadian Academies, 2019 (https://www.cca-reports.ca/reports/the-potential-socio-economic-impacts-of-antimicrobial-resistance-in-canada, accessed 10 October 2022).

Figure 4. By 2030, around one in every five infections in G7 countries will be caused by bacteria resistant to antimicrobial treatment



Note: Average proportion of infections caused by bacteria resistant to antibiotic treatment for eight antibiotic–bacterium combinations in 2005, 2015 and 2030. Countries are sorted from left to right on the basis of ascending proportions of resistance in 2015. Projections to 2030 are carried out using available data between 2005 and 2015, omitting changes in epidemiology that may have happened thereafter.
Sources: Stemming the superbug tide: just a few dollars more. Paris: Organisation for Economic Co-operation and Development; 2018 (https://www.oecd.org/health/stemming-the-superbug-tide-9789264307599-en.htm, accessed 24 September 2022).
When antibiotics fail - the expert panel on the potential socio-economic impacts of antimicrobial resistance in Canada. Ottawa: Council of Canadian Academies, 2019 (https://www.cca-reports.ca/reports/the-potential-socio-economic-impacts-of-antimicrobial-resistance-in-canada, accessed 10 October 2022).

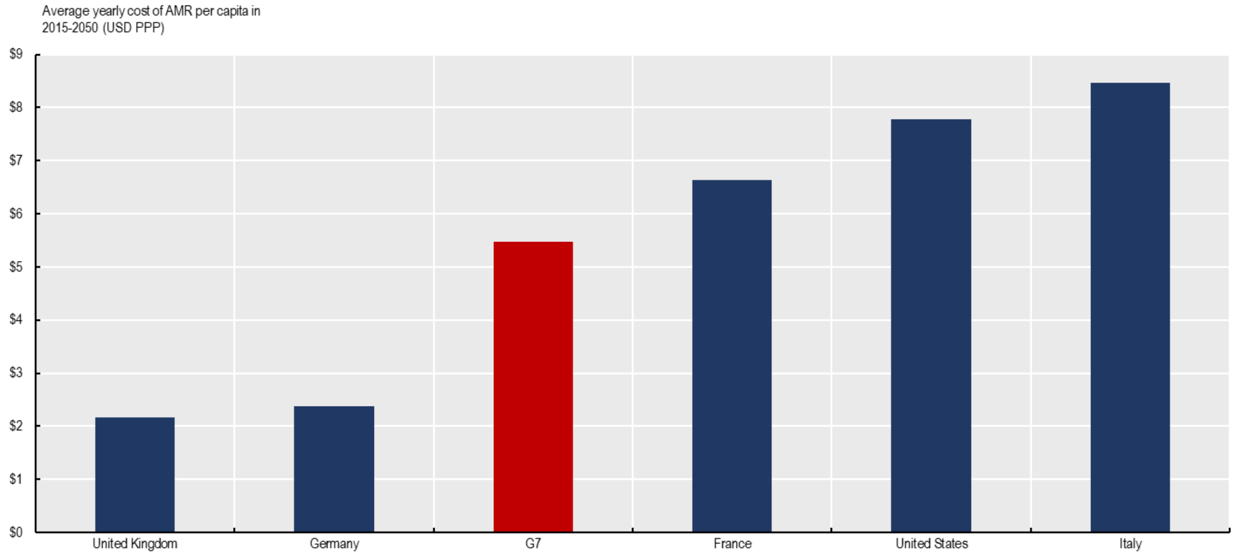
Impact on the economy

The growing AMR burden will present a substantial burden for G7 economies.

By using a microsimulation model and data from international source,s[3] the OECD had calculated that, if antibiotic resistance rates continue to follow the expected growth rates, G7 countries are forecast to spend more than 4 billion USD PPP annually on average between 2015 and 2050 for treating infections caused by pathogens resistant to antimicrobial treatment, corresponding to nearly 5.5 USD PPP per capita (Figure 5). In effect, this means that G7 countries are expected to spend on antibiotic resistance each year nearly 2.5 times the amount of the average health expenditure they incurred on HIV/AIDS in 2015.[37]

[37] Dieleman JL, Haakenstad A, Micah A, Moses M, Abbafati C, Acharya P et al. Spending on health and HIV/AIDS: domestic health spending and development assistance in 188 countries, 1995–2015. Lancet. 2018;391(10132):1799–829.

Figure 5. If current trends continue, antibiotic resistance will continue to have deleterious effects on the budget of health care systems in G7 countries



Note: Countries are sorted from left to right on the basis of the rising yearly cost of antibiotic resistance per capita in 2015–2050.
Source: Stemming the superbug tide: just a few dollars more. Paris: Organisation for Economic Co-operation and Development; 2018 (https://www.oecd.org/health/stemming-the-superbug-tide-9789264307599-en.htm, accessed 24 September 2022).

While both susceptible and resistant infections exacerbate health expenditures, resistant infections are considerably more costly to treat. Treating complications caused by resistant bacteria typically requires greater reliance on more intensive medical procedures and longer stays at hospitals. Further, these complications necessitate additional investigations and advanced laboratory tests, as well as greater reliance on more expensive and aggressive antimicrobial therapies using second-line treatment or combinations of various antimicrobials.

According to the analyses, the economic burden of antibiotic resistance is expected to vary substantially across G7 countries. France, Italy and the United States would spend the greatest amount of financial resources, with the annual spending on antibiotic resistance, averaging around 7-8 USD PPP per capita, whereas the United Kingdom would spend the least. In Canada, a report by the Council of Canadian Academies looked at the economic burden of AMR using a different methodology. This work estimated that AMR cost Canadian hospitals around CAD 1.4B in 2018, and projected increasing costs to the healthcare system could reach CAD 7.6B annually by 2050, if the resistance rate were to rise to 40%.[36] This cross-country variation is driven primarily by the differences in the incidence of infections, although other factors such as the differences in clinical practices also play a role. While these figures are relatively lower than the cost of chronic conditions such as cancers, AMR poses a greater long-term threat given its complexity and far-reaching consequences even in health systems with lower AMR rates and robust prevention systems.[3]

The model used for the analysis forecasts that antibiotic resistance will increase the pressure on the use of hospital resources across G7 countries. On average, treating resistant infections will result in more than 7 million additional days spent in hospitals across G7 countries each year between 2015 and 2050. Italy and the United States are facing the greatest pressure on hospital resources. In the United States, around 4 million extra days are estimated to be spent in hospitals to treat HAIs, whereas this figure stands at around 1 million additional hospital days in Italy.[3]

AMR threatens the safety and feasibility of many invasive and complex medical procedures. Across all G7 countries, antimicrobials play an integral role in the success of an array of complex medical procedures from surgeries to organ transplantations to cancer treatments. Reductions in the efficacy of existing antimicrobials means a greater risk of infection and mortality.

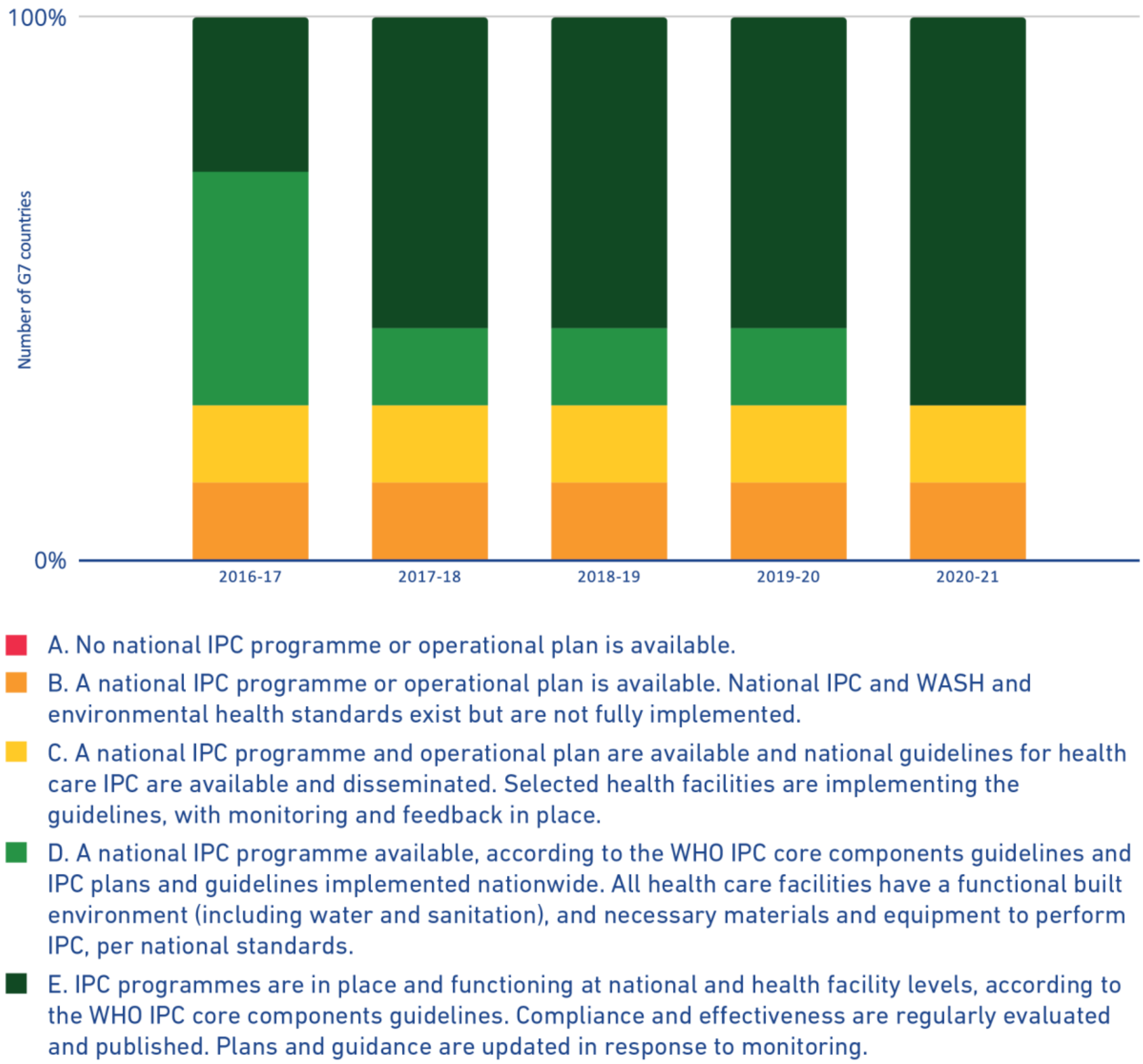
National IPC programmes across G7 countries

> ***A national IPC programme or operational plan is available in all G7 countries, though some gaps exist in the implementation of the IPC core components.***

Most G7 countries have advanced IPC programmes, including systems for HAI and AMR surveillance or participation in international surveillance networks. Therefore, they have capacity to monitor the epidemiological situation and identify the endemic burden of HAIs, AMR, and emerging pathogens. However, the available data show concerning percentages of patients who acquire HAIs and alarming AMR rates which have a dramatic impact on morbidity and mortality, despite the availability of expertise and tools to combat them (see country profiles in Annex A).

All G7 countries have already developed a national IPC programme or operational plan. According to the TrACSS survey, by 2020–2021, five G7 countries reported reaching the most advanced level of progress (level E), indicating that IPC programmes are available and are implemented at both national and facility levels, according to the WHO-recommended core components. In addition, these countries reported monitoring of compliance with and effectiveness of the programmes, and the updating of plans according to the results. Two G7 countries reported lower levels of progress (B or C) (Figure 6). As at the global level, temporal trends of the TrACSS responses between 2018 and 2021 (when the IPC indicator was always the same) show substantial improvements over time with an increase in the number of countries which achieved the most advanced stage of implementation of their IPC programmes (E)[31] (Figure 6).

Figure 6. Since 2016, most G7 countries made important strides in the implementation of their IPC programmes



Source: FAO, OIE, WHO. Global Database for the Tripartite Antimicrobial Resistance (AMR) Country Self-assessment Survey (TrACSS) [online database]. Geneva: World Health Organization; 2022 (http://amrcountryprogress.org/, accessed 29 September 2022).

All G7 countries completed the WHO assessment tool on the minimum requirements for national IPC programmes[38] in 2022, as part of the development of this brief. Overall, none of the countries fulfilled all WHO minimum requirements; however, five countries met > 80% of them.

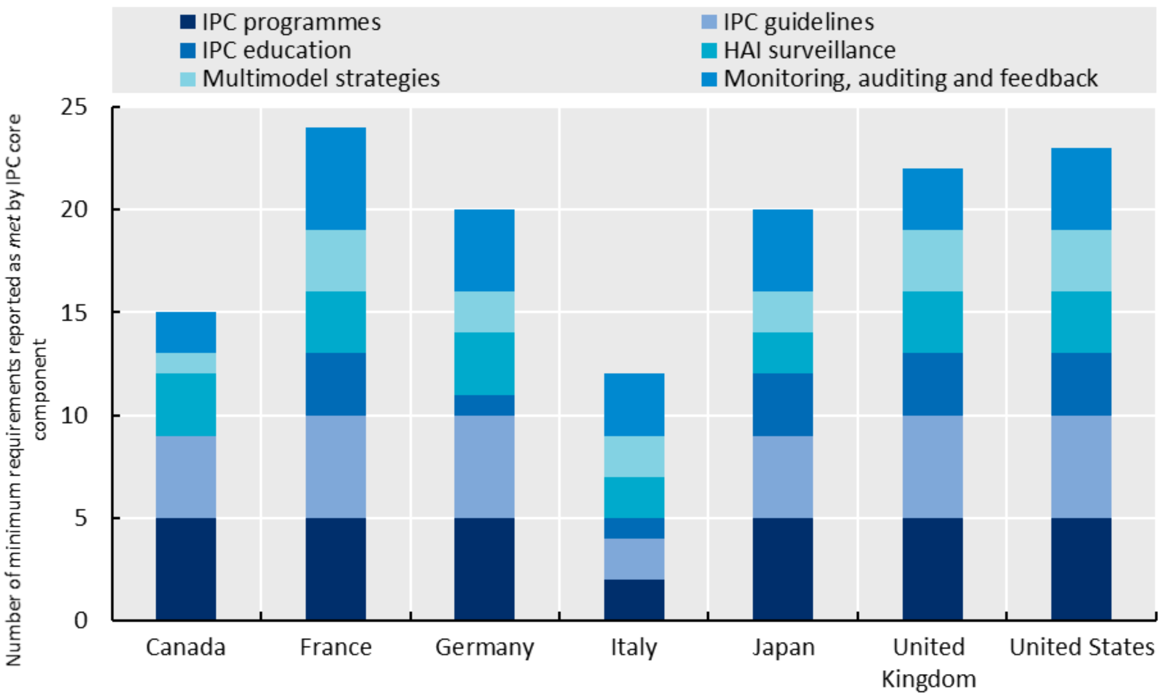
[38] Assessment tool of the minimum requirements for infection prevention and control programmes at the national level. Geneva: World Health Organization; 2021(https://www.who.int/publications/m/item/assessment-tool-of-the-minimum-requirements-for-infection-prevention-and-control-programmes-at-the-national-level, accessed 01 October 2022).

Minimum requirements fulfilled by all seven reporting countries were:

- An appointed IPC focal point in charge of the programme can be identified
- The appointed IPC focal points have undergone training in IPC in the prevention of HAI
- The IPC guidelines are for national coverage, including all acute health care facilities, both public and private
- The development of guidelines involves the use of evidence-based scientific knowledge and international national standards
- A multidisciplinary technical group for HAI surveillance is established at the national level by the national IPC focal point

Analysing the minimum requirements by IPC core component (Figure 7), the requirements related to the general IPC programme and IPC guidelines were the requirements that were most frequently met among G7 countries. In terms of individual minimum requirements, the ones least frequently met were those related to: having a national system and schedule of monitoring and evaluation is in place to check on the effectiveness of training and education at least annually having a national IPC curriculum for in-service training of health-care workers; the expertise of the national IPC focal point in implementation science and multimodal improvement strategies and their application to IPC; having a strategic plan for IPC monitoring is in place, including an integrated system for collection and analysis of data; hand hygiene compliance monitoring and feedback identified as a key national indicator.

