Reckitt Global
Hygiene Institute

# *A life-course approach to hygiene:*
understanding burden and behavioural changes

Written by

The Economist INTELLIGENCE UNIT

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# About this report

*A life-course approach to hygiene: understanding burden and behavioural changes* is a report produced by The Economist Intelligence Unit and sponsored by the Reckitt Global Hygiene Institute.

This research covers the factors that need to be considered to establish good hygiene practices and behaviour, with a particular focus on four areas: diarrhoea, slums, menstrual hygiene and respiratory hygiene.

Extensive evidence was gathered from the literature and 11 expert interviews were conducted to help inform our research and this report. Our thanks are due to the following for their time and insights (listed alphabetically):

**Kelly Alexander**
Senior learning and influencing advisor, Water+, CARE, Atlanta, Georgia, US

**Jason Corburn**
Professor at the School of Public Health and Department of City and Regional Planning, and director of the Institute of Urban and Regional Development, University of California, Berkeley, US

**David Duncan**
Chief of WASH, UNICEF, Laos

**Samayita Ghosh**
Senior research associate at the Centre for Environmental Health, Public Health Foundation of India, India

**Julie Hennegan**
Research fellow, Maternal, Child and Adolescent Health Programme, Burnet Institute, Melbourne, Australia; adjunct research associate, Johns Hopkins Bloomberg School of Public Health, US

**Karin Leder**
Professor of clinical epidemiology and head of the infectious diseases epidemiology unit at the School of Public Health and Preventive Medicine, Monash University, Melbourne, Australia

**Stephen Luby**
Professor of medicine (Infectious Diseases & Geographic Medicine) and director of research at the Center for Innovation in Global Health, Stanford University, California, US

**David Nabarro**
Co-director of the Imperial College Institute of Global Health Innovation, London, UK; special envoy to the World Health Organisation (WHO) director-general on covid-19; and strategic director of 4SD (Skills, Systems and Synergies for Sustainable Development)

**Poornima Prabhakaran**
Additional professor, head (environmental health) and deputy director, Centre for Environmental Health, Public Health Foundation of India, India

**Ian Ross**
Economist and PhD student (health economics), London School of Hygiene and Tropical Medicine, UK

**Joy Ruwodo**
Director, public affairs for the Ending Neglected Diseases (END) Fund Africa Region

This report was led and edited by Elizabeth Sukkar of The Economist Intelligence Unit and written by Ingrid Torjesen. It follows an initial phase of research—namely, a literature review, conducted by Bettina Redway and Alicia White with oversight by Rob Cook, looking at the burden of disease associated with hygiene practices. The findings and views expressed in this report are those of The Economist Intelligence Unit and do not necessarily reflect the views of the sponsor.

*February 2021*

# Foreword


**Peter Piot**
FCMG FRCP FMedSci
Director, London School of Hygiene & Tropical Medicine
Chair, RGHI Expert Panel



**Simon Sinclair**
PhD MB BChir
Executive director, RGHI


Hygiene has been brought sharply to the front of our minds in 2020, as the world has grappled with the covid-19 pandemic. Never before have so many people been manoeuvred so quickly into new hygiene behaviours in the direct interest of public health. Although the efforts from governments, non-governmental organisations, the media and healthcare systems to create that behaviour change have been unprecedented, it has been far from universally adopted, and its effectiveness continues to be debated.

The basic principle is rather simple: reduce the chance of transmission, and the burden of the disease on the population decreases. The cost and effort of treating people declines, and fewer people perish.

For most infectious diseases, particularly in high-income countries, therapeutic options have burgeoned through the 20th century and into the 21st, and florid cases rarely present to front-line healthcare. This has allowed a degree of complacency to develop. However, we have gradually started to recognise that antibiotics have a limited lifecycle before resistance renders them useless; and effective treatments for viral infections have often proved elusive. We have seen heroic efforts in vaccine development – necessarily after the fact – to battle epidemics and pandemics of emerging infections, including the present one. And so far, each time, we have enjoyed the feeling that the panic is over.

But just as good diet and lifestyle function to reduce the chance of developing diabetes and heart disease, we need to recognise the truth that ‘prevention is better than cure’ in infectious disease too. Hygiene has historically contributed enormously in this regard, from the Romans’ great aqueducts to Semmelweis’ handwashing efforts against puerperal fever. But it has languished as a minority scientific and political interest for decades. Hygiene now deserves its rightful position back at the centre, as the preventive component of the global fight against infectious disease.