Figure 7. Number of individual minimum requirements reported as "met", by IPC core component among G7 countries



Source: WHO Unpublished data, based on the WHO 2021-22 global survey on the minimum requirements for national IPC programmes.[1, 38]

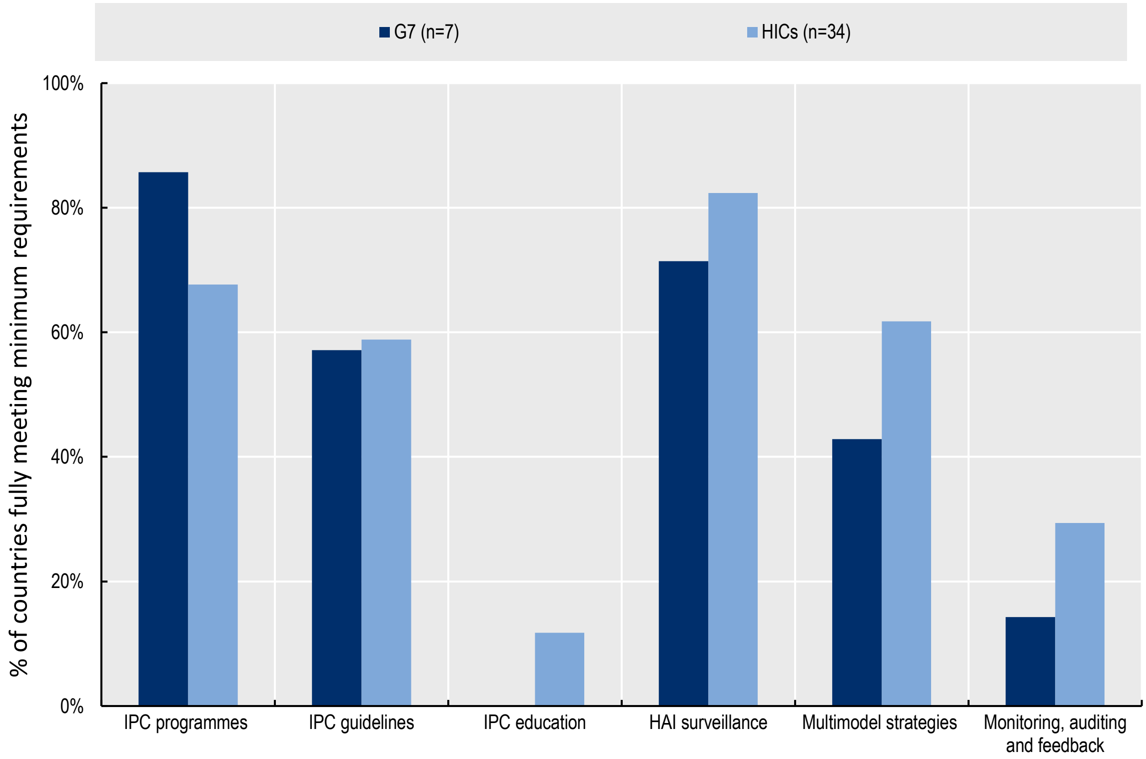
Notably, the IPC core component that presents more gaps among G7 countries is IPC training and education whose minimum requirements are particularly focused on in-service IPC training of all health and care workers at the facility level (Table 1). According to a recent WHO global survey this core component was the least implemented also in other countries worldwide,[1] including HICs (Figure 8). This may have had an impact on the ability to ensure adequate IPC response preparedness and safety in health care facilities in the initial phase of the COVID-19 pandemic when many health workers got infected.[39] Indeed, evidence from a living systematic review on risk factors for SARS-CoV-2 infection among health workers demonstrated that having undergone appropriate IPC training was a protective factor.[16] In addition, according to a WHO/OECD modelling study, IPC training combined with increased access to personal protective equipment, if in place and appropriately strengthened at the beginning and in the first six months of the COVID-19 pandemic, would have averted SARS-CoV-2 infections among health workers, generating substantial net savings (up to 7.23 billion USD) globally.[1]

Regarding the two core components related to the crucial activity of evaluation and feedback (i.e., core component 4 on HAI and AMR surveillance, and core component 6 on IPC indicators' monitoring), most G7 countries fulfil the minimum requirements for core component 4; however, it should be noted that in this area, the minimum requirements are very basic (see Table 1) and having a system for HAI surveillance is not a minimum requirement. Conversely, some G7 countries have more challenges to meet the minimum requirements for core component 6, in particular regarding having a strategic plan and a system in place for IPC monitoring and feedback, and hand hygiene compliance monitoring and feedback identified as a key national indicator.

Finally, Figure 8 shows the proportion of countries meeting all IPC minimum requirements by IPC core component. None of the G7 countries met all minimum requirements for IPC training and education and, among the requirements of this core component, no G7 country reported having a national system for monitoring and evaluation at least annually of the effectiveness of training and education. This is alarming as it shows that, despite the devastating consequences of the pandemic, countries have not established mechanisms for sustained basic training of health-care workers according to evidence-based guidelines.

[39] COVID-19 weekly epidemiological update, 2 February 2021. Geneva: World Health Organization; 2021 (https://apps.who.int/iris/handle/10665/339548, accessed 01 October 2022).

Figure 8. Proportion of countries meeting all national minimum requirements by IPC core component among G7 countries (n = 7) compared to all HICs (n = 34)* (33)



IPC: infection prevention and control; HAI: health care-associated infection.
*According to World Bank income classification
Source: WHO unpublished data, based on the WHO 2021-22 global survey on the minimum requirements for national IPC programmes.[1, 38]

What will success look like?

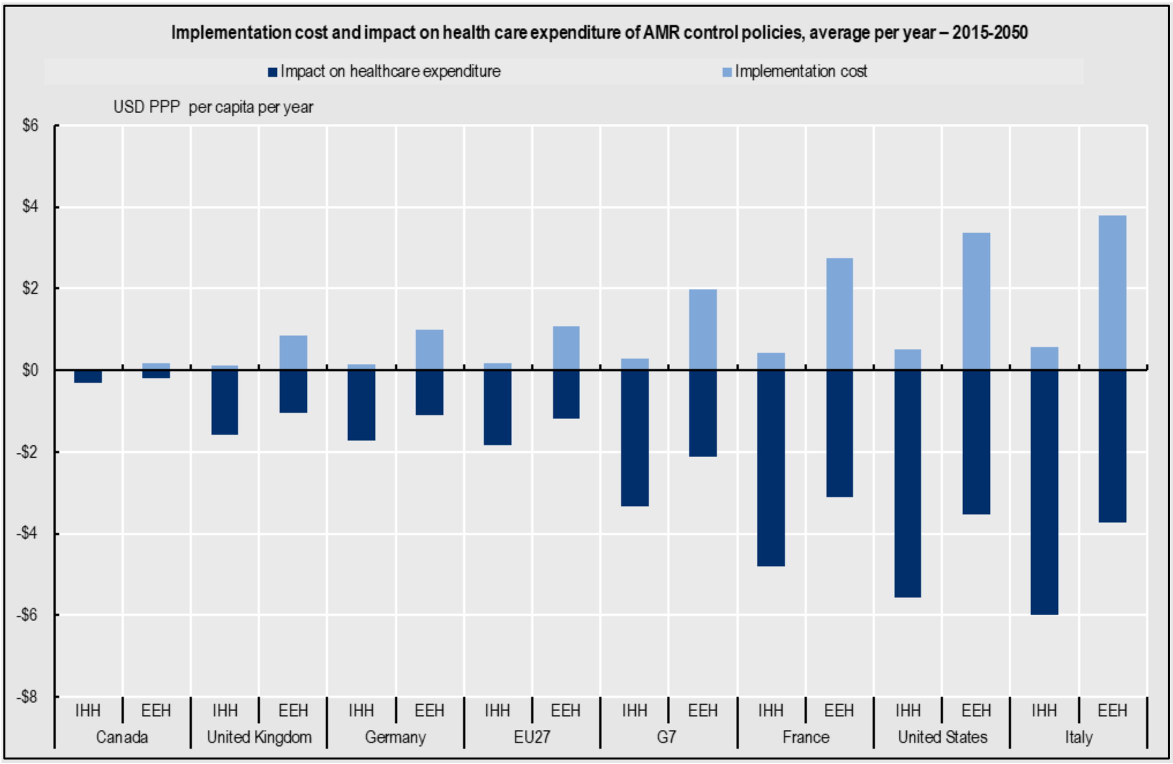
Investing in IPC measures will improve population health without putting inordinate pressure on health-care budgets.

OECD analyses show that improving hand hygiene and enhancing environmental hygiene can be important components of comprehensive approaches to reduce the HAI and AMR burden in G7 and EU27 members[3] (Figure 9). Among G7 members, on average, improving hand hygiene costs less than one third of USD PPP 1 per capita annually, whereas the price tag for enhancing environmental hygiene stands at around USD PPP 2 per capita each year. For example, in Italy, the implementation costs for improving hand hygiene and enhancing environmental hygiene programmes average at around USD PPP 0.6 and 4 per capita each year from 2015 to 2050, respectively, the highest across all G7 countries. The implementation costs are estimated to be less than half of USD PPP 1 for both interventions in Canada, the lowest across all G7 countries. The costs associated with implementing programmes to improve hand hygiene and environmental hygiene are even lower among the EU27 members, with the annual cost averaging at around USD PPP 0.16 and 1.08 per capita, respectively.[3]

Both interventions are designed to improve the current IPC practices in health-care settings in accordance with existing IPC guidelines and international standards. The modelled intervention to improve hand hygiene is broadly based on WHO's 5 Moments for Hand Hygiene approach.[40] This intervention entails various structural changes to ensure that cleaning facilities (e.g., alcohol-based hand rub products, soap, and water, etc.) are available at the point of care, combined with training of health care personnel and regular hand hygiene audits and feedback. The modelled intervention for enhancing environmental hygiene aims to improve the effectiveness of cleaning practices through a composite of strategies – such as switching from detergents to more effective disinfectants, using automated cleaning devices, and improving the effectiveness of existing cleaning practices (e.g., increasing cleaning time, new opportunities for staff education, introducing monitoring and feedback mechanisms for cleaning practices).

[40] Your 5 moments for hand hygiene [poster]. In: World Health Organization [website]. Geneva: World Health Organization;2009 (https://www.who.int/teams/integrated-health-services/infection-prevention-control/hand-hygiene/training-tools, accessed 1 October 2022).

Figure 9. Small investments in IPC measures will yield large savings in health-care expenditure



IHH: Improving hand hygiene; EEH: Enhancing environmental hygiene. Countries are sorted from left to right on the basis of the growing impact of each intervention on health expenditure.
Source: Stemming the superbug tide: just a few dollars more. Paris: Organisation for Economic Co-operation and Development; 2018 (https://www.oecd.org/health/stemming-the-superbug-tide-9789264307599-en.htm, accessed 24 September 2022).

These interventions will yield non-negligible savings associated with reduced use of health care resources. Across G7 countries, investing 0.3 USD PPP per capita in improving hand hygiene will reduce health expenditure by 3 USD PPP each year between 2015 and 2050; investing 1.9 USD PPP per capita in enhancing environmental hygiene will yield a 2.1 USD PPP reduction in health expenditure annually over the same period. When both intervention costs and related savings in health-care expenditure are considered, IPC policies usually show a very positive return on investment ratios. For example, each USD PPP invested to improve hand hygiene is expected to return average savings exceeding 11 USD PPP consistently across the G7 and EU27 members.[3]

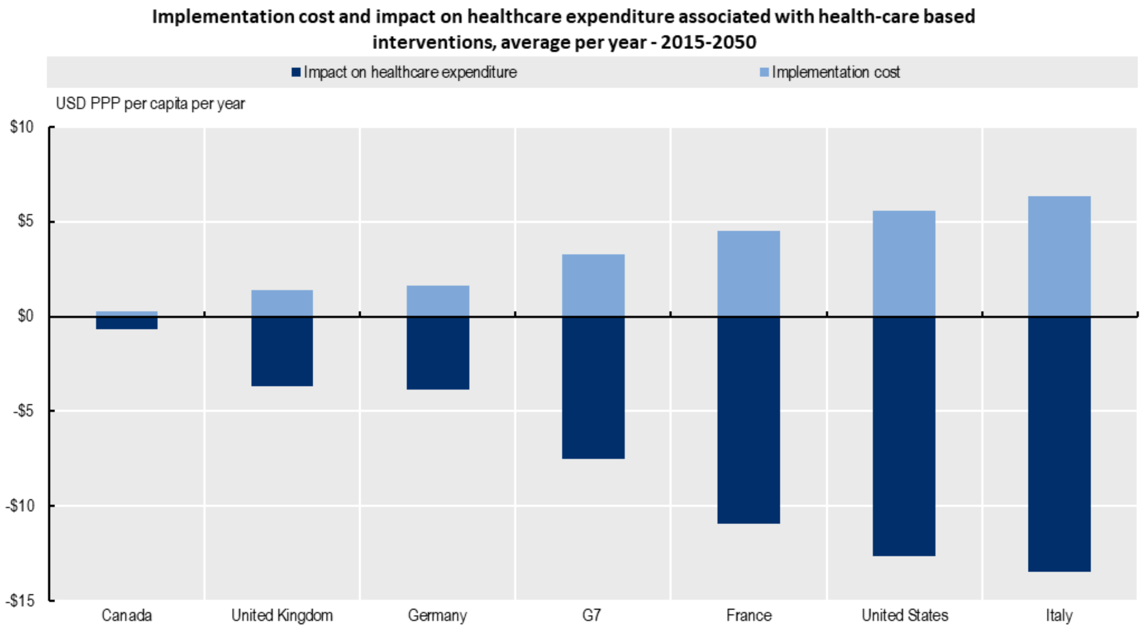
Both interventions will safeguard the health of the populations in G7 countries by preventing mortality. Between 2015 and 2050, improving hand hygiene will prevent more than 30 000 deaths each year across all the G7 countries, whereas the annual number of deaths avoided through enhanced environmental hygiene practices is expected to reach around 28 000. Across EU/EEA members, the same interventions will respectively avoid 19 000 and 18 000 deaths per year.[3]

Investing in improvements in hand hygiene and environmental hygiene practices will also yield reductions in the use of hospital resources. Across G7 countries, improving hand hygiene practices in health facilities will reduce the extra time spent in hospitals each year by more than 2.2 million days. Improving environmental hygiene practices will yield similar improvements, with the additional time spent in hospitals reducing by 1.7 million days.[3]

Beyond the health sector, investing in these two interventions will have a positive impact on workforce productivity in G7 and EU/EEA economies. Fewer HAIs will lead to reductions in the extra time spent away from work due to hospitalization and subsequent convalescence, as well as improving productivity at work.

Enhancing IPC would provide a significant contribution to tackling AMR, particularly in the longer term, but additional actions to promote prudent use of antibiotics are needed. By reducing the number of infections to treat, IPC measures also help reduce the use of antibiotics, including both appropriate and inappropriate use. At the macro level, lower use of antibiotics also translates to lower waste.[41] However, on its own, IPC would not be sufficiently effective in promoting prudent use of antimicrobials. Therefore, IPC interventions should be combined with additional actions that specifically promote responsible and appropriate antimicrobial use such as stewardship programmes. OECD analyses show that investing in a policy package that combines improved hand hygiene, enhanced environmental hygiene, and stewardship programmes would provide greater benefits. Across G7 countries, investing 3.2 USD PPP per capita in health-care based interventions will reduce health expenditure by 7.5 USD PPP every year from 2015 to 2050.[3]

Figure 10. A policy package that combines health care-based interventions also offers a positive return on investment across G7 countries



Note: Countries are sorted from left to right on the basis of the growing impact of each intervention on health expenditure. The policy package presented in this graph include the following health care interventions: improving hand hygiene, enhancing environmental hygiene and strengthening stewardship.
Source: Stemming the superbug tide: just a few dollars more. Paris: Organisation for Economic Co-operation and Development; 2018 (https://www.oecd.org/health/stemming-the-superbug-tide-9789264307599-en.htm, accessed 24 September 2022).

[41] OECD (2017), *Tackling Wasteful Spending on Health*, OECD Publishing, Paris, (https://doi.org/10.1787/9789264266414-en accessed 2 October 2022).

Final considerations and strategic directions for G7 countries

Considerations for global progress in scaling up IPC capacity

This brief has provided an overview of the mounting evidence on the effectiveness of IPC interventions and their return on investments, as well as on the status of implementation of IPC both globally and in G7 countries. The findings presented in this brief and other recent reports underscore the urgent need globally to:

- ensure the sustainability of advancements made in recent years in the implementation of IPC capacity;
- scale up long-term investments to support IPC programmes in order to end the COVID-19 pandemic;
- bridge existing gaps in IPC capacity;
- maintain IPC operational readiness to ensure surge capacity, and prevent and control future outbreaks;
- reduce the endemic burden of HAIs and AMR; and
- strengthening IPC in the context of resilient health systems. including in primary care settings.

At the global level, and particularly in countries where IPC capacity is limited or non-existent, it is urgent to ensure that, at least, the WHO minimum requirements for IPC[28] are put in place as soon as possible at both national and facility levels, and to progress gradually towards the full achievement of all requirements of the IPC core components.[27] While evidence on the estimates on the cost-effectiveness of IPC interventions remains beyond OECD countries, investing in IPC interventions is expected to offer substantial benefits, particularly in countries where HAIs present a substantial threat to population health.

Considerations for scaling up IPC capacity in G7 countries

Overall, G7 countries have an advanced level of implementation of IPC minimum requirements although none of these countries fulfilled them all. Furthermore, some heterogeneity in the level of progress emerges (see Annex A). This variation in IPC capacity may be partly due to the differences in levels of investment in IPC by the governments; however, it may also depend on the extent to which IPC is regulated at the national level versus the subnational level. Countries that have a decentralized health system with more authority and organization of service delivery at the regional/state/provincial level may report lower levels of fulfilment of the IPC minimum requirements at the national level, whereas stronger activities may be in place at the subnational level that are not fully captured by a national assessment. Furthermore, achieving the IPC minimum requirements is only the starting point to provide minimum protection to patients, health workers and visitors to health care facilities.[28] All countries, in particular G7 and the other high-income countries given their higher level of progress in IPC, should aim to achieve full implementation of all core components using a step-wise approach,[27,42,43] in order to have strong, effective and sustained IPC programmes both at the national and facility level.

Based on a global situation analysis of IPC implementation worldwide, the WHO global report on IPC[1] suggested some critical priorities for IPC in national and international health agendas (Figure 11).

[42] Interim practical manual: supporting national implementation of the WHO guidelines on core components of infection prevention and control programmes. Geneva: World Health Organization; 2017 (https://www.who.int/publications/i/item/WHO-HIS-SDS-2017-8, accessed 2 October 2022).

[43] Improving infection prevention and control at the health facility: an interim practical manual. Geneva: World Health Organization; 2018 (https://www.who.int/publications/i/item/WHO-HIS-SDS-2018.10, accessed 2 October 2022).

Figure 11. Critical national and international priorities for IPC indicated in the 2022 WHO Global Report on IPC

1 Functional IPC programmes	• Dedicated budget • Trained IPC professionals
2 IPC minimum requirements	• At national and facility levels in all countries • Demonstrated by M&E of key IPC and WASH indicators
3 Decisive and visible political commitment and leadership engagement	• At the highest levels • Allocation of national and local health budgets • Establishing targets for IPC investment
4 Regulations and legal framework	• To enforce IPC requirements and policies through accreditation and accountability systems • Reporting of key IPC performance indicators and targets
5 Integration and alignment with other programmes	• Specific IPC programme that horizontally integrates/aligns with existing ones
6 Embedding IPC within the patient pathway and clinical care	• Tools and SOPs to support IPC understood and practiced at the point of care in all clinical areas • Workflow, human factors, ergonomics to be considered
7 IPC training and education at all levels	• Implementation of accredited IPC curricula (pre- & postgraduate, in-service) • Based on the WHO IPC core competencies
8 Human resources and career pathway for IPC	• IPC professionals: - with a recognized career pathway - empowered with a clear mandate and authority - accountable for implementation and reporting impact
9 Surveillance of HAIs and AMR in health care	• Functioning and quality-controlled systems for HAI and AMR surveillance • Connected with existing platforms (e.g. GLASS) • Existing standardized surveillance protocols (e.g. ECDC PPS)
10 Quality diagnostics	• Access to quality laboratory diagnostics and services
11 Monitoring IPC programmes	• Using standard M&E approaches • Regular assessments and feedback to health workers • WHO Global IPC Portal as a protected and confidential solution
12 Using data for action and communications	• Use of data for action and development of local, tailored IPC improvement plans • Tailored and consistent communications from authoritative source, based on science

ECDC: European Centre for Disease Prevention and Control; GLASS: Global Antimicrobial Resistance and Use Surveillance System; IPC: infection prevention and control; M&E: monitoring and evaluation; PPS: point prevalence study; WASH: water, sanitation and hygiene.