There are many gaps in our understanding: What are the key hygiene behaviours that are most effective in different settings? How can we best convince people to adopt and sustain them? Despite the ‘basic principle’ above being intuitively true, what is the real cost-effectiveness of a given behaviour change in hygiene?

Wider society needs to recognise that practical, high-quality scientific research will support the adoption of globally sustainable hygienic practices and achieve enduring behaviour change. How can it be done? By expanding the body of research around and advance the understanding of the links between hygiene and health; enhancing the understanding of hygiene science to encourage new hygiene standards; promoting behaviour change to improve global hygiene and health; and informing the global public health agenda. If these things can be done, policymakers can more successfully drive locally relevant and effective hygiene policies that improve community and individual health and development outcomes.

This Report is the first commissioned by RGHI. It highlights the burden created by deficits in hygienic practice and examines the behavioural and societal challenges that need to be addressed in key settings. We are grateful to Rob Cook, Elizabeth Sukkar and their team at the Economist Intelligence Unit, and the many researchers and experts who brought their expertise to this project.

# Executive Summary

Hygiene refers to the practices that help to maintain health and prevent the spread of diseases. While good hygiene is primarily about behaviours, the ability to practise them well is supported by having the appropriate infrastructure in place, such as access to clean water and soap.

Poor water, sanitation and hygiene (WASH) increases death rates and ill health, creates greater demand for healthcare interventions, widens social inequalities, and has repercussions for quality of life and the wider economy.

There are two main transmission routes for infection—the faecal-oral and respiratory pathways—and hygiene measures work by disrupting them.

Attaining good hygiene is complex, and it is becoming increasingly clear that a more holistic approach is needed that engages and empowers local populations, and is locally sensitive and sustainable.

The life-course approach, which has its origins in preventing or reducing the impact of non-communicable diseases through encouraging good behaviours while recognising the contribution of other factors, including environmental ones, could provide a useful framework for communicable disease and hygiene. Looking at hygiene through a life-course lens could form part of a smarter approach that embeds good hygiene behaviour from childhood (to gain the most cumulative benefit), and then reinforces it throughout a person's lifetime to boost good hygiene practices if these start to wane.

This report looks at the burden, challenges and opportunities of a life-course approach at four key life stages by focusing on specific infectious diseases or challenges at those time points.

| Life stage | Influencers |
|---|---|
| Childhood | Parents/caregivers<br>Nursery and school<br>Wider family and friends<br>Maternal and healthcare services<br>Public health initiatives<br>Society and media |
| Adolescence | Parents/caregivers<br>School and university<br>Wider family and friends<br>Healthcare services and public health initiatives<br>Society and media |
| Adulthood | Work environment<br>Wider family and friends<br>Healthcare services and public health initiatives<br>Society and media |
| Older person | Wider family and friends<br>Healthcare services and public health initiatives<br>Society and media |

## Childhood and hygiene: a focus on diarrhoea

Every year diarrhoeal diseases kill around 0.5m children under five,[1,2] with the majority of deaths in South Asia and sub-Saharan Africa.[3,4] The majority of diarrhoeal deaths in low- and middle-income countries (LMICs) across all age groups can be attributed to WASH.[5] Handwashing with soap can reduce transmission of diarrhoeal diseases and, to a lesser extent, respiratory infections.[6] It is estimated that handwashing with soap after faecal contact only occurs in about 26% of events globally[7,8] and the frequency of handwashing was lowest in regions with poor access to handwashing facilities. In 2017 the UN estimated that 3bn people lacked basic handwashing facilities at home.[9] Furthermore almost half (47%) of schools worldwide lack handwashing facilities with available soap and water,[10] and one in four health care facilities lack basic water services.[11]

Experience from implementing hygiene interventions in schools and health centres suggests that interventions to improve hygiene in LMICs need to be two pronged, encouraging handwashing behaviour while also improving infrastructure to enable it.