Source: Global report on infection prevention and control. Geneva: World Health Organization; 2022 (https://www.who.int/publications/i/item/9789240051164, accessed 24 September 2022).

Although the G7 countries have several core components of IPC in place, these priorities remain relevant for all of them, either to be pursued or to be strengthened depending on the context of the country. More specifically for the G7 countries, the following strategic directions can be identified on the basis of the current levels of progress of their IPC programmes:

1. **Strengthen IPC programmes and infrastructures at national and facility levels:**
   - Ensure continued advancements towards meeting all of the minimum requirements for IPC programmes at national, subnational and facility levels, as well as achieving the full implementation of all the core components for IPC programmes.
   - Provide sustained political commitment and leadership engagement, in particular by allocating or sustaining dedicated budgets and increasing human resources for IPC programmes, including increasing staffing levels of IPC professionals at all levels of the health system.
   - Enforce IPC requirements and policies through legal frameworks, regulations, and accreditation and accountability systems, in both public and private health-care settings.
   - Ensure integration and alignment of IPC with other programmes and vice versa, in particular health emergencies, AMR (including antimicrobial stewardship), WASH, patient safety, quality of care and occupational health.
   - Improve infrastructures (e.g., single rooms availability, ventilation systems) and supplies procurement (e.g., alcohol-based handrub products) in health care facilities to ensure a sustained and strong built environment to enable appropriate IPC measures and practices.

2. **Improve IPC training and education**
   - Develop accredited IPC curricula (pre- & postgraduate, in-service).
   - Ensure annual refreshing of IPC training for all front-line health-care workers.
   - Make available and promote the use of a range of IPC training resources that should be practical and innovative (e.g. using simulation and gaming technology).
   - Increase IPC expertise through certification, by offering adequate career pathways and specialized and refreshers courses.

3. **Strengthen monitoring and surveillance**
   - Strengthen functioning systems for HAI and AMR surveillance supported by advanced diagnostics (including genomics) and quality control.
   - Set and regularly report on key IPC performance indicators and targets and embed HAI, AMR and IPC data collection within national health information systems.

4. **Use data for action**
   - Produce and disseminate timely data reports, including their interpretation, to ensure their use for action- i.e. to rapidly inform tailored interventions to prevent infections.
   - Produce costed IPC plans based on local data and priorities, and cost-effectiveness analyses to provide the business case for investing in IPC.
   - Develop and implement multimodal interventions to reduce their burden at the point of care.

As part of their response to COVID-19, countries have made substantial investments in IPC interventions. In addition, G7 countries have also committed to ensuring that such investments would result in long-term sustainable capacity gains, enhancing the health systems' performances and global health security capacities.[44] Upscaling action on the four strategic directions mentioned above would contribute towards this objective and help develop more resilient health-care systems.

Given their capacity and more advanced level of progress in the implementation of IPC programmes, the G7 could also support other countries which may have lower resources and lack IPC expertise, in collaboration with WHO and other stakeholders.

Finally, G7 countries have the capacity for, and a key leading role in financing and conducting, research and supporting knowledge platforms to bridge evidence gaps and promote innovative solutions in the field of IPC.

WHO and OECD stand ready to work with in-country partners and ministry staff of G7 countries to achieve these priorities and to strengthen IPC in global and national health agendas.

[44] G7. Communiqué of the G7 Heads of State and Government. Elmau. 2022. Available at: https://www.g7germany.de/resource/blob/974430/2062292/9c213e6b4b36ed1bd687e82480040399/2022-07-14-leaders-communique-data.pdf?download=1

Annex A. Country profiles: detailed situation analysis of HAIs and AMR in health care in each of the G7 countries

Country profile: Canada

Key messages

- The activities to prevent and control infections and AMR in health care in Canada are advanced and long-standing since many years.
- However, they are not all conducted in the context of the national IPC programme which is based within the Public Health Agency of Canada (PHAC) and has an intermediate level of progress, in line with some aspects of the WHO-recommended core components for IPC. The programme has demonstrated progress over time in recent years and reported implementation and monitoring of IPC interventions in selected health care facilities.
- According to the Canadian Nosocomial Infection Surveillance Program (CNISP), data from 2016–2020 indicate increased rates among hospitalized patients for MRSA and vancomycin-resistant *Enterococcus* (VRE) bloodstream infections, and carbapenemase-producing Enterobacterales (CPEs) infections.
- Continued improvement in the scope and quality of implementation and focus on the development of long-term plans are important needs to sustain and further promote the role of the existing IPC programme.
- A national curriculum to support training of health workers at facility level would be critical to align IPC training nationwide.
- A longstanding committee of subject matter experts, the National Advisory Committee for Infection Prevention and Control (NAC-IPC) provides content advice in the development of the guidelines and timely advice related to IPC and public health emergencies.
- In 2018, it was estimated that over one quarter of bacterial infections in Canada were resistant to at least one antibiotic and that 14 000 Canadian deaths were associated with AMR. The same analysis suggests that, if resistance rates rose to 40% by 2050, AMR would cause 13 700 deaths annually. The accompanying costs to the healthcare system are estimated to reach CAD 7.6B each year by 2050, resulting in a CAD 21B reduction to Canadian gross domestic product, based on a resistance rate of 40%.

The burden of HAIs and AMR in health care

In Canada, CNISP is implemented at sentinel acute-care hospitals across the country, in collaboration with PHAC and the Association of Medical Microbiology and Infectious Disease Canada.

In 2020, it was estimated that 1 in 223 patients admitted to a CNISP-participating hospital developed an HAI[45]. From 2016 to 2020, increases in rates per 10 000 patient-days were observed for MRSA bloodstream infections (33%; 0.84–1.12, p=0.037), VRE bloodstream infections (72%; 0.18–0.31, p=0.327), CPE infections (67%, 0.03–0.05, p=0.117) and CPE colonizations (86%, 0.14–0.26, p=0.050);

[45] Trends among healthcare-associated infections (HAIs) and antimicrobial-resistant organisms (AROs) in Canada. Ottawa: Canadian Nosocomial Infection Surveillance Program; 2022 (https://ipac-canada.org/photos/custom/Members/pdf/2022-08_CNISP%20Infographic%20EN.pdf, accessed 15 September 2022).

however, rates of Clostridium difficile infection (CDI) decreased by 8.5% between 2016 and 2020 (from 5.77 to 5.28, p=0.050).[46]

Additionally, CNISP estimates that 1 in 171 patients undergoing hip or knee replacement, paediatric cardiac, or cerebral spinal fluid shunt surgery at a CNISP-participating hospital had a surgical site infection (SSI).[46] Between 2011 and 2020, 4751 device and surgical procedure-related infections were reported, with central line-associated bloodstream infections (CLABSIs) in ICUs representing 67% of all reported infections.[47] Over the surveillance period, significant rate increases were observed in adult mixed ICU CLABSIs (0.8 to 1.6 per 1000 line days, p=0.004) while decreases were observed in neonatal ICU CLABSIs (4.0 to 1.6 per 1000 line days, p=0.002) and SSIs following knee arthroplasty (0.69 to 0.29 infections per 100 surgeries, p=0.002).[47]

In 2018, it was estimated that over one quarter of bacterial infections in Canada were resistant to at least one antibiotic and that 14 000 Canadian deaths were associated with AMR, of which AMR was directly responsible for 5400.[48]

Status of IPC implementation: intermediate level of progress of the national IPC programme but activities led and implemented by province- level public health agencies.

In the reports of IPC indicators provided in recent years through different WHO surveys some discrepancies should be noted for Canada. According to the State party self-assessment annual reporting tool (SPAR)[29] which is completed annually to reflect adherence to the International Health Regulations,[49] Canada has the highest score (5), indicating nationwide implementation of IPC programmes and standards and of HAI surveillance. According to the Tripartite Antimicrobial Resistance Country Self-assessment Survey (TrACSS)[31] completed annually to reflect the national action plan for AMR, national IPC programme and guidelines are available but they are implemented in selected health care facilities. The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicates that 15 out of 25 (60%) IPC minimum requirements are met (Figure 12).

These results indicate that the Canadian national IPC programme is functioning at an intermediate level with some elements of the WHO-recommended core components in place; however, key priority areas for improvement have been identified. Furthermore, it is also critical to recognize that the role of the national programme is relatively limited, given that many activities are decentralized in Canada and are led by province-level public health agencies.

Furthermore, it is critical to note that Canadian public hospitals participate in accreditation through Accreditation Canada which assesses organizations against defined standards which include 14 IPC standards. These standards include a required organizational practice of multimodal hand hygiene training for team members and volunteers, and auditing compliance of hand hygiene practices. The federal IPC guidelines are implemented and audited through accreditation. All accredited Canadian organizations must

[46] Canadian Nosocomial Infection Surveillance Program. Healthcare-associated infections and antimicrobial resistance in acute care hospitals in Canada, 2016–2020. Can Commun Dis Rep. 2022;48(7/8):308–24 (https://doi.org/10.14745/ccdr.v48i78a03, accessed 16 September 2022)

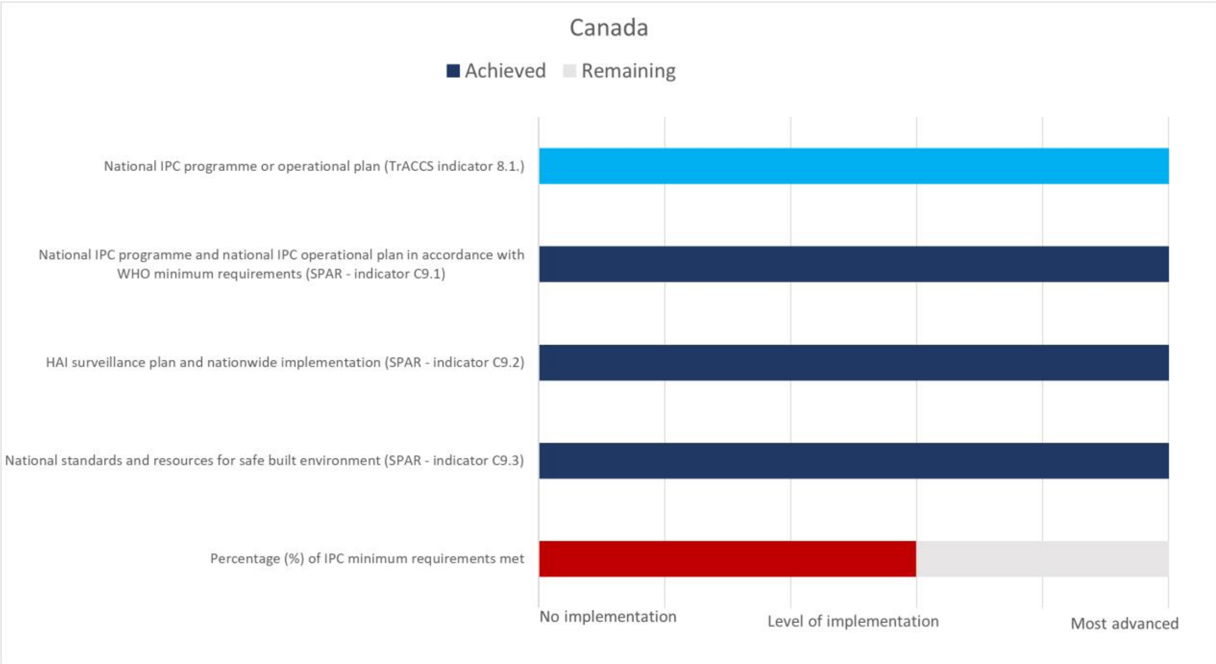
[47] Canadian Nosocomial Infection Surveillance Program. Device and surgical procedure-related infections in Canadian acute care hospitals from 2011 to 2020. Can Commun Dis Rep. 2022;48(7/8):325–39 (https://doi.org/10.14745/ccdr.v48i78a04, accessed 16 September 2022).

[48] Forecasting the future of antimicrobial resistance (AMR) in Canada. Ottawa: Council of Canadian Academies; 2019 (https://cca-reports.ca/forecasting-the-future-of-amr/, accessed 1 October 2022).

[49] International Health Regulations (2005): IHR monitoring and evaluation framework. Geneva: World Health Organization; 2018 (https://apps.who.int/iris/handle/10665/276651, accessed 01 October 2022).

have policies and procedures in place for routine practices, additional precautions, education programmes, surveillance plans and ongoing activities.

Figure 12. National-level IPC implementation results in Canada according to global surveys



Notes: TrACCS survey is for the years 2017-2021; SPAR survey is for the year 2021; WHO global survey on IPC minimum requirements at the national level is for the year 2022. All questions extracted from TrACCS and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized has having no implementation with respect to that indicator whereas countries that reported the highest rating were categorized as achieving the most advanced stage of implementation.

Gaps identified

Given the intermediate level of implementation of the national IPC programme in Canada, the following gaps have been identified, in relation to the WHO-recommended minimum requirements for IPC at the national level (Table 1):[38]

- Given its limited role in implementation at the province level, the national programme does not actively address guideline adaptation and standardization.
- Regarding the gaps on IPC education and training, most of the minimum requirements are not met by the national programme because they are the responsibility of the provinces and territories.
- The national IPC focal point does not have specific expertise in implementation science.
- The national programme is not in charge of nationwide monitoring of IPC indicators as this is defined through accreditation standards for acute-care facilities. Therefore, a strategic national plan for IPC monitoring and an integrated system for collection, analysis and feedback of data do not exist.
- Hand hygiene compliance monitoring and feedback is not identified as a key national indicator.

To measure ongoing progress in IPC practices nationally, PHAC will be conducting an analysis of the IPC landscape by collating information and data on health care IPC activities, programmes and implementation within Canada (e.g., environmental scan, identification of health care IPC activities not publicly available, and ongoing monitoring of the Canadian context for health care IPC).

Economic costs and burden associated with AMR

Health and economic losses due to AMR continue to pose non-negligible public health risks in Canada.

An analysis released by the Canadian Council of Academies using methodology different from the OECD analysis and a different set of diseases estimated that about 26% of bacterial infections were resistant to first-line antimicrobials in 2018.[48] The same report found that, if resistance rates rose to 40% by 2050, there would be 13 700 deaths annually. The accompanying increased costs to the healthcare system are estimated to reach CAD 7.6B annually by 2050, resulting in a CAD 21B reduction to Canadian GDP, based on a resistance rate of 40%.

Canada is poised to make substantial gains from investing in infection prevention and control measures.

In Canada, investing in improved hand hygiene practices in health-care settings can improve health by gaining, on average, 6 952 disability-adjusted life-years per 100 000 persons every year between 2015 and 2050. This intervention can also alleviate the burden on hospital resources by preventing an additional 9 500 days spent in hospitals every year.[3]

Enhancing environmental hygiene in health-care settings can improve population health by gaining, on average, around 3 535 disability-adjusted life-years per 100 000 persons every year from 2015 to 2050. Further, around 7400 additional days spent in hospitals can be avoided by scaling up environmental hygiene investments.[3]

Investing in IPC measures can yield savings generated through reduced health expenditure that offset implementation costs. Between 2015 and 2050, improving hand hygiene can lead to saving more than CAD 0.3 (USD 0.3 PPP) per capita each year, whereas enhancing environmental hygiene can decrease health expenditure by more than CAD 0.2 (USD 0.2 PPP) per capita every year.[3]. More broadly, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programmes and enhanced environmental hygiene can help save 1.5 life years every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate annual savings that are about 2.5 times bigger than the implementation costs.[3]

Country profile: France

Key messages

- France has a very advanced national IPC programme that is based within the French public authorities, and which has demonstrated progress over time in recent years, in line with the WHO recommended core components for IPC, and has reported nationwide implementation and monitoring of IPC interventions at the health-care facility level.
- Preventing infections and antibiotic resistance is a major public health issue that has been identified as a priority by the French public authorities since the 1990s and continues to be so today despite the advanced status of IPC. Various national plans for preventing health care-associated infections (HAIs) have been implemented, such as the 2009–2013 National Strategy for Preventing Health Care-Associated Infections, the 2013–2017 National Patient Safety Programme or the 2015–2022 National Prevention Action Plan Against Health Care-Associated Infections (Propias).
- France has issued a 2022–2025 National Strategy for the Prevention of Infections and Antibiotic Resistance in Human Health, which emphasizes two major complementary axes – IPC (covering both health care-associated and community-acquired infections) and antibiotic stewardship.
- In the last point prevalence study (PPS) conducted in 2017, a HAI prevalence of 5% was reported, comparable to the 5.9% average prevalence reported in the EU/EEA countries
- According to the assessment of the WHO minimum requirements for IPC at the national level, the impact of IPC training should be assessed through a specific monitoring and evaluation system in France.
- Without an effective policy response, multidrug resistant bacterial infections (around one third being community-acquired) in France are expected to cause more than 5 600 deaths every year between 2015 and 2050, corresponding to nearly four times the number of deaths attributable to tuberculosis, HIV and influenza combined in 2016. If antibiotic-resistance rates continue as projected, the annual health-care expenditures attributable to antibiotic-resistance are expected to reach more than EUR 319.1 million (USD 440.2 million PPP) annually between 2015 and 2050.
- Improving and investing in enhanced hand hygiene and environmental hygiene practices in health care facilities offer cost-effective options with notable health and economic benefits to tackle HAIs and antibiotic-resistance in France.

The burden of HAIs and AMR in health care

Despite the advanced status of the system for IPC, the spread of infection and AMR in health-care settings remains a relevant patient safety issue in France.

In France, surveillance of HAIs is conducted under the auspice of the national institute for public health surveillance through a central coordinating structure, the *Réseau d'alerte, d'investigation et de surveillance des infections nosocomiales* (RAISIN).[50]

[50] "Raisin". A national programme for early warning, investigation and surveillance of healthcare-associated infection in France. Santé Publique France, 2019 (https://www.santepubliquefrance.fr/docs/raisin-.-a-national-programme-for-early-warning-investigation-and-surveillance-of-healthcare-associated-infection-in-france, accessed 02 October 2022)

Every five years, a PPS is organized in hospitals according to the protocol of the European Centre for Disease Prevention and Control (ECDC). In the last PPS conducted in 2017, a HAI prevalence of 5% was reported,[51] comparable to the 5.9% average prevalence reported in the EU/EEA members. Subsequently, a PPS study was conducted in nursing homes in 2016 (Prev'EHPAD) and a prevalence of 3% HAIs on a given day among residents was reported,[52] which was lower in comparison with the European prevalence (mean value 3.9%).

A national programme for the surveillance and prevention of infections associated with invasive devices (SPIADI) exists in France since 2018. The incidence of catheter-associated bloodstream infections was assessed between January and April 2019[53] and the reported results indicated that from 1001 participating health care institutions, 11 785 health care–associated bacteraemia episodes were reported, including 3189 catheter-related bacteraemia (27.1%). The incidence density rate was >1 per 1000 patient-days (PDs) for central catheter-related bacteraemia in neonatal intensive care, oncology and haematology. In ICUs (adult and paediatric sectors) and radiotherapy ward rates were varying between 0.45 and 1 per 1000 PDs, and in medical and surgical services (adult sector) between 0.10 and 0.45 per 1000 PDs. 8% of catheter-related bacteraemia were due to multidrug-resistant microorganisms. SSI are the second most frequent HAIs in France and are associated with increased length of hospital stay, revision surgery, cost and mortality.

Since 1999, national SSI surveillance is conducted in France by RAISIN, which estimates incidence rates for most frequent interventions by specialty and individual risk factor. In 2018, 95 388 surgical interventions were reported across 357 participating hospitals. An overall unadjusted SSI incidence rate is estimated at 1.64% (1.55–1.72) and 0.72% (0.56–0.91) in patients without risk factors. In the past five years, evolutions in SSI incidence rates by surgery have been identified, with an upward trend for revised hip replacement and a downward trend for abdominal hysterectomy.[54]

A voluntary and confidential national AMR surveillance system, known as SPARES[55], exists for hospitals. This surveillance system is maintained by a voluntary network of 1066 hospitals representing 53% of patient-days in France. Since 1996, national surveillance networks have been in place for the monitoring

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51 Enquête nationale de prévalence des infections nosocomiales et des traitements anti-infectieux en établissements de santé, mai-juin 2017. Santé Publique France, 2019 (https://www.santepubliquefrance.fr/maladies-et-traumatismes/infections-associees-aux-soins-et-resistance-aux-antibiotiques/infections-associees-aux-soins/documents/enquetes-etudes/enquete-nationale-de-prevalence-des-infections-nosocomiales-et-des-traiteme, accessed 02 October 2022)

52 National prevalence survey of healthcare-associated infections and antibiotic treatments in nursing homes (EHPAD). National results 2016. Saint-Maurice: Santé publique France; 2017:67 (https://www.santepubliquefrance.fr/les-actualites/2017/prev-ehpad-infectionsassociees-aux-soins-et-traitements-antibiotiques-en-etablissements-d-hebergement-pour-personnes-agees-dependantes-resultat, accessed 02 October 2022)

53 Surveillance des infections associées aux dispositifs invasifs. Mission nationale SPIADI. Résultats de la surveillance menée en 2019. Santé Publique France, 2021(https://www.santepubliquefrance.fr/maladies-et-traumatismes/infections-associees-aux-soins-et-resistance-aux-antibiotiques/infections-associees-aux-soins/documents/rapport-synthese/surveillance-des-infections-associees-aux-dispositifs-invasifs.-mission-nationale-spiadi.-resultats-de-la-surveillance-menee-en-2019, accessed 02 October 2022)

54 Villeneuve S, Miliani K. Surveillance des infections du site opératoire dans les établissements de santé français. Mission Spicmi, septembre 2020, données 2018 du réseau ISO Raisin (https://www.santepubliquefrance.fr/maladies-et-traumatismes/infections-associees-aux-soins-et-resistance-aux-antibiotiques/infections-associees-aux-soins/documents/enquetes-etudes/surveillance-des-infections-du-site-operatoire-dans-les-etablissements-de-s, accessed 28 September 2022).

55 Les champs d'action de SPARES (https://www.preventioninfection.fr/spares-surveillance-et-prevention-de-lantibioresistance-en-etablissements-de-sante/, accessed 28 September 2022).

of multidrug-resistant bacteria such as MRSA and extended-spectrum beta-lactamase-producing Enterobacterales (ESBL-E).

According to SPARES, among Enterobacterales (E) strains, 8.3% produced extended spectrum beta-lactamase (ESBL) – 2.7% in obstetrics and gynaecology wards versus 17.6% in long-term care wards. ESBL-E incidence was 0.58 per 1000 patient-days. Two thirds of the 31486 ESBL-E were isolated from urine samples. MRSA accounted for 14.0% of *S. aureus*. MRSA incidence was 0.17 per 1000 patient-days. Over 40% of the 9221 MRSA samples were isolated in patients from medical wards. In cohorts of hospitals that participated in 2019 and 2020, MRSA incidence decreased from 0.19 to 0.17 and ESBL-E incidence increased from 0.55 to 0.59 per 1000 patient-days. Data on infections due to extensively drug-resistant (XDR) bacteria showed that 46.5% of the 99 vancomycin-resistant *Enterococcus faecium* strains were isolated from urine samples and that 39.7% of the 673 carbapenemase-producing Enterobacterales strains were *K. pneumoniae*.

France contributes to the European surveillance resistance data produced by hospital-based laboratory networks annually in the context of the European Antimicrobial Resistance Surveillance Network (EARS-Net). France holds an unenviable position in Europe in terms of MRSA (11.6% in the EARS-Net 2019 report, giving France 16th place out of 31 countries in descending order of performance) and to third-generation cephalosporins for *Klebsiella pneumoniae* (30.2%, 16th place). For glycopeptide-resistant *Enterococcus faecium*, France is among the countries in Europe with a low prevalence (4th place), whereas for carbapenemase-producing Enterobacterales, specifically for *K. pneumoniae*, France's prevalence of 1% puts it in 14th place.[56]

A surveillance system for primary care and nursing homes, known as Primo, has been available since 2020 and has carried out 584 183 antibiotic susceptibility tests on strains of *Enterobacterales* isolated from urine samples (including 86.1% of *E. coli* and 9.1% of *K. pneumoniae*). In patients living at home, 3.3% of *E. coli* strains were resistant to third-generation cephalosporins and 3.0% by ESBL production. Within the population of nursing home residents, resistance to third-generation cephalosporins concerned 10.2% of strains of *E. coli*, including 9.2% by ESBL production.[57]

Over a 10-year period (2008-2017), 986 deaths associated with HAIs were reported, approximately 10–15% of hospital deaths, making HAIs the 4th most frequent cause of death in hospitals. HAIs incurred additional costs due to extended hospital stays (approximately 6 additional days), from heavier reliance on additional tests and treatments (including antibiotic treatments), and from a total average additional cost estimated at more than EUR 10 000 per HAI in France.[58] In 2015, it was estimated that 63.5% of multidrug-resistant bacterial infections were HAIs and a total of 5500 deaths were attributed to multidrug-resistant bacterial infections in the same year, making antibiotic resistance a major public health issue.[17]

[56] Antimicrobial resistance in the EU/EEA (EARS-Net). Annual Epidemiological Report for 2019. Stockholm: European Centre for Disease Prevention and Control; 2020 (https://www.ecdc.europa.eu/sites/default/files/documents/surveillance-antimicrobial-resistance-Europe-2019.pdf, accessed 28 September 2022).

[57] Lemenand O, Thibaut-Jovelin S, Coeffic T, Caillon J. Surveillance of antibiotic resistance in the elderly population. Santé publique France. 2020 (https://www.santepubliquefrance.fr/view/content/423392/full/1/498979; and https://www.santepubliquefrance.fr/view/content/423397/full/1/498986, accessed 28 September 2022).

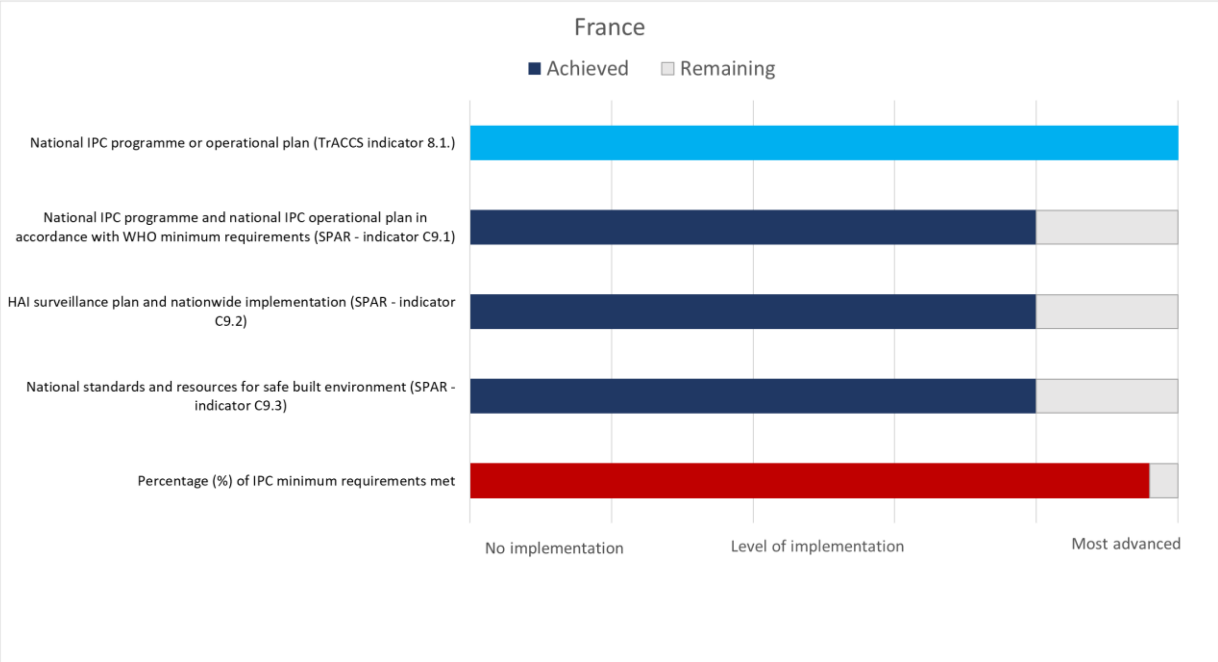
[58] Deniau N, Poujol de Molliens I, Soing-Altrach S, Maugat S, Berger-Carbonn A. Deaths resulting from healthcare associated infections: 2008–2017 results of external notifications in France – Focus on Staphylococcus aureus bacteraemia. Bulletin épidémiologique hebdomadaire. 2020;15:305–13 (http://beh.santepubliquefrance.fr/beh/2020/15/2020_15_2.html, accessed 28 September 2022).

Status of IPC implementation: very advanced, in line with the WHO-recommended core components for IPC

France has issued a 2022–2025 National Strategy for the Prevention of Infections and Antibiotic Resistance in Human Health, which emphasizes two major complementary axes – IPC (covering both health care-associated and community-acquired infections) and antibiotic stewardship.[59]

According to annual WHO assessments, France reported a very advanced level of IPC implementation at the national level, in line with the WHO-recommended core components for IPC (Figure 13) The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicated that 24 out of 25 (96%) IPC minimum requirements are met.

Figure 13. National level IPC implementation results in France according to global surveys



Notes: TrACCS survey is for the years 2017-2021; SPAR survey is for the year 2021; WHO global survey on IPC minimum requirements at the national level is for the year 2021 – 2022. All questions extracted from TrACCS, and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized has having no implementation with respect to that indicator whereas countries reported the highest rating were categorized as achieving the most advanced stage of implementation.

Gaps identified

According to the WHO global survey on the IPC minimum requirements at the national level, although training and education activities on IPC take place throughout the country, a national system and schedule for monitoring and evaluating the effectiveness of training activities do not exist.

[59] 2022–2025 National Strategy for the Prevention of Infections and Antibiotic Resistance in Human Health. Ministère des Solidarités et de la Santé. 2022 (https://solidarites-sante.gouv.fr/IMG/pdf/national_strategy_for_preventing_infections_and_antibiotic_resistance_2022-2025_.pdf, accessed 28 September 2022)

Economic costs associated with AMR

Spread of resistant infections will pose a major health and economic burden on France in the coming years.

Without effective policy response, multidrug resistant bacterial infections in France are expected to cause more than 5 600 deaths every year between 2015 and 2050, corresponding to nearly four times the deaths attributable to tuberculosis, HIV and influenza combined in 2016.[3]

If antibiotic resistance rates continue as projected, the annual health-care expenditures attributable to antibiotic resistance are expected to reach more than EUR 319.1 million (USD 440.2 million PPP) annually between 2015 and 2050. This corresponds to EUR 4.8 (USD 6.6 PPP) per capita each year, surpassing the average per capita spending on antibiotic resistance in G7 countries (USD 5.5 PPP). AMR contributes to longer hospital stays, which have a negative effect on the health of the population and on the health-care sector's resources. Almost 479 400 additional hospital days are expected due to the spread of antibiotic resistance in France each year between 2015 and 2050.[3]

France stands to benefit from scaling up investments in IPC interventions to tackle health care-associated infections.

In France, investing in enhanced hand hygiene practices in health-care settings can avoid around 3 540 deaths every year caused by resistant and susceptible bacterial infections. This intervention can also yield reductions in the use of hospital resources by preventing more than 360 900 additional days spent in hospitals each year between 2015 and 2050.[3]

Enhancing environmental hygiene also help safeguard the health of the French population by preventing around 3 310 deaths every year from 2015 to 2050. More than 280 800 additional days spent in hospitals can be avoided by increasing investments in environmental hygiene practices.[3]

France is poised to make substantial economic gains by investing in improved hand hygiene and environmental hygiene practices. Between 2015 and 2050, improving hand hygiene is expected to result in savings of almost EUR 3.2 (USD 4.4 PPP) per capita every year, whereas enhancing environmental hygiene can help save about EUR 0.2 (USD 0.3 PPP) per capita each year. More broadly, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programmes and enhanced environmental hygiene can help save 35 life years every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate savings that are about 2.4 times bigger than the implementation costs.[3]

Country profile: Germany

Key messages

- Germany has a very advanced national programme for IPC reinforced by a legal framework – the German Protection against Infection Act within the German federal law. This system is in line with the WHO-recommended core components for IPC and reported nationwide implementation and monitoring of IPC interventions at the health-care facility level.
- The major strength of the German system is the national system for health care-associated infections (HAIs) surveillance which has been established nationwide for over 25 years and which provides regular data on HAIs and AMR in different settings and patient populations.
- Germany has a national IPC committee (KRINKO = Kommission für Krankenhaushygiene und Infektionsprävention) which has the mandate to develop guidelines according to § 23 of the Infection Protection Act (Infektionsschutzgesetz, "IfSG"). The commission recommendations on IPC are based on scientific evidence and are regularly reviewed and updated.
- Despite this advanced status of the system for IPC, the spread of infection and AMR in health-care settings remains a relevant patient safety issue, posing a major challenge to the health system because antibiotic resistance is expected to claim about 2 180 lives each year in Germany between 2015 and 2050.
- In 2011, the burden of HAIs in Germany was higher than the average for EU/EEA countries. It was also estimated to be substantially higher than the burden of other communicable diseases reported in Germany.
- In the context of the 2016 ECDC PPS, the annual number of patients with at least one HAI was estimated at 604 495 (95% CI: 373 766–938 383) and HAI prevalence was 3.6% in acute-care hospitals.
- However, between 2006 and 2013, a significant reduction of primary bloodstream infections and lower respiratory tract infections (LRTI) was observed in German ICUs. A significant decrease of HAIs caused by MRSA was also shown in Germany over a 10-year period (2007–2016).
- Important areas for improvement have been identified in the context of IPC training. A national IPC curriculum for in-service training of health-care workers should be developed in alignment with the national IPC guidelines. The impact of IPC training should be assessed through a specific monitoring and evaluation system.
- A national strategic plan for IPC monitoring should be developed, including establishing an integrated system for collection and analysis of data and defining a minimal set of IPC core indicators for health care facilities.
- At health-care facility level awareness and implementation of multimodal strategies for IPC interventions are not yet fully accomplished. In addition, workload and staffing levels revealed considerable potential for improvement.
- Without an effective policy response, Germany is projected to spend nearly EUR 144.5 million (USD 195 million PPP) each year between 2015 and 2050 to treat infections caused by resistant organisms, corresponding to about EUR 1.8 (USD 2.4 PPP) per capita. The increased length of stay in hospitals is a key driver of health expenditures related to AMR. On average, nearly 459 500 extra days are expected to be spent in hospitals due to antibiotic resistance each year between 2015 and 2050.

- It is estimated that 20–30% of HAIs in Germany could be preventable, primarily through improved adherence to hygiene recommendations and optimization of procedures.
- Improving hand hygiene and scaling up environmental hygiene practices in health care facilities offers an excellent investment to lessen the health burden of HAI and AMR with notable health and economic benefits in Germany.
- One lesson learned from the COVID-19 pandemic is the need to strengthen IPC in long-term care facilities within the legal framework and this has been reflected in a recent amendment to the German Protection against Infection Act.

The burden of HAIs and AMR in health care

Despite an advanced status of the system for IPC, the spread of HAI and AMR in health-care settings remains a relevant patient safety issue in Germany.

Since 1997, a voluntary and confidential national system for surveillance of nosocomial infections – the Krankenhaus-Infektions-Surveillance-System (KISS) – has existed in Germany. It includes different components for intensive care units (ITS-KISS), non-intensive care units (STATIONS-KISS), very low birth weight infants (NEO-KISS) and surgical site infections (OP-KISS); it also monitors infections due to MRSA, glycopeptide-resistant enterococci (GRE), multidrug-resistant gram-negative organisms, and the consumption of alcohol-based hand-rub. Germany also regularly participates in the PPS of HAIs coordinated by ECDC. Participating in the national surveillance system and using surveillance data for internal quality management were shown to lead to substantial HAI reduction.[8]

Between 2006 and 2013, a significant reduction of primary bloodstream infections and LRTI was observed in German ICUs with the maximum effect in year 5 or later years (incidence rate ratio 0.60 and 0.61, respectively).[60] The results suggest a marked decrease in HAI rates during participation in the surveillance network. The reasons for this decrease may be due to a “surveillance effect”, or may be due to the implementation of evidence-based practices and appropriate interventions introduced after obtaining feedback on the infection rates in comparison with benchmarking data.