## Adolescence and hygiene: a focus on menstrual hygiene

Around 1.9bn women—about 26% of the world's population—are of menstruating age, spending around 65 days per annum managing menstrual blood flow. As defined by the WHO/UNICEF Joint Monitoring Programme for Water Supply Sanitation and Hygiene (JMP), adequate menstrual hygiene requires women and adolescent girls to be able to access clean menstrual management material to absorb or collect menstrual blood, change their sanitary protection in privacy, have access to soap and water to clean themselves and wash reusable pads, and have an understanding of the basic facts linked to the menstrual cycle and how to manage it with dignity and without discomfort or fear.[12,13]

Although menstrual hygiene issues impact girls and women across the globe, they have the biggest impact in LMICs where cultural, social and religious beliefs can further disadvantage menstruating girls and women.[14,15,16] Menstruation affects the education of girls, including their attendance, engagement with lessons and potentially their life chances, and research is needed to measure the impact.[17] In the workplace, menstruation affects women's productivity and absenteeism.[18,19]

Improving menstrual hygiene management is complex but must begin primarily with education in schools. Currently many girls in LMICs are unprepared for their first period; they often rely on information from their mothers, which tends to be framed in the context of protection from pregnancy rather than the needs and preferences of their daughters.

## Adults and hygiene: a focus on slums

The world is becoming increasingly urbanised owing to adults being drawn from rural areas to towns and cities. Over 90% of this urban growth is occurring in LMICs, where the number of urban residents is growing by an estimated 70m each year,[20] and many will end up in urban slums. The number of urban slum dwellers stands at over 880m and is growing.[21] High-density living conditions, poor housing, low incomes, lack of convenient access to affordable clean water and soap, and lack of effective solutions for sanitation and solid waste management mean that the people in these communities are particularly vulnerable to infectious diseases. Currently, opportunities for interventions to reinforce the importance of hygiene behaviour during adulthood are limited, especially in informal settlements. Innovative slum improvement initiatives are required, with the full participation of slum residents.

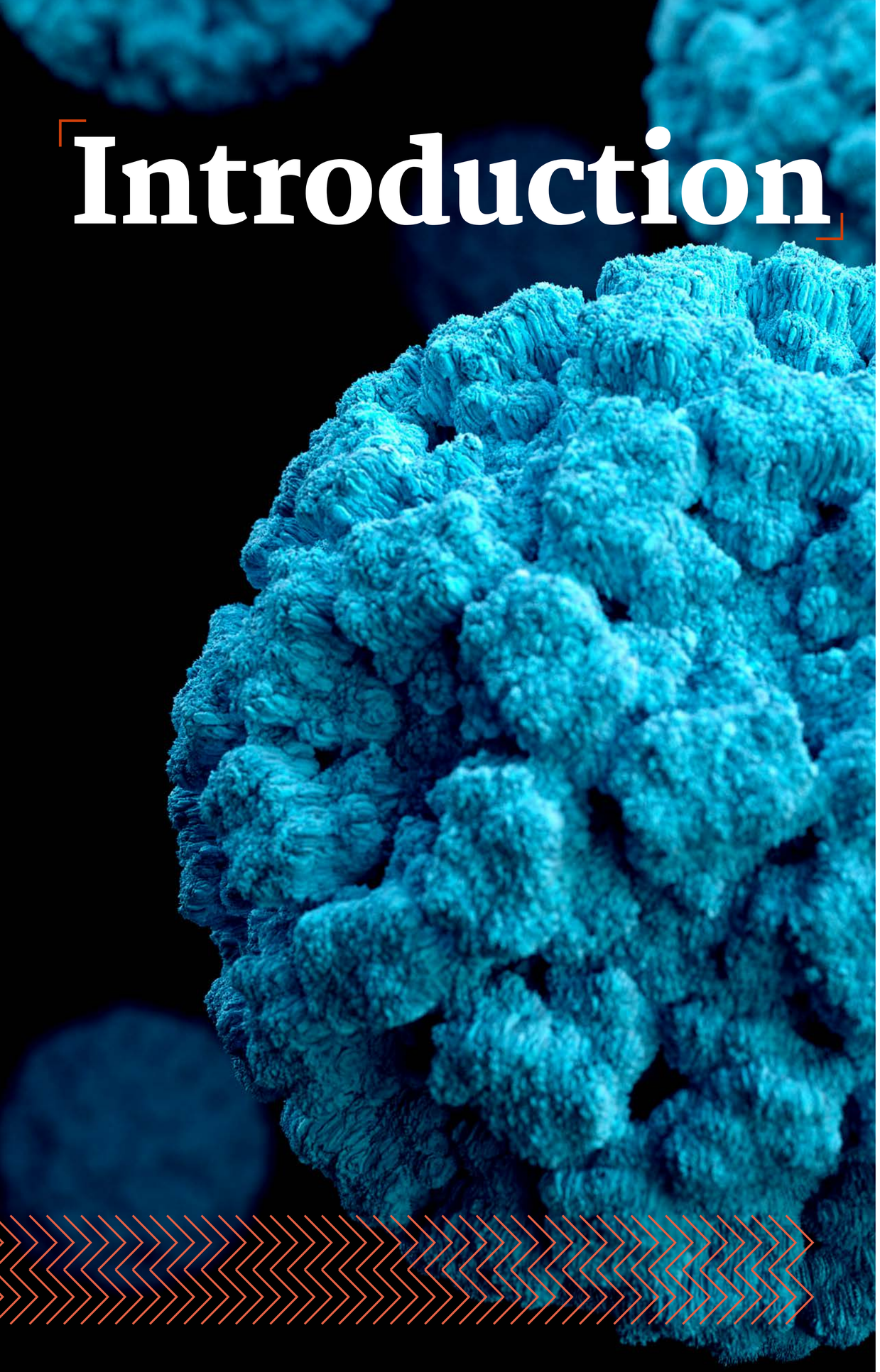
## Older people and hygiene: a focus on respiratory hygiene