Another study evaluating the incidence of HAIs, attributable deaths and disability-adjusted life years (DALYs) in Germany in 2011, estimated a total of 478 222 (95% uncertainty interval (UI):421 350–537 787) HAI cases, resulting in 16 245 (95% UI: 10 863–22 756) attributable deaths and 248 920 (95%UI: 178 693–336 239) DALYs.[61] The burden of HAIs in Germany (308.2 DALYs per 100 000 population; 95%UI:221.2–416.3) was higher than the average for EU and EEA countries (290.0 DALYs per 100 000 population; 95%UI:214.9–376.9). The burden of all five most frequent HAIs in Germany was also higher than the burden of 31 selected infectious diseases in the EU/EEA, which was estimated to be 273 (95%UI:249–299) DALYs per 100 000 population.

In the context of the 2016 ECDC PPS, the annual number of patients with at least one HAI was estimated at 604 495 (95% CI: 373 766–938 383) and HAI prevalence was 3.6% in acute-care hospitals.[8] This prevalence was lower than the average in EU/EEA members; however, the number of HAIs per 100 000 was estimated to be higher in Germany (735.6, 95%CI:452.8–1141.9) compared to the EU/ EEA estimate

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[60] Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals 2011-2012. European Centre for Disease Prevention and Control Surveillance report, 2013 (https://www.ecdc.europa.eu/en/publications-data/point-prevalence-survey-healthcare-associated-infections-and-antimicrobial-use-0, accessed on 2 October 2022).

[61] Zacher B, Haller S, Willrich N, Walter J, Sin MA, Cassini A et al. Application of a new methodology and R package reveals a high burden of healthcare-associated infections (HAI) in Germany compared to the average in the European Union/European Economic Area, 2011 to 2012. Euro Surveill. 2019;24(46):1900135.

(658.5, 95%CI:437.0–957.6).[8] A probable cause for the high burden of HAIs in Germany is the country's large hospital patient population, and the fact that health care facilities have more patient beds per 100 000 inhabitants compared to other EU countries.[61]

The 2016 ECDC PPS in long-term care facilities (HALT-3) reported a HAI prevalence of 1.7%, which was lower in comparison with the European prevalence (mean value 3.9%). Urinary tract infections were the most common infections at almost 50%, followed by respiratory, skin and soft-tissue infections.[62]

In 2019, the Institute for Health Metrics and Evaluation (IHME) estimated that 9650 deaths were attributable to AMR in Germany (mortality rate: 5 per 100 000) and 45 700 deaths were associated with AMR as a result (mortality rate: 22 per 100 000).[63] While there is undoubtedly a large clinical and public health burden associated with AMR and this burden is likely to increase over time, warranting urgent action, the different methodologies used in the estimation of AMR burden need to be considered.

A significant decrease in HAIs caused by MRSA was shown over a period of 10 years (2007–2016).[64] MRSA decreased from 37.1% to 21.8% ($p = 0.01$) for BSIs, from 38.7% to 19.2% for LRTI ($p < 0.01$), and from 21.1% to 7.4% ($p < 0.01$) in SSI.[64] A similar decrease in MRSA rates has been reported in other European countries.

The incidence of HAIs in Germany does not seem to have increased in the first year of the COVID-19 pandemic. According to the data from the ICU component of KISS for the period 2019–2020, catheter-associated urinary tract infections and ventilator-associated LRTI rates decreased in 2020 compared with 2019 and no increase was detected for CLABSI or BSI associated with the use of extracorporeal life support systems, despite a significant increase in device utilization rates for central lines and ventilator use.[64] In 2020, only 7% of ICU beds were used for COVID-19 patients. The reason for this low utilization rate of ICU beds is the high overall number of ICU beds per 100 000 inhabitants which is probable the highest in Europe. Consequently, there was no overcrowding in ICUs during the COVID-19 pandemic. In addition, the reason for the decrease may be due to a change of the patient mix in ICUs due the halting of admissions for many patient groups (e.g., those with planned operations).

Status of IPC implementation: very advanced, in line with the WHO-recommended core components for IPC

National level

According to annual WHO assessments, Germany reports a very advanced level of IPC implementation at the national level, mostly in line with the WHO-recommended core components for IPC (Figure 14). The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicated that 20 out of 25 (80%) IPC minimum requirements are met.

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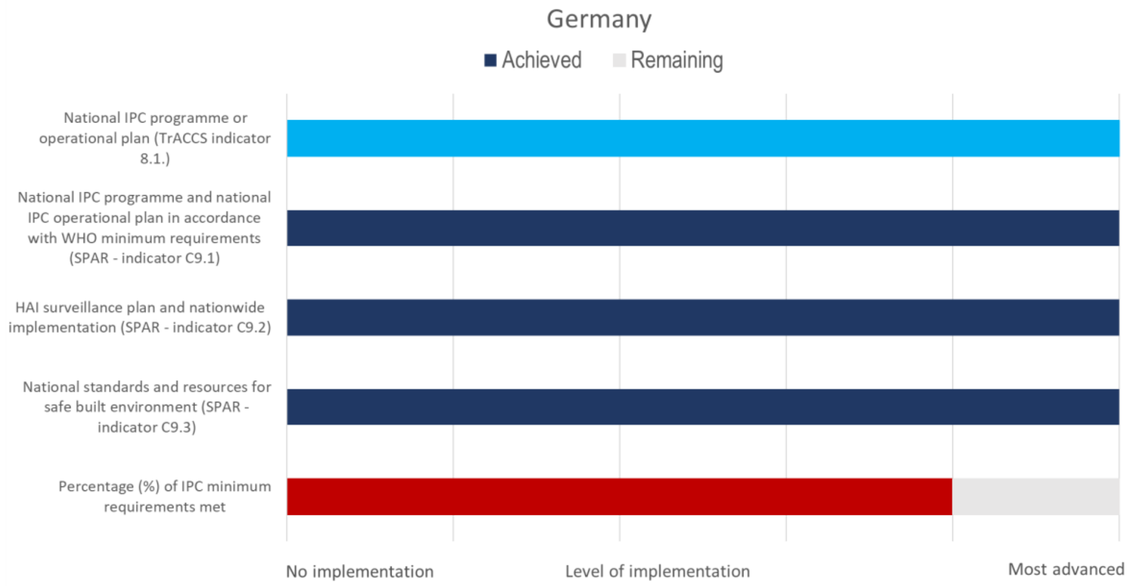
[62] Schmidt N, Marujo V, Eckmanns T, Zacher B, Arvand M, Ruscher C. Nosokomiale Infektionen und Antibiotikaanwendung in Langzeitpflegeeinrichtungen. Deutsche Ergebnisse der dritten europäischen Punkt-Prävalenz-Erhebung HALT-3. Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz. 2022;65(9):863–71.

[63] The burden of antimicrobial resistance in G7 countries and globally: IHME AN URGENT CALL FOR ACTION. doi: 10.25646/10218 (accessed 15 September 2022).

[64] Geffers C, Schwab F, Behnke M, Gastmeier P. No increase of device associated infections in German intensive care units during the start of the COVID-19 pandemic in 2020. Antimicrob Resist Infect Control. 2022;11(1):1–7.

Figure 14. National-level IPC implementation results in Germany according to global surveys



Notes: TrACCS survey is for the years 2016-2021; SPAR survey is for the year 2018-2021; WHO global survey on IPC minimum requirements at the national level is for the year 2022. All questions extracted from TrACCS, and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized has having no implementation with respect to that indicator whereas countries that reported the highest rating were categorized as achieving the most advanced stage of implementation.

Facility level

In a recent publication, a total of 736 hospitals used the WHO IPC assessment framework (IPCAF) in the context of a national survey.[65] The survey demonstrated that IPC structures and activities were well established in German acute-care hospitals. Indeed, the overall median score reached 690, which corresponded to an advanced level of IPC implementation according to the WHO core components. Only three hospitals (0.4%) fell into the category "basic", with 111 hospitals (15.1%) being "intermediate" and 622 hospitals (84.5%) being "advanced". More profound differences were found between the respective core components. The lowest scores were found for implementation of IPC interventions using multimodal strategies, workload, staffing levels, ward design and bed occupancy while HAI surveillance scored the highest.[65]

Gaps identified

Despite the very advanced level of IPC implementation, the following gaps have been identified in Germany, in relation to the WHO-recommended minimum requirements for IPC at the national level (Table 1) :[38]

- Important areas for improvement have been found in the context of IPC training, including the lack of a national IPC curriculum for in-service training of health workers, which should be based on national guidelines/standards and reviewed/updated routinely.

[65] Aghdassi SJ, Hansen S, Bischoff P, Behnke M, Gastmeier P. A national survey on the implementation of key infection prevention and control structures in German hospitals: results from 736 hospitals conducting the WHO Infection Prevention and Control Assessment Framework (IPCAF). Antimicrob Resist Infect Control. 2019;8(1):1–8.

- Furthermore, it was reported that a national system and schedule for monitoring and evaluation of the effectiveness of IPC training and education at least annually do not exist.
- A strategic plan for IPC monitoring should be developed, including establishing an integrated system for collection, analysis and feedback of data.
- The IPCAF survey identified that the awareness and implementation of multimodal strategies for IPC interventions are not yet fully accomplished at health-care facility level.
- Workload and staffing levels revealed considerable potential for improvement.

Economic costs associated with AMR

Germany faces substantial health and economic burdens associated with the spread of resistant infections.

If antibiotic resistance rates continue as projected, AMR is expected to claim around 2180 lives each year in Germany between 2015 and 2050. This is almost 1.2 times the deaths caused in 2020 by other communicable diseases such as tuberculosis, HIV, and influenza combined.[3]

Without an effective policy response, Germany is projected to spend nearly EUR 144.5 million (USD 195 million PPP) each year between 2015 and 2050 for treating infections caused by resistant organisms, corresponding to about EUR 1.8 (USD 2.4 PPP) per capita. The increased length of stay in hospitals is a key driver of health expenditures related to AMR. On average, nearly 459 500 extra days are expected to be spent in hospitals due to antibiotic resistance each year between 2015 and 2050.[3]

Germany can stem the health and economic burden of hospital-acquired infections by scaling up investments in infection prevention and control measures.

Improving hand hygiene at health facilities offers an excellent investment to lessen the health burden of hospital-acquired infections by preventing more than 1 300 deaths per year. This intervention can reduce the use of hospital resources by avoiding more than 173 900 extra days spent in hospitals each year between 2015 and 2050.[3]

Enhancing environmental hygiene can provide similar health gains by preventing more than 1 200 deaths annually. More than 135 300 extra days spent in hospitals can be avoided by scaling up environmental hygiene practices in hospital settings.[3]

Both interventions can reduce the financial burden of AMR by generating savings that offsets the cost of implementation. Each year, improving hand hygiene is associated with savings almost EUR 1.2 (USD 1.6 PPP) per capita, whereas enhancing environmental hygiene can result in saving almost EUR 0.1 (USD 0.1 PPP) per capita.[3] More broadly, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programmes and enhanced environmental hygiene can help save 14 life years every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate savings that are about 2.3 times bigger than the implementation costs.[3]

Country profile: Italy

Key messages

- Italy does not currently have a national programme for IPC but there is a plan to establish one within the national plan for prevention of infections and antibiotic resistance (PNCAR 2017-2020 and the updated draft version of PNCAR 2022–2025). Furthermore, some IPC core components are covered by the AMR national plan.
- Overall, according to various assessments, the level of IPC implementation can be considered intermediate.
- Recently, Italy has established a new national digital system for the notification of infectious diseases by law (Ministerial Decree 8 March 2022, published on 7 April 2022) which updates and strengthens the previous one and also includes HAIs. Although the new system has already been launched, the HAI section has not been activated yet, but this is planned for 2023.
- Two active national networks collect and analyse data on HAIs in ICUs; meanwhile in three regions, there are surveillance systems for surgical site infections (SSI).
- Among European countries, Italy has one of the highest prevalence of infections due to antibiotic-resistant bacteria, posing a major challenge to the health system since antibiotic resistance is expected to cause nearly 10 800 deaths each year between 2015 and 2050.
- Italy regularly participates in the ECDC PPS on HAIs and some regions conduct PPS even more frequently. In the context of the 2016-ECDC PPS, a HAI prevalence of 8.0% was estimated in Italy – higher than the average prevalence of 5.9% for EU/EEA countries.
- The creation of an active national IPC programme supported by a dedicated budget and a trained and full-time team is recommended to strengthen and sustain the prevention and surveillance of HAIs and AMR.
- National IPC guidelines produced by the Ministry of Health are not available yet, but WHO guidelines have been translated and disseminated and other IPC guidelines have been developed by national professional societies. Regular guidelines update and implementation should be ensured by providing content and support for IPC health workers training at the facility level.
- The impact of IPC training should be assessed through a specific monitoring and evaluation system.
- A multidisciplinary technical group and a system for HAI surveillance should be established at the national level and the national IPC focal point/team should be trained in HAI surveillance.
- The national IPC focal point/team should be trained in implementation science and IPC multimodal improvement strategies and provide support for their implementation at the facility level.
- A strategic plan for IPC monitoring should be developed, including establishing an integrated system for collection and analysis of data and defining a minimal set of IPC core indicators for health care facilities. Mechanisms are needed to train IPC auditors.
- Without an effective policy response, Italy is projected to spend nearly EUR 319 million (USD 487.8 million PPP) each year between 2015 and 2050 for treating infections caused by resistant organisms, corresponding to about EUR 5.5 (USD 8.5 PPP) per capita. Increased length of stay in hospitals is a key driver of health expenditures related to AMR. On average, more than 1.3 million extra days are expected to be spent in hospitals due to antibiotic resistance each year between 2015 and 2050.
- Improving hand hygiene and enhancing environmental hygiene practices in health care facilities offer cost-effective options with notable health and economic benefits to tackle HAIs in Italy.

The burden of HAIs and AMR in health care

Although a nationwide system for HAI surveillance does not exist in Italy, surveillance is conducted in some regions. Furthermore, the country has always participated in the ECDC PPS on HAIs and contributes to the European surveillance resistance data produced by hospital-based laboratory networks annually in the context of EARS-Net. In 2016, in the context of the ECDC study on HAI[8], a prevalence of 8.0% was found in Italy[66] whereas in EU/EEA members the average prevalence was 5.9%. This was also a higher prevalence than found in 2011, when the first Italian survey reported a HAI prevalence of 6.3%.[67]

Furthermore, a nationwide study evaluating the burden of HAIs estimated a total of 641 065 (95% uncertainty interval, UI 585 543.00–699 207.90) new annual cases of HAIs and 29 375 (95% UI 23 705.97–35 905.80) deaths in Italy in 2016. The total annual disability-adjusted life years (DALYs) were estimated to be 424 657.45 (95% UI 346 240.35–513 357.28), corresponding to 702.53 DALYs (95% UI 575.22–844.66) per 100 000 general population. Bloodstream infections accounted for the majority of DALYs (59%), health care-associated pneumonia for 29%, SSI for 9%, Clostridium difficile infection (CDI) for 2% and urinary tract infections accounted for less than 1% of total DALYs[68]. The majority of total DALYs were attributable to years of life lost (YLLs) (79.7%), indicating that mortality is a more important factor compared with long-term sequelae.[69] These results suggest that HAIs caused a significant burden of disease in 2016 in Italy – similar to that of the highest-ranking noncommunicable diseases.

In line with the Commission Implementing Decision (EU) 2018/945, the Ministry of Health included HAIs in the list of diseases subject to notification by the Ministerial Decree of 7 March 2022 "Revision of the reporting system for infectious diseases (Premal)" (published 7 April 2022).

Although a nationwide system for HAI surveillance is not yet in place in Italy, systems for surveillance of selected HAIs exist in three regions. For instance, the surveillance system of SSI (SIChER) in the Emilia-Romagna region (around 4.5 million inhabitants), reported 1205 infections in 2020, corresponding to a 1.2% global risk of infection.[70]

Furthermore, two active national networks collect and analyse data on HAIs in ICUs (SPIN-UTI and GiViTI). SPIN-UTI reported 757 HAIs acquired in the ICU among 2477 patients observed in the period October 2020–March 2021. Almost half of the SPIN-UTI patients died in the hospital (45.4%) within the ICU (42.6%). The overall length of hospitalization in the hospital was 51 869 days, with an average of 22.9 days (median 17; range 1–196 days). The infections registered by SPIN-UTI were: pneumonia (PN: 415 infections; 54.8%), bloodstream infections (BSI: 122 infections; 16.12%), urinary tract infections (UTI, urinary tract infection: 112 infections; 14.8%), infections related to the central venous catheter (CVC-

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[66] Secondo studio di prevalenza italiano sulle infezioni correlate all'assistenza e sull'uso di antibiotici negli ospedali per acuti – protocollo ECDC. Turin: Dipartimento Scienze della Salute Pubblica e Pediatriche, Universita` di Torino; 2018 (www.salute.gov.it/imgs/C_17_pubblicazioni_2791_allegato.pdf, accessed 29 September 2022).

[67] Studio di prevalenza italiano su infezioni correlate all'assistenza e uso di antibiotici negli ospedali per acuti e rapporto nazionale. Bologna: Agenzia Sanitaria e Sociale Regionale e Regione Emilia-Romagna; 2012 (http://assr.regione.emilia-romagna.it/it/servizi/pubblicazioni/rapporti-documenti/studio-di-prevalenzaeuropeo-sulle-infezioni-correlate-allassistenza-e-sulluso-diantibiotici-negli-ospedali-per-acuti)

[68] Antimicrobial resistance surveillance in Europe 2022 – 2020 data. Stockholm: European Centre for Disease Prevention and Control; 2022 (https://www.ecdc.europa.eu/en/publications-data/antimicrobial-resistance-surveillance-europe-2022-2020-data, accessed 29 September 2022).

[69] Bordino V, Vicentini C, D'Ambrosio A, Quattrocolo F, Novati R, Sticchi C et al. Burden of healthcare-associated infections in Italy: incidence, attributable mortality and disability-adjusted life years (DALYs) from a nationwide study, 2016. J Hosp Infect. 2021;113:164–71.

[70] Sorveglianza delle infezioni del sito chirurgico in Emilia-Romagna. Interventi dal 1-1-2020 al 31-12-2020. SIChER. Bologna: Agenzia Sanitaria e Sociale Regionale e Regione Emilia-Romagna; 2021.

related infection, CRI: 108 infections; 14.3%).[71] In 2020, GIVITI registered 15 647 infected patients (46%) out of 34 021 observed. Overall, 13 714 (40.3%) were infected at the time of admission only, while 1860 (5.4%) were also infected during their hospitalization among the infected patients, 30.8% had no sepsis, 40.6% experienced sepsis and 28.6% had septic shock.[72]

In order to pilot a national system for HAI surveillance, the Ministry of Health launched a two-year project in 2020 in collaboration with Istituto Superiore di Sanità, the National Public Health Institute, with the objective of strengthening existing surveillance and promoting the participation of all regions in SSI and ICU surveillance. Pilot surveillance of *C. difficile* and of MRSA and national monitoring of alcohol-based hand-rub consumption at the hospital level were launched in 2022. Moreover, in November 2022 a number of Italian acute-care hospitals will participate in the ECDC PPS-3 on HAIs.

Furthermore, in the period October 2020–July 2022, a surveillance system to monitor the number of SARS-CoV-2 cases in long-term health care facilities (LTCF) has been in place and is ongoing, reporting data from an average of 714 facilities (range 629–793) per week in 8 out of the 21 Italian regions. The average number of the new confirmed SARS-CoV-2 cases reported among the LTCF residents was 254 (range 0–1189) per week; the average number of new deaths from any cause among COVID-19 cases in LTCF residents was 6.2 (range 0–33) per week; the average number of new deaths in LTCFs from any cause among COVID-19 cases among LTCF residents was 15.0 (range 0–89) per week (Source: ISS/MoH, unpublished).

Among European countries, Italy has one of the highest prevalence of infections due to antibiotic-resistant bacteria, which are the most frequent causes of HAIs.[18,19]

Status of the national IPC programme: intermediate level of progress and need for further improvement to be in line with the WHO-recommended core components for IPC

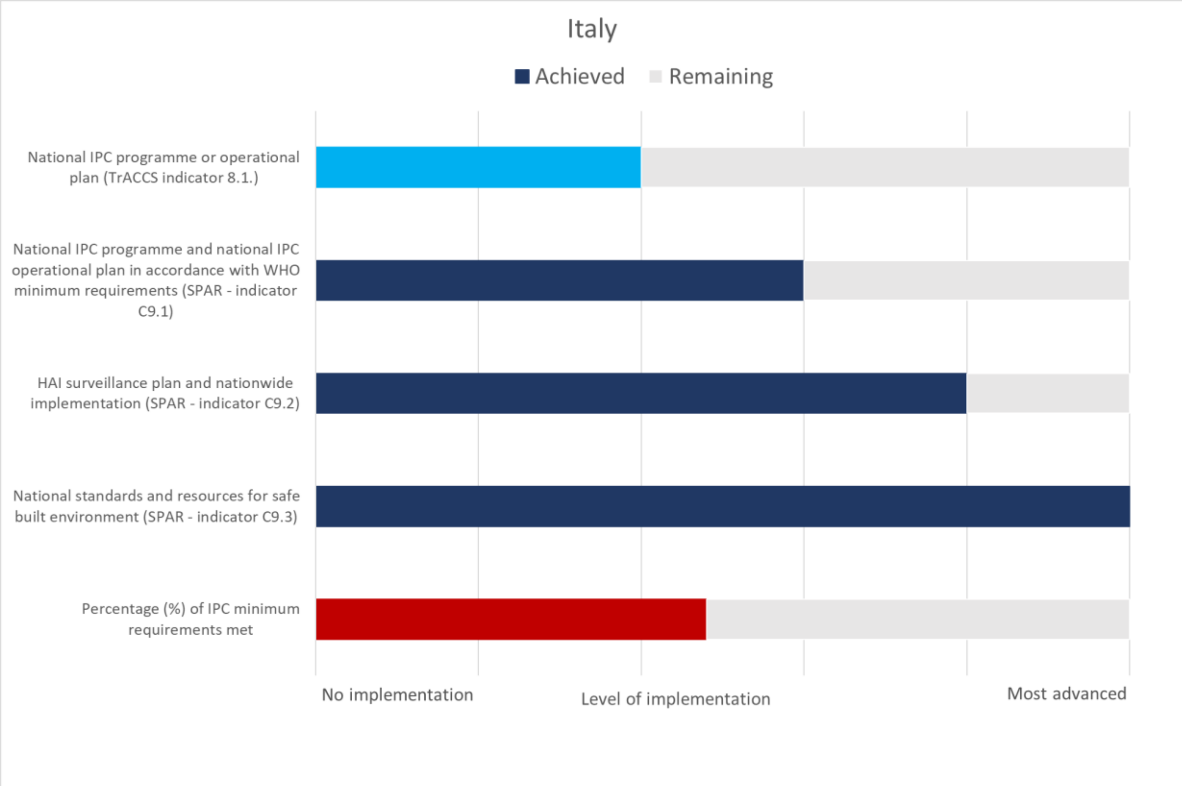
National level

According to annual WHO assessments, Italy reports an intermediate level of IPC implementation at the national level (Figure 15). The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicated that 12 out of 25 (48%) IPC minimum requirements are met. These results indicate that IPC programme in Italy needs further improvement for it to be in line with the WHO-recommended core components for IPC.

[71] Sorveglianza attiva Prospettica delle Infezioni Nosocomiali nelle Unità di Terapia Intensiva (UTI) – Risultati finali. Risultati del Progetto SPIN-UTI 2020–2021. Rome: Società Italiana de Igiene; 2021 (https://www.epicentro.iss.it/infezioni-correlate/pdf/REPORT%20SPIN-UTI%202020-2021.pdf, accessed 29 September 2022).

[72] GIVITI, Report 2021. Bergamo: Gruppo Italiano per la Valutazione Degli Interventi in Terapia Intensiva; 2021 (https://giviti.marionegri.it/portfolio/infezioni/#ssfa-meta-container-2555, accessed 29 September 2022).

Figure 15. National-level IPC implementation results in Italy according to global surveys



Notes: TrACCS survey is for the years 2017-2021; SPAR survey is for the year 2021; WHO global survey on IPC minimum requirements at the national level is for the year 2021 – 2022. All questions extracted from TrACCS, and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized as having no implementation with respect to that indicator whereas countries that reported the highest rating were categorized as achieving the most advanced stage of implementation.

Facility level

In 2007–2008 a strong national hand hygiene campaign was launched in Italy in collaboration with WHO, leading to an increase in hand hygiene compliance from 40% to 63% (absolute increase: 23%, 95% CI: 22–24%). This improvement was found to be sustained in 44 of 48 facilities assessed in 2017; these scored advanced/intermediate hand hygiene compliance that was between 51% and 80%.[73]

In 2019, 236 Italian hospitals participated in the WHO Hand hygiene Self-assessment Framework (HHSAF) survey.[74] The average score (348/500) indicated an intermediate level of progress in implementing the recommended standards for hand hygiene. The lowest score was found for hand hygiene training and the implementation of a patient safety climate/culture supportive of hand hygiene performance. The highest scores were reported for the existence of infrastructures and supplies for performing hand hygiene, availability of guidelines, reminders and communications on hand hygiene.

[73] Moro ML, Morsillo F, Nascetti S, Parenti M, Allegranzi B, Pompa MG, Pittet D. Determinants of success and sustainability of the WHO multimodal hand hygiene promotion campaign, Italy, 2007–2008 and 2014. Euro Surveill. 2017;22(23):pii=30546. DOI: http://dx.doi.org/10.2807/1560-7917.ES.2017.22.23.30546

[74] de Kraker MEA*, Tartari E*, Tomczyk S, Twyman A, Francioli LC, Cassini A, et al. Implementation of hand hygiene in health-care facilities: results from the WHO Hand Hygiene Self-Assessment Framework global survey 2019. Lancet Infect Dis 2022;22: 835–44.

In the context of the same WHO global survey, participating hospitals also completed the WHO IPCAF.[32] The average score (637/800) indicated an advanced level of progress in implementing the recommended core components (CCs) for IPC (in 236 participating hospitals). “CC 3 Education and Training” scored the lowest, followed by “CC5 Multimodal strategies for implementation of IPC”. The highest scores were reported for “CC8 Built environment, materials and equipment for IPC” followed by “CC2 IPC guidelines”.

Gaps identified

The following gaps have been identified, in relation to the WHO-recommended minimum requirements for IPC at the national level (Table 1):[38]

- Despite a number of IPC minimum requirements are being fulfilled at the national level, an active national programme for IPC leading on all the core functions has not yet been established in Italy. This is also reflected on the fact that there is no protected and dedicated budget for IPC. However, some IPC core components are covered within the national plan for AMR.
- Although there is an appointed focal point for IPC in the context of the AMR national action plan, this professional is not full time dedicated to IPC.
- National IPC guidelines are not available. However in 2006, the WHO recommendations and implementation tools on hand hygiene in health care were translated into Italian by the Ministry of Health and are widely implemented. Furthermore, the WHO “Guidelines for the prevention and control of carbapenem-resistant Enterobacteriaceae, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* in health care facilities” and the related implementation manual were translated into Italian and published on the website of the Ministry of Health. In addition, national professional societies have translated the WHO guidelines on the core components for IPC programmes and published a national guideline on the evaluation of the process for environmental cleaning in health-care settings. There is no mechanism for guidelines adaptation and implementation through standard operating procedures to reflect local conditions.
- Important gaps have been identified in the context of IPC training, including lack of curriculum and guidance for in-service IPC training at the facility level. Further, there is no national system and schedule for monitoring and evaluation of the effectiveness of IPC training and education at least annually.
- It was reported that the national IPC focal point has not been trained in HAI surveillance concepts and methods and implementation science and multimodal improvement strategies for application to IPC. The focal point does not have a role to coordinate/support local implementation of IPC improvement interventions.
- A national system and multidisciplinary technical group for HAI surveillance have not been established. There is no mechanism in place to train IPC auditors. A strategic plan for IPC monitoring should be developed, including establishing an integrated system for collection and analysis of data and defining a minimal set of IPC core indicators for health care facilities.
- The IPCAF survey at health-care facility level identified that the core components of education and training and awareness and implementation of multimodal strategies for IPC interventions are not yet fully accomplished.
- The HHSAF survey at health-care facility level reported gaps in hand hygiene training and the implementation of a patient safety climate/culture supportive of hand hygiene performance highlighting considerable potential for improvement.

Evidence-based national IPC recommendations are planned to be implemented by the end of 2023, in line with the standards, measurement and implementation resources provided by WHO.[42,43,75]

Economic costs associated with AMR

Health and economic impact of AMR in Italy is among the highest across G7 countries (8).

If current antibiotic resistance trends continue as expected, the number of deaths attributable to AMR in Italy is projected to average nearly 10 780 each year from 2015 to 2050. The death toll due to antibiotic resistance is estimated to reach more than 7.6 times the number of deaths caused by tuberculosis, HIV and influenza combined in 2017.[3]

AMR puts non-negligible pressure on the health-care budget in Italy. Health expenditure on antibiotic resistance is estimated to reach EUR 319 million (USD 487.8 million PPP) each year from 2015 to 2050. This figure corresponds to around EUR 5.5 (USD 8.5 PPP) per capita, which is the highest level of health-care spending estimated for antibiotic resistance across G7 countries relative to their population. Increased hospital stay is a key determinant of health-care expenditure associated with AMR. More than 1.3 million extra days are expected to be spent in hospitals for treating resistant infections each year between 2015 and 2050, adding a substantial burden to hospital resources.[3]

Italy stands to make important gains by investing in IPC measures to stem the spread of HAIs.

Scaling up investments in hand hygiene practices in health care facilities could alleviate the health burden attributable to HAIs by preventing more than 7 120 deaths each year between 2015 and 2050. By improving hand hygiene, Italy can also expect to see an annual reduction of almost 576 900 additional days spent in hospitals due to HAIs.[3]

Enhancing environmental hygiene could also play a vital role in tackling resistant and susceptible infections. Investing in this measure can prevent more than 6 700 deaths every year between 2015 and 2050. This measure can also reduce reliance on the use of hospital resources by preventing more than 448 800 additional days being spent in hospitals each year. More broadly, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programs and enhanced environmental hygiene can help save 60.5 life-years for every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate savings that are about 2.1 times bigger than the implementation costs.[3]

[75] Strengthening infection prevention and control in primary care: a collection of existing standards, measurement and implementation resources. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240035249, accessed 29 September 2022).

Country profile: Japan

Key messages

- Japan has an advanced national IPC programme which has demonstrated progress over time in recent years, in line with the WHO recommended core components for IPC and reported nationwide implementation and monitoring of IPC interventions at the health-care facility level.
- Japan has a national system for surveillance of priority HAIs including CLABSI, catheter-associated urinary tract infection (CAUTI) and SSI.
- The creation of a multidisciplinary technical group for IPC monitoring at the national level is suggested to strengthen and sustain the impact of the current IPC programme.
- The national IPC focal point/team should be trained in implementation science and IPC multimodal improvement strategies and HAI surveillance.
- The impact of IPC training should be assessed through a specific monitoring and evaluation system.
- The national IPC programme should review existing guidelines regularly and update them on the basis of current evidence.
- Without effective policy action, the AMR burden in Japan is likely to be considerable. In other G7 countries where the antibiotic resistance rates are similar to those of Japan, organisms resistant to antimicrobials are expected to cause between 3 and 8.4 deaths per 100 000 inhabitants between 2015 and 2050. On average, other G7 countries with AMR burdens similar to that of Japan are expected to spend, around JPY 782–849 (USD 6.6–7.8 PPP) per capita on treating resistant infections, which would correspond to about JPY 83.7–98.3 billion (USD 834–979 million PPP) per year.
- Improving hand hygiene and scaling up environmental hygiene practices in health care facilities offer cost-effective options with notable health and economic benefits to tackle HAIs and AMR in Japan.

The burden of HAIs and AMR in health care

Japan has a national system for HAI surveillance - the Japan Surveillance for Infection Prevention and Healthcare Epidemiology System (J-SIPHE) – since 2019. J-SIPHE coordinates data collection of a range of HAIs (CLABSI, CAUTI and SSI) across 574 hospitals in Japan (as of July, 2022).[76]

The rates of CLABSI were 1.8 per 1000 device-days on critical care wards (58 hospitals) and 1.6 per 1000 device-days on acute general wards (98 hospitals) across Japan from 1 January 2020 to 31 December 2020. The rates of CAUTI were 1.7 per 1000 catheter-days on critical care wards (44 hospitals) and 1.5 per 1000 device-days on acute general wards (78 hospitals) during the same period.[76]

The overall incidence of SSI was reported to be 4.4% in 100 surgical procedures in 786 hospitals in 2020, according to the Japan Nosocomial Infections Surveillance (JANIS) SSI division.[77]

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[76] The Japan Surveillance for Infection Prevention and Healthcare Epidemiology (J-SIPHE). [website] Tokyo: National Center for Global Health and Medicine (https://j-siphe.ncgm.go.jp, accessed 30 September 2022).

[77] Japan Nosocomial Infections Surveillance (JANIS). [website] Tokyo: Ministry of Health, Labour and Welfare (https://janis.mhlw.go.jp, accessed 30 September 2022).

An annual report from the Japan Healthcare-associated Infections Surveillance (JHAIS), another surveillance system led by the Japanese Society for Infection Prevention and Control (JSIPC), reported the rate of ventilator-associated pneumonia (VAP) as 2.0 per 1000 ventilator-days in ICUs across 68 hospitals between 2019 and 2021.[78]

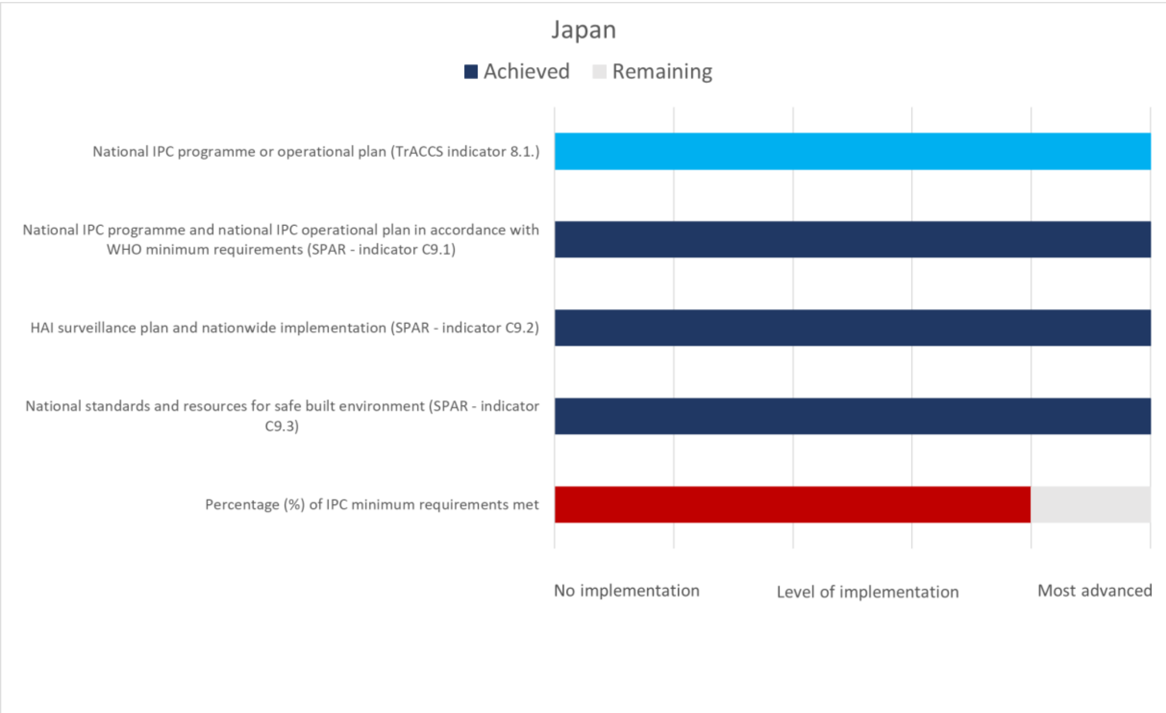
An annual report of the JANIS Antimicrobial-Resistant Bacterial Infection division reported that the proportion of infections caused by resistant bacteria (i.e. the number of newly infected patients divided by the total number of newly hospitalized patients) in 923 hospitals in 2020 was 0.279% for MRSA and 0.009% for carbapenem-resistant Enterobacteriaceae (CRE), respectively.[77]

Status of IPC implementation: advanced, mostly in line with the WHO-recommended core components for IPC

National level

According to annual WHO assessments, Japan reported an advanced level of IPC implementation at the national level (Figure 16), mostly in line with the WHO-recommended core components for IPC. The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicated that 20 out of 25 (80%) IPC minimum requirements are met.