Deaths from lower respiratory tract infections are highest in the under 5 and over 70 age groups, and most of this burden occurs in countries with low socio-demographic development.[22]

The covid-19 pandemic of 2020 has highlighted the particular risks posed to older people by respiratory disease. For example, until December 23rd 2020, 92% of covid-19 deaths in the US had occurred among those aged 55 or older, and only 0.2% in the under-25s.[23] As countries have grappled to contain the pandemic, it has also become clear that there needs to be greater consideration of and emphasis on hygiene standards for preventing respiratory diseases. Hygiene interventions generally put particular importance on behaviours that reduce diarrhoeal diseases, particularly washing hands after using the toilet and before eating, rather than regular cleaning and disinfection of frequent touch points, cough etiquette and washing hands when entering or leaving a different environment.

Our understanding of the basic science of respiratory pathogen transmission pathways and how to interrupt them also needs to be improved. More attention to hygiene during pandemics and epidemics has been shown to have benefits for reducing the incidence of other infectious diseases. For example, from March to September 2020 there were 7,029 influenza notifications in Australia, compared with an annual average of 149,832 over the same period in the previous five years.[24]

# Introduction



According to the WHO, “hygiene refers to conditions and practices that help to maintain health and prevent the spread of diseases.”[25] This broad definition encompasses a wide variety of hygiene practices or behaviours—predominantly handwashing, but also cleaning of surfaces, and behaviours related to coughing, sneezing and spitting, all of which aim to reduce the spread of infections.

“Non-pharmaceutical interventions, which are different versions of hygiene, have an incredibly important role in the prevention of contagious diseases that are either transmitted by body fluids or droplet spread,” says David Nabarro, co-director of the Imperial College Institute of Global Health Innovation, London. “It’s a totally unvalued set of interventions.”

“What we need to recognise is that germs are single minded—they like to spread—and what hygiene is about is first trying to avoid individuals being caught by germs, and second trying to avoid individuals spreading germs.”

Good hygiene is not only about whether these behaviours are practised, but how frequently and how well. For many of these behaviours, this is dependent on the availability and quality of water, sanitation, and products such as soap and detergent. However, their presence alone does not guarantee that good hygiene practices are followed.

“You cannot wash your hands well without more than a cup full of water, you cannot wash your hands well without soap to help you. You cannot clean surfaces well without a cloth, and some kind of substance that helps to break down fat so there is no doubt an infrastructure issue,” says Dr Nabarro, who is also strategic director of a Swiss-based social enterprise, 4SD (Skills, Systems and Synergies for Sustainable Development), and one of six special envoys to the WHO director-general on covid-19.

This is also emphasised by David Duncan, chief of WASH at UNICEF: “Handwashing and hygiene are the forgotten partners of WASH.”

In low-and middle-income countries (LMICs), hygiene is usually considered within the wider context of water, sanitation and hygiene (WASH), with the water and sanitation facets often the focus, owing to inadequate infrastructure. But poor hygiene is also an important contributor to illness in wealthier countries where generally infrastructure is not a major issue.

# Impact of poor hygiene

Poor hygiene can impact a wide range of bodily systems and cause a range of diseases, including gastrointestinal, respiratory, oral and skin conditions. The impact can be rapid—in the form of an acute diarrhoeal or respiratory infection, for example—and can be cumulative, impacting growth, development, immunity and long-term healthy life expectancy.

Where poor hygiene exists, it widens existing inequalities, as those most impacted will already be the most disadvantaged: the poor, women, and marginalised groups, including refugees, slum dwellers and prisoners.