Figure 16. National level IPC implementation results in Japan according to global surveys



Notes: Notes: TrACCS survey is for the years 2020-2021; SPAR survey is for the year 2021; WHO global survey on IPC minimum requirements at the national level is for the year 2021 – 2022. All questions extracted from TrACCS, and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized has having no implementation with respect to that indicator whereas countries reported the highest rating were categorized as achieving the most advanced stage of implementation.

[78] Japan Healthcare-associated Infections Surveillance (JHAIS). [website] Tokyo: Japanese Society for Infection Prevention and Control (http://www.kankyokansen.org/modules/iinkai/index.php, accessed 30 September 2022).

Facility level

Sixty hospitals in Japan participated in the WHO global survey on infection prevention and control and fully/partly completed the IPCAF in 2019.[32] Tertiary and secondary hospitals were scored as "advanced" (median scores of 715 and 623, respectively) while primary hospitals scored as "intermediate" (median score of 522).

Compared to the other core components of IPC, Core Component 5 "multimodal strategies" and Core Component 6 "Monitoring and Feedback" scored lower (median scores of 65 and 70, respectively). These data should be interpreted with caution given the small sample size.

Gaps identified

Despite the very advanced level of IPC implementation, the following gaps have been identified, in relation to the WHO-recommended minimum requirements for IPC at the national level (Table 1):[38]

- Having a multidisciplinary technical group and thus, a system for IPC monitoring at the national level is yet to be achieved.
- Although national IPC guidelines are available, they are not reviewed at least once every five years and updated to reflect the current evidence base.
- It was reported that the national IPC focal point has not been trained in HAI surveillance concepts and methods and implementation science and multimodal improvement strategies for application to IPC. A multidisciplinary technical group for HAI surveillance has not been established yet.
- Furthermore, it was reported that there is no national system for monitoring and evaluating effectiveness of IPC training and education at least annually.
- At the national level, a multimodal strategy is considered important to further implement the IPC programme.
- According to the WHO global survey on IPC core components at the health-care facility level, multimodal strategies for implementing IPC interventions, monitoring/audit of IPC and providing feedback require further improvement to strengthen IPC activities further.

Economic costs associated with AMR

Much like other G7 countries, Japan faces considerable health and economic costs associated with AMR.

Without effective policy action, the AMR burden in Japan is likely to be considerable. In other G7 countries where the antibiotic resistance rates are similar to those of Japan, organisms resistant to antimicrobials are expected to cause between 3 and 8.4 deaths per 100 000 inhabitants between 2015 and 2050[3].

In this period, Japan can incur considerable health expenditure due to AMR. On average, other G7 countries with AMR burden similar to that of Japan are expected to spend around JPY 782–849 (USD 6.6–7.8 PPP) per capita on treating resistant infections, which would correspond to about JPY 83.7–98.3 billion (USD 834–979 million PPP) per year while accounting for Japan's population in 2020. As in other G7 countries, AMR is likely to put additional pressure on hospital resources in Japan. In G7 countries where the AMR burden is similar to that of Japan, the number of additional days spent in the hospital due to antibiotic resistance averages between 722 and 1140 per 100 000 inhabitants each year between 2015 and 2050.[3]

Investing in infection prevention and control interventions is vital for Japan to limit the health and economic burden of health care-associated infections.

Similar to the situation in other G7 countries, investments in Japan to improve hand hygiene practices in health facilities can reduce the risk of death by preventing resistant and susceptible infections. The findings from the OECD model suggests that, in other G7 countries with an AMR profile similar to that of Japan, reductions in mortality associated with this intervention ranged between 4.6 and 5.3 deaths per 100 000 inhabitants every year. This would correspond to about 5 736–6 706 deaths per year after accounting for Japan's population in 2020. By investing in this intervention Japan can also expect to reduce reliance on hospital resources. In G7 countries with a similar AMR burden, this intervention was associated with a reduction in the number of additional days spent in hospital of between 270 and 544 per 100 000 inhabitants annually between 2015 and 2050.[3]

Enhancing environmental hygiene in health facilities offers another high value investment for Japan. In other G7 countries with a similar AMR burden, investments in this intervention have been shown to avoid between 4.2 to 5 deaths per 100 000 inhabitants each year, corresponding to about 5 270–6 270 deaths per year based on Japan's population in 2020. Further, this intervention was shown to prevent some 210–423 additional days per 100 000 inhabitants spent in hospitals each year between 2015 and 2030.[3]

Both interventions generate considerable savings in health-care expenditure that largely offset the cost of implementation. Across G7 countries with similar AMR burdens, improving hand hygiene yields average net savings of around JPY 442–512 per capita (USD 4.4–5.1 PPP) each year, whereas net savings associated with enhancing environmental hygiene averages around JPY 10–20 (USD 0.1–0.2 PPP) per capita In addition, across G7 countries that has an AMR burden similar to Japan, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programmes and enhanced environmental hygiene is estimated to save, on average, 26 life years every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate savings that are about 2.4 times bigger than the implementation costs.[3]

Country profile: United Kingdom

Key messages

- The United Kingdom has a very advanced national IPC programme, based within the four countries, in line with the WHO-recommended core components for IPC and reported nationwide implementation and monitoring of IPC interventions at the health-care facility level.
- Trends in reported HAIs were impacted by waves of COVID-19 which affected care delivery; however, some HAIs – MRSA and *E. coli* bacteraemia (ECB) – across the four countries are returning to pre-pandemic levels.
- The impact of IPC training should be assessed through a specific monitoring and evaluation system, with a mechanism to train auditors.
- The national programmes should consider the integration of hand hygiene compliance data with their robust reporting mechanisms already in place and use hand hygiene compliance as a key national indicator, at the very least for reference hospitals.
- Without effective policy response, around 2 120 deaths are expected to occur in the United Kingdom each year due to resistant infections between 2015 and 2050. This figure corresponds to about 1.3 times that of the number of deaths in 2019 due to tuberculosis, HIV and influenza combined.
- AMR is expected to impose a substantial burden on the United Kingdom's health-care budget. Annual health expenditure due to treating infections caused by resistant organisms is projected to exceed GBP 104.8 million from 2015 to 2050, equivalent to an average of GBP 1.5 per capita each year.
- Of the interventions that have been evaluated, investments in improving hand hygiene, enhancing environmental hygiene and strengthening stewardship can yield savings which offset the cost of these interventions. Investing in the workforce has the potential to significantly improve IPC practice.

The burden of HAIs and AMR in health care

Surveillance of HAIs is undertaken in the four United Kingdom countries, although direct comparison of rates is limited by differences in methodologies. There are objectives in each country to reduce the rates of HAIs with a focus on ECB and carbapenemase-producing Enterobacterales both of which have an increased incidence across the United Kingdom in recent years. These data are published on a quarterly[79] and annual basis.[80]

[79] MRSA, MSSA, Gram-negative bacteraemia and CDI: quarterly report. London: UK Health security Agency; last updated July 2022 (https://www.gov.uk/government/statistics/mrsa-mssa-gram-negative-bacteraemia-and-cdi-quarterly-report, accessed 14 September 2022).

[80] MRSA, MSSA and Gram-negative bacteraemia and CDI: annual report. London: UK Health Security Agency; last updated September 2021 (https://www.gov.uk/government/statistics/mrsa-mssa-and-e-coli-bacteraemia-and-c-difficile-infection-annual-epidemiological-commentary, accessed 14 September 2022).

The United Kingdom's five-year national action plan for tackling AMR (2019–2024)[81] includes a commitment to use national measurement tools to identify opportunities for the greatest impact and to benchmark, target and inform individual organizations and practices. The United Kingdom's 20-year vision on AMR[82] is to have a zero tolerance of avoidable infection in human health-care settings.

A brief overview of the current burden for the four countries that make up the United Kingdom is provided below:

- **Scotland:** In a recent quarterly epidemiological report issued July 2022, no national health service (NHS) board was above the normal variation for health care or community-associated *Clostridioides difficile* infection (CDI), ECB and *Staphylococcus aureus* bacteraemia (SAB) when analysing trends over the past three years.[83] SSI surveillance was on pause due to support for the COVID-19 response.
- **England:** Incidence of MRSA bacteraemia generally decreased during the pandemic period; however, peaks in incidence were observed during the COVID-19 waves. MRSA rates for May–July 2022 were around one tenth lower than in the same pre-pandemic period in 2019. CDI increased overall throughout the pandemic with May–July 2022 case numbers approximately one fifth higher than the same period in 2019. Long-term increases in ECB incidence had begun to slow before the pandemic, although during the pandemic substantial reductions were observed especially in community onset cases. ECB incidence has subsequently increased although it is below that observed pre-pandemic (case numbers one seventh lower in May–July 2022 versus the same period in 2019). The number of *Pseudomonas aeruginosa* and *Klebsiella* spp. bacteraemia cases reduced at outset of the COVID-19 pandemic, although over the course of the pandemic numbers returned or exceeded those seen in 2019, with peaks of infection coinciding with COVID-19 activity.[84] SSI and ICU surveillance continued throughout the pandemic.
- **Wales:** Long-term decreasing trends in MRSA bacteraemia and CDI have been interrupted by the changes in health-care delivery during the pandemic and have yet to stabilize. Prior to the pandemic, small decreases had been achieved in ECB reversing long-term increasing trends. Large reductions in ECB were observed during the pandemic period, and incidence has yet to return to pre-pandemic levels.[85] Surveillance of these organisms as well as *P. aeruginosa* and

[81] Tackling antimicrobial resistance 2019–2024. The UK's five-year national action plan. London: HM Government; 2019 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1070263/UK_AMR_5_year_national_action_plan.pdf, accessed 15 September 2022).

[82] Contained and controlled. The UK's 20-year vision for antimicrobial resistance. London: HM Government; 2019 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/773065/uk-20-year-vision-for-antimicrobial-resistance.pdf, accessed 15 September 2022).

[83] Clostridioides difficile infection, Escherichia coli bacteraemia, Staphylococcus aureus bacteraemia and surgical site infection in Scotland, January to March 2022. Glasgow: Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Scotland; 2022 (https://hpspubsrepo.blob.core.windows.net/hps-website/nss/3243/documents/1_2022-07-05-SAB-CDI-EColi-SSI-Infections-Q1-2022-Report.pdf, accessed 18 September 2022).

[84] Annual epidemiological commentary: gram-negative bacteraemia, MRSA bacteraemia, MSSA bacteraemia and C. difficile infections, up to and including financial year April 2020 to March 2021. London: UK Health Security Agency; 2021 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1016843/Annual_epidemiology_commentary_April_2020_March_2021.pdf, accessed 14 September 2022).

[85] Healthcare associated infections (HCAI). [website] Cardiff: Public Health Wales (https://phw.nhs.wales/services-and-teams/harp/healthcare-associated-infections-hcai/, accessed 30 September 2022).

Klebsiella spp. bacteraemia continued throughout the pandemic. SSI surveillance is in the process of restarting following a pause for the pandemic response.

- **Northern Ireland:** In general, rates of MRSA bacteraemia (per 1000 occupied bed days) have shown a decreasing trend from 2015 to 2022, while meticillin-sensitive *Staphylococcus aureus* bacteraemia appear to be increasing, CDI infection rates (per 1000 occupied bed days) have shown a fluctuating but upward trend from 2017 to 2022, with the peak rates in Quarter 2 of 2021. The pandemic appears to have affected the typical seasonal variation of CDI rates. Gram-negative bloodstream infections rates have remained relatively stable between 2018 and 2022, with the majority having *E. coli* as the causative organism, followed by *Klebsiella spp*. and then *Pseudomonas spp*. Northern Ireland appears to have proportionately lower numbers of CPE cases (colonizations and infections) than the Republic of Ireland or other UK nations. Annual case numbers were increasing prior to the pandemic – peaking in 2019, then dropping off sharply in 2020 and 2021. However, the number of cases reported so far in 2022 indicated that Northern Ireland is now approaching pre-pandemic levels.

Status of IPC implementation: very advanced, mostly in line with the WHO-recommended core components for IPC

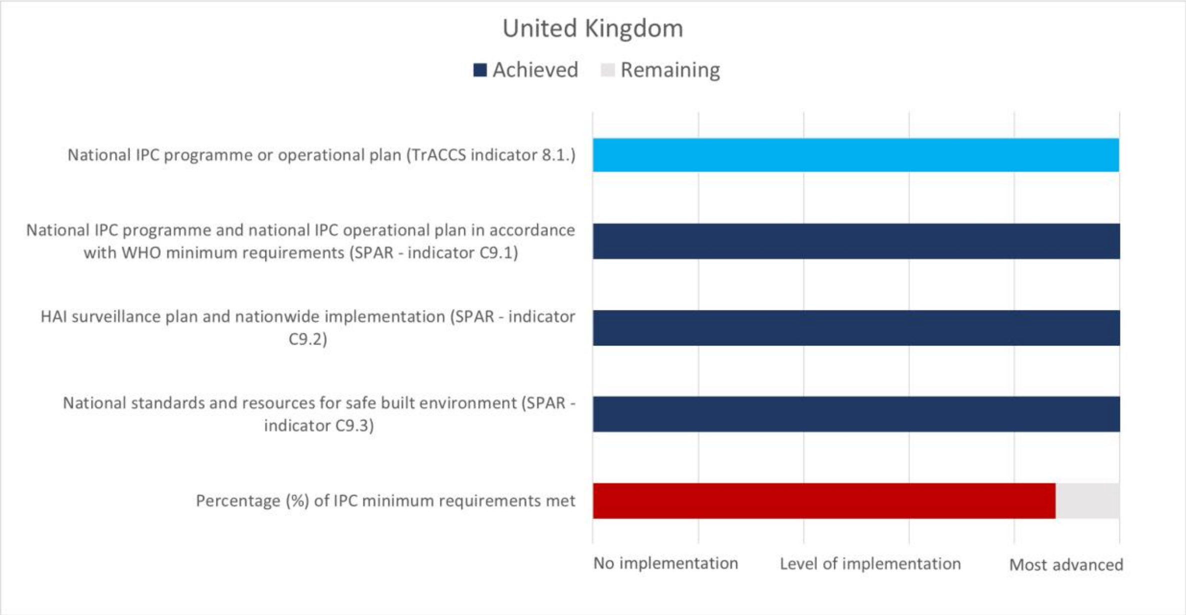
National level

According to annual WHO assessments, the United Kingdom reported a very advanced level of IPC implementation at the national level (Figure 17), mostly in line with the WHO-recommended core components for IPC. The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicated that 22 out of 25 (88%) IPC minimum requirements are met.

Health policy is devolved across the four countries of the United Kingdom, and the importance of strengthening IPC is emphasized in the UK five-year national action plan for tackling AMR (2019–2024)[81] as is the need to ensure that IPC programmes and activities are aligned to the WHO core components. Data are used across the four countries to identify effective interventions that will bring about the greatest impact in terms of IPC in relation to patient safety. These data also inform quality improvement initiatives at national, regional and local levels.

Work is underway to support the growth of a resilient workforce with strong leadership skills and the ability to lead, challenge and implement safe standards of IPC practice. National programmes support the dissemination and implementation of evidence-based learning strategies that are most likely to bring about behavioural change.

Figure 17. National level IPC implementation results in the United Kingdom according to global surveys



Notes: TrACCS survey is for the years 2020-2021; SPAR survey is for the year 2021; WHO global survey on IPC minimum requirements at the national level is for the year 2021–2022. All questions extracted from TrACCS, and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized has having no implementation with respect to that indicator whereas countries reported the highest rating were categorized as achieving the most advanced stage of implementation.

Facility level

Each of the four UK countries has processes and systems in place to support health and care organizations to implement IPC programmes and monitor trends of HAIs. Locally available facility-level data provide context in terms of risk factors and epidemiology. This process is enhanced by national and regional technical expertise in all aspects of IPC and HAI where appropriate.

Gaps identified

Despite the very advanced level of IPC implementation, the following gaps have been identified, in relation to the WHO-recommended minimum requirements for IPC at the national level (Table 1):[38]

- It was reported that there is no national system for monitoring and evaluating effectiveness of IPC training and education at least annually.
- There is no single mechanism to train national and local auditors, although appointed IPC focal points would have to have undertaken appropriate specialist training.
- Hand hygiene compliance data are not collected nationally although this is monitored and fed back at facility level as part of continuous quality improvement in IPC.

Economic costs associated with AMR

The United Kingdom will incur substantial health and economic costs due to AMR.

Without effective policy response, around 2 120 deaths are expected to occur in the United Kingdom each year due to resistant infections between 2015 and 2050. This figure corresponds to about 1.3 times the number of deaths in 2019 due to tuberculosis, HIV and influenza combined.[3,86]

AMR is expected to impose a substantial burden on the health-care budget in the United Kingdom. Annual health expenditure due to treating infections caused by resistant organisms is projected to exceed GBP 104.8 million (USD 151.3 million PPP) from 2015 to 2050, equivalent to GBP 1.5 (USD 2.17 PPP) per capita each year. Infections caused by resistant organisms will also add pressure on the use of hospital resources, with additional hospital days attributable to resistant bacterial infections expected to average around 339 500 each year between 2015 and 2050.[3]

IPC interventions can be excellent investments to stem the impact of hospital acquired infections in the United Kingdom.