Two of the main mechanisms for the spread of infections are micro-organisms being transferred through traces of faecal material into people's mouths (Figure 1), and the transfer of micro-organisms from one person's respiratory tract to another in droplets or airborne particles (Figure 2). This transfer can be direct or via intermediate surfaces. Respiratory hygiene is higher on the general public's agenda than ever before as a result of the current coronavirus pandemic.

The likely pathways for the transmission of disease from faecal matter—namely, fluids, fields, flies, fingers and food—can be disrupted by improved hygiene and other measures highlighted in the F diagram (Figure 1).

Figure 1. Transmission of infections from faecal matter

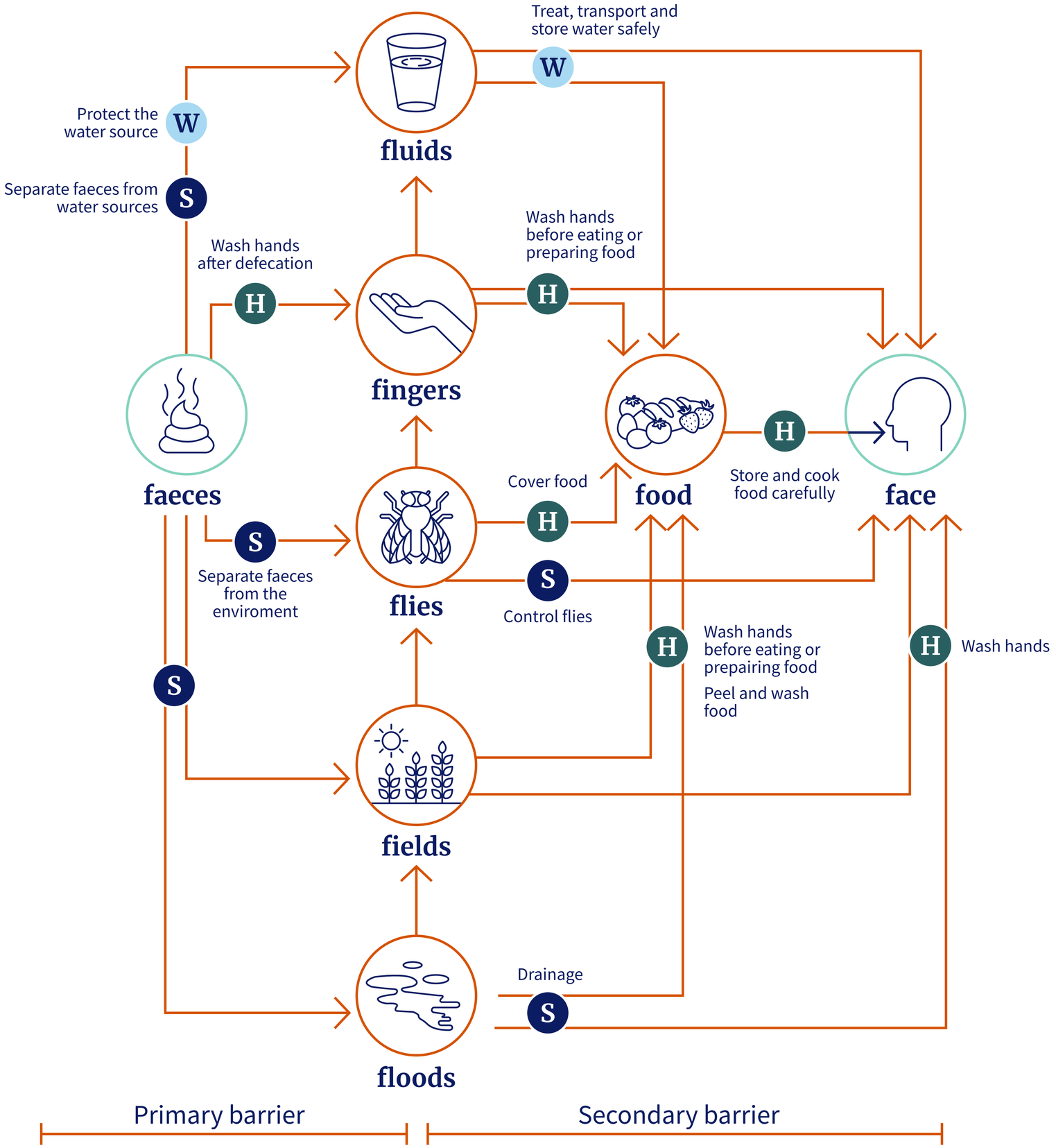
# The ‘f’ diagram

The movement of pathogens from the faeces of a sick person to where they are ingested by somebody else can take many pathways, some direct and some indirect. This diagram illustrates the main pathways. They are easily memorised as they all begin with the letter **‘f’: fluids** (drinking water)**, food, flies, fields** (crops and soil)**, floors, fingers and floods** (and surface water generally).