In the United Kingdom, improving hand hygiene in health-care settings can help prevent more than 1 300 deaths annually between 2015 and 2050. Further, this measure can avert more than 119 200 extra days spent in hospital every year, alleviating the burden on hospital resources.[3]

Enhanced environmental hand hygiene practices in health-care settings offers another effective means to lessen the deleterious effects of hospital-acquired infections on population health by averting more than 1230 deaths every year. This measure can also lessen the pressure on the use of hospital resources by preventing almost 92 800 extra days spent in hospitals each year between 2015 and 2050.[3]

Investments in improving hand hygiene and enhancing environmental hygiene can yield savings which offset the cost of these interventions. Annual savings associated with improved hand hygiene are expected to average around GBP 1.0 (USD 1.46 PPP) per capita between 2015 and 2050, whereas enhancing environmental hygiene can lead to saving around GBP 0.1 (USD 0.2 PPP) per capita each year.[3] More broadly, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programmes and enhanced environmental hygiene can help save 11 life years every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate savings that are about 2.7 times bigger than the implementation costs.

[86] OECD. (2022). *Health Status: Causes of mortality.* Retrieved from stats.oecd.org

Country profile: United States of America

Key messages

- The United States has a very advanced national IPC programme, based within the United States Centers for Disease Control and Prevention (US-CDC). This has demonstrated progress over time in recent years, in line with the WHO-recommended core components for IPC, and has reported nationwide implementation and monitoring of IPC interventions at the health-care facility level.
- Despite this advanced status of IPC, the spread of infection and AMR in health-care settings remains a relevant patient safety problem. US-CDC estimates that, on any given day, one in 31 hospital patients and one in 43 nursing home residents has a HAI.
- Since the outset of the COVID-19 pandemic, the burden of HAIs increased considerably, threatening the gains made before the pandemic.
- During the COVID-19 pandemic, significant increases in standardized infection ratios (SIRs) for CLABSIs, CAUTIs, ventilator-associated events (VAEs), and hospital-onset MRSA bacteraemia were observed compared to the pre-pandemic period. Investigations about the determinants of these increases are ongoing to ensure that effective strategies and interventions are implemented.
- According to the gaps identified, ongoing monitoring and evaluation of IPC training at the national, state, territorial and local levels (conducted by those responsible for programme implementation) would be additional important components of ensuring the quality of health care and the safety of patients and health-care personnel.
- In the same period, the United States is expected to incur the highest level of health expenditure due to antibiotic-resistant infections across G7 countries – around USD 2.7 billion annually.
- Implementation of IPC and antibiotic stewardship, and other health care quality and patient safety best practices in health
- care facilities, offers cost-effective options with notable health and economic benefits to stop the spread of AMR and pathogens in health care.

The burden of HAIs and AMR in health care

The National Healthcare Safety Network (NHSN) is the United States's most widely used HAI tracking system, covering 38 000 health care facilities, and providing facilities, states, regions, and the nation with data to identify problem areas, measure progress of prevention efforts and reduce the burden of HAIs and AMR in the United States. A complementary system, the Emerging Infections Program (EIP) Healthcare-Associated Infections – Community Interface (HAIC) activity engages a network of state health departments and their academic medical centre partners to help answer critical questions about HAI threats, advanced infection tracking methods and AMR in the United States. Additional data sources, such as electronic health records data, are also used to support analyses of the HAI and AMR burden.

US-CDC estimates more than 2.8 million antimicrobial-resistant infections occur in the United States every year, and more than 35 000 die as a result.[87] On average, one in 31 hospital patients and one in 43 nursing home residents has an HAI.[88]

In the pre-pandemic period, the United States reduced the burden of AMR and HAIs in health care. In 2015, it was reported that 3.2% of 12 299 patients in 199 hospitals in the United States had an HAI, which was significantly lower than in 2011 (4.0%, P=0.003).[89] In US-CDC's 2019 *Antibiotic resistance threats in the United States*, there were 28% fewer deaths from AMR in hospitals and 18% fewer deaths overall since 2013.[87]

However, the progress made has been threatened by the COVID-19 pandemic. Data show an alarming increase in antimicrobial-resistant infections starting during hospitalization, growing at least 15% from 2019 to 2020.[90] A 2022 report on the impact of COVID-19 on HAI showed significantly higher SIRs in 2021 for CLABSIs, CAUTIs, VAEs, and hospital-onset MRSA bacteraemia than during the pre-pandemic period (2019), particularly during quarters one (Q1) and three (Q3) (see Table A A.1). Most US studies show that *Clostridioides difficile* infections decreased or plateaued during the COVID-19 pandemic.[91]

Table A A.1. Percentage increase in SIR in 2021-Q1 and Q3 compared to 2019-Q1 and Q3

HAI type	% increase in Q1 2021	% increase in Q3 2021
VAE	51%	60%
CLABSI	45%	48%
MRSA	39%	45%
CAUTI	11.5%	14%

CAUTI: catheter-associated urinary tract infection; CLABSI: central line-associated bloodstream infection; HAI: health care-associated infection; MRSA: meticillin-resistant Staphylococcus aureus; Q1: quarter 1; Q3: quarter 3; SIR: standardized infection ratios; VAE: ventilator-associated events.

Status of the national IPC programme: very advanced, in line with the WHO-recommended core components for IPC

National level

According to annual WHO assessments, the United States reported a very advanced level of IPC implementation at the national level, in line with the WHO-recommended core components for IPC. (Figure 18). The recent completion of the more detailed tool assessing the IPC minimum requirements at national level (Table 1)[38] indicated that 23 out of 25 (92%) IPC minimum requirements are met.

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[87] Antibiotic resistance threats in the United States. Atlanta (GA): Centers for Disease Control and Prevention; 2019 (https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf, accessed 15 September 2022).

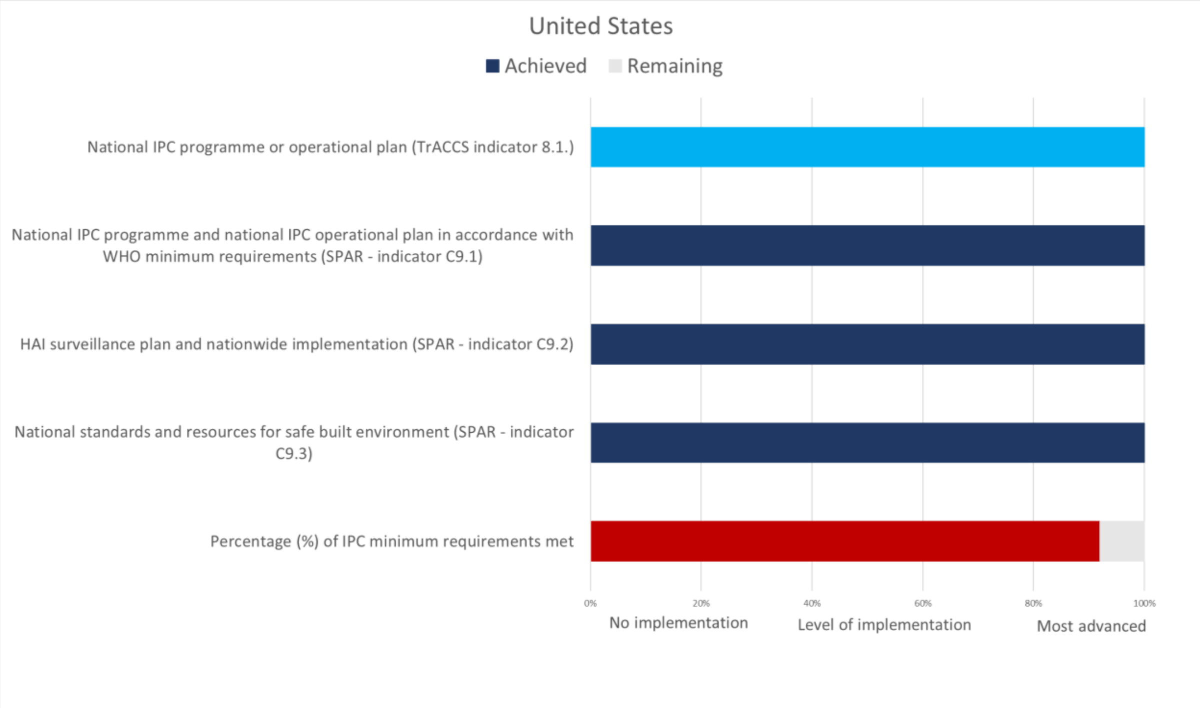
[88] HAI and Antibiotic Use Prevalence Survey [webpage]. Atlanta (GA): Centers for Disease Control and Prevention (https://www.cdc.gov/hai/eip/antibiotic-use.html, accessed 15 September 2022).

[89] Magill SS, O'Leary E, Janelle SJ, Thompson DL, Dumyati G, Nadle J et al. Changes in prevalence of health care-associated infections in U.S. hospitals. N Engl J Med. 2018;379(18):1732–44.

[90] COVID-19: U.S. Impact on Antimicrobial Resistance, Special Report 2022. Atlanta (GA): Centers for Disease Control and Prevention; 2022 (https://www.cdc.gov/drugresistance/covid19.html, accessed 15 September 2022).

[91] Lastinger LM, Alvarez CR, Kofman A, Konnor RY, Kuhar DT, Nkwata A et al. Continued increases in the incidence of healthcare-associated infection (HAI) during the second year of the coronavirus disease 2019 (COVID-19) pandemic. Infect Control Hosp Epidemiol. 2022:1–5. doi: 10.1017/ice.2022.116.

Figure 18. National level IPC implementation results in the United States according to global surveys



Notes: TrACCS survey is for the years 2018-2021; SPAR survey is for the year 2018-2021; WHO global survey on IPC minimum requirements at the national level is for the year 2021 – 2022. All questions extracted from TrACCS, and SPAR surveys include a five-point rating scale to summarise a country's progress. Countries that have reported the lowest rating were categorized has having no implementation with respect to that indicator whereas countries reported the highest rating were categorized as achieving the most advanced stage of implementation.

Gaps identified

Despite the very advanced level of IPC implementation, the following gaps have been identified, in relation to the WHO-recommended minimum requirements for IPC at the national level (Table 1):[38]

- The national IPC programme, primarily within US-CDC and supported by programmes across United States government departments and agencies, has staff dedicated full-time to supporting IPC at the national level. National IPC implementation and capacity enhancements would continue to benefit from additional staff with dedicated time at the subnational, health-care system and facility levels across all health-care settings.
- It was reported that a national system for monitoring and evaluating effectiveness of IPC training and education (at least annually) does not exist in the United States. Training and education activities are implemented through state, territorial and local health departments; health care systems and facilities; the academic systems; and other organizations. Each is responsible for implementation of evaluation activities. At the national level, the US-CDC supports partners across the country to implement IPC training and education through Project Firstline and annually evaluates the reach, impact, and effectiveness of those activities. Project Firstline also provides support to all state health departments to implement and evaluate health-care IPC training and education targeted to the specific needs of the jurisdiction. Ongoing monitoring and evaluation of IPC training at the national, state, territorial and local levels (conducted by those responsible for programme implementation) would be additional important components of ensuring the quality of health care and the safety of patients and health-care personnel.

- Hand hygiene compliance monitoring and feedback has not been identified as a key national indicator in the United States.

Economic costs associated with AMR

The United States faces considerable health and economic costs associated with AMR.

Without effective policy action, the United States is expected to bear one of the highest AMR burdens among G7 countries, with around 29 500 deaths occurring annually between 2015 and 2050. This is more than 2.5 times all the deaths in 2020 due to HIV, tuberculosis and influenza combined.[3]

In the same period, the United States is expected to incur the highest level of health expenditure due to antibiotic resistance of the G7 countries – around USD 2.7 billion annually. This figure corresponds to about USD 7.8 per capita. Longer hospital stay is estimated to be a key driver of AMR-attributable expenditures, particularly in the case of older persons. On average, the number of additional days spent in the hospital due to antibiotic resistance is estimated to reach over 4 million each year between 2015 and 2050.[3]

Enhanced IPC interventions are vital investments for the United States to limit the health and economic burden of HAIs and AMR.

In the United States, improving hand hygiene at health facilities can reduce the risk of death by preventing more than 16 000 deaths each year by resistant and susceptible infections. This intervention can also reduce the pressure on the use of hospital resources by preventing more than 947 200 hospital days annually between 2015 and 2050.[3]

Enhancing environmental hygiene in health facilities can also alleviate the detrimental impact of hospital-acquired infections on population health by preventing more than 14 700 deaths every year. Around 737 000 extra hospital days each year can be avoided by improving environmental hygiene in hospital settings.[3]

Both interventions are excellent investments with the produced saving in health-care expenditure largely offsetting implementation costs. Enhancing hand hygiene would lead to saving almost USD 5.1 per capita per year. Environmental hygiene can lead to saving almost USD 0.2 per capita each year.[3] In addition, a health-care based package that combines improved hand hygiene, antimicrobial stewardship programmes and enhanced environmental hygiene can help save 16 life years every 100 000 persons per year between 2015 and 2050. In the same period, the same policy package would generate that are about 2.3 times bigger than the implementation costs.[3]

Annex B. Indicators for IPC within Tripartite AMR Country Self-assessment Survey (TrACCS) and the State Party Self-Assessment Annual Reporting (SPAR) tool

Global IPC survey	Response categories
TrACCS Indicator 8.1.	Infection Prevention and Control (IPC) in human health care (Please select one rating for each question that most closely matches the country situation): A - No national IPC programme or operational plan is available. B - A national IPC programme or operational plan is available. National IPC and water, sanitation, and hygiene (WASH) and environmental health standards exist but are not fully implemented. C - A national IPC programme and operational plan are available and national guidelines for health care IPC are available and disseminated. Selected health facilities are implementing the guidelines, with monitoring and feedback in place. D - National IPC programme available according to the WHO IPC core components guidelines* and IPC plans and guidelines implemented nationwide. All health care facilities have a functional built environment (including water and sanitation), and necessary materials and equipment to perform IPC, per national standards E - IPC programmes are in place and functioning at national and health facility levels according to the WHO IPC core components guidelines. Compliance and effectiveness are regularly evaluated and published. Plans and guidance are updated in response to monitoring.
SPAR – Indicator C9.1. IPC programmes	Level 1. An active national IPC programme or operational plan according to the WHO minimum requirements is not available or is under development Level 2. An active national IPC programme or operational plan according to WHO minimum requirements exists but is not fully implemented. National IPC guidelines/ standards exist but are not fully implemented Level 3. An active national requirements is available. National guidelines/standards for IPC in health care are available and disseminated. Selected health facilities are implementing guidelines using multimodal strategies, including health workers' training and monitoring and feedback Level 4. An active national IPC programme is available according to WHO IPC core components guidelines and is leading implementation of the national IPC operational plan and guidelines nationwide using multimodal strategies, including health workers' training and monitoring and feedback in place. More than 75% of health care facilities meet WHO minimum requirements for IPC programmes, guidelines, training, and monitoring/feedback Level 5. IPC programmes are in place and functioning at national and health facility levels according to the WHO IPC core components and their compliance and effectiveness are exercised (as applicable), reviewed, evaluated, and published. Plans and guidance are regularly updated in response to monitoring and feedback
SPAR – Indicator C9.2. Health care-associated infections (HAI) surveillance	Level 1. No national HCAI surveillance programme or national strategic plan for HCAI surveillance, including pathogens that are antimicrobial resistant and/or prone to outbreaks is available or under development Level 2. A national strategic plan for HCAI surveillance (including antimicrobial resistant pathogens that are antimicrobial resistant and/or prone to outbreaks) is available but not implemented Level 3. A national strategic plan for HCAI surveillance (including antimicrobial resistant pathogens that are antimicrobial resistant and/or prone to outbreaks) is available and implemented through a national system. Selected

	secondary and tertiary health care facilities are conducting HCAI surveillance (as specified above) and provide timely and regular feedback to senior management and health workers Level 4. A national strategic plan for HCAI surveillance (including antimicrobial resistant pathogens that are antimicrobial resistant and/or prone to outbreaks) is available and implemented nationwide in all health care facilities through a national system according to the WHO recommendations on IPC core components. Regular reports are available for providing feedback Level 5. A national strategic plan for HCAI surveillance (including antimicrobial resistant pathogens that are antimicrobial resistant and/or prone to outbreaks) is available and implemented nationwide in health care facilities through a national system according to the WHO recommendations on IPC core components. Data are shared and being used continuously and in a timely manner to inform prevention efforts. The quality and impact of the system are regularly evaluated, and improvement actions are taken accordingly
SPAR – Indicator C9.3. Safe environment in health facilities	Level 1. National standards and resources for safe built environment, e.g., water, sanitation and hygiene (WASH) in health care facilities, including appropriate infrastructure, materials and equipment for IPC; as well as standards for reduction of overcrowding and for optimization of staffing levels in health care facilities are not available or under development Level 2. National standards and resources for safe built environment e.g., WASH in health care facilities, including appropriate infrastructure, materials and equipment for IPC; as well as standards for reduction of overcrowding and optimization of staffing levels in health care facilities, according to WHO minimum requirements, exist but they are not fully implemented through a national plan Level 3. National standards and resources for safe built environment, e.g., WASH in health care facilities, including appropriate infrastructure, materials and equipment fort IPC; as well as standards for reduction of overcrowding and optimization of staffing levels in health care facilities, according to WHO minimum requirements, exist and are implemented in health care facilities at national level through a national plan Level 4. National standards and resources for safe built environment, e.g., WASH in health care facilities, including appropriate infrastructure, materials and equipment for IPC; as well as standards for reduction of overcrowding and optimization of staffing levels in health care facilities, according to WHO minimum requirements, are implemented at national and intermediate levels according to a national plan Level 5. National standards and resources for safe built environment, e.g., WASH in health care facilities, including appropriate infrastructure, materials and equipment for IPC; as well as standards for reduction of overcrowding and for optimization of staffing levels in health care facilities, according to WHO minimum requirements, are implemented at national and subnational levels according to a national plan, and are regularly exercised (as applicable) and monitored and improvement actions are taken accordingly

Sources: Tripartite AMR Country Self-Assessment Survey (TrACSS) 2020-2021. Geneva: World Health Organization; 2021 (https://www.who.int/publications/m/item/tripartite-amr-country-self-assessment-survey-(tracss)-2020-2021, accessed 29 September 2022). International health regulations (2005): state party self-assessment annual reporting tol, 2nd ed. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789240040120, accessed 29 September 2022).