- **Water**
- **Sanitation**
- **Hygiene**

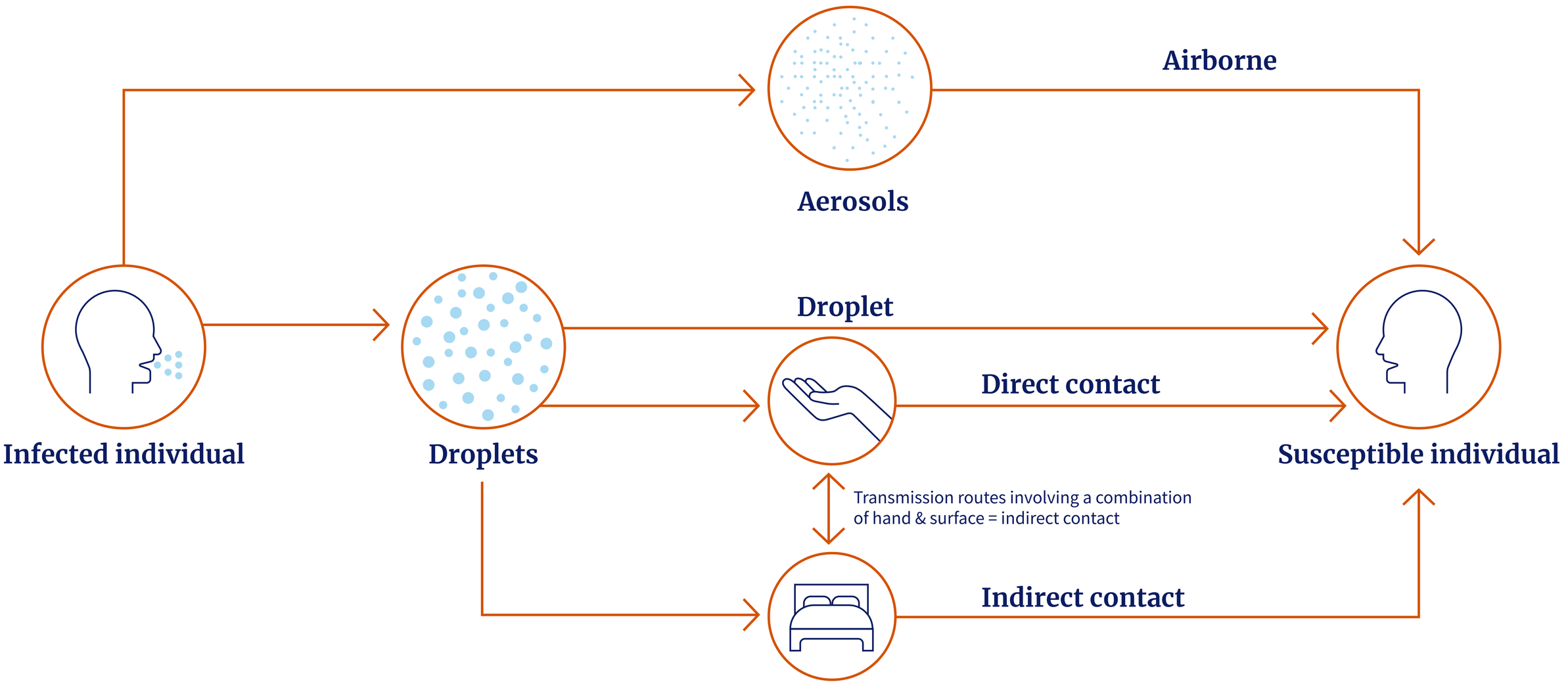
Barriers can stop the transmission of disease; these can be primary (preventing the inital contact with the faeces) or secondary (preventing it being ingested by a new person). They can be controlled by water, sanitation and hygiene interventions.

Note: The diagram is a summary of pathways: other associated routes may be important. Drinking water may be contaminated by dirty water containers, for example, or food may be infected by dirty cooking utensils.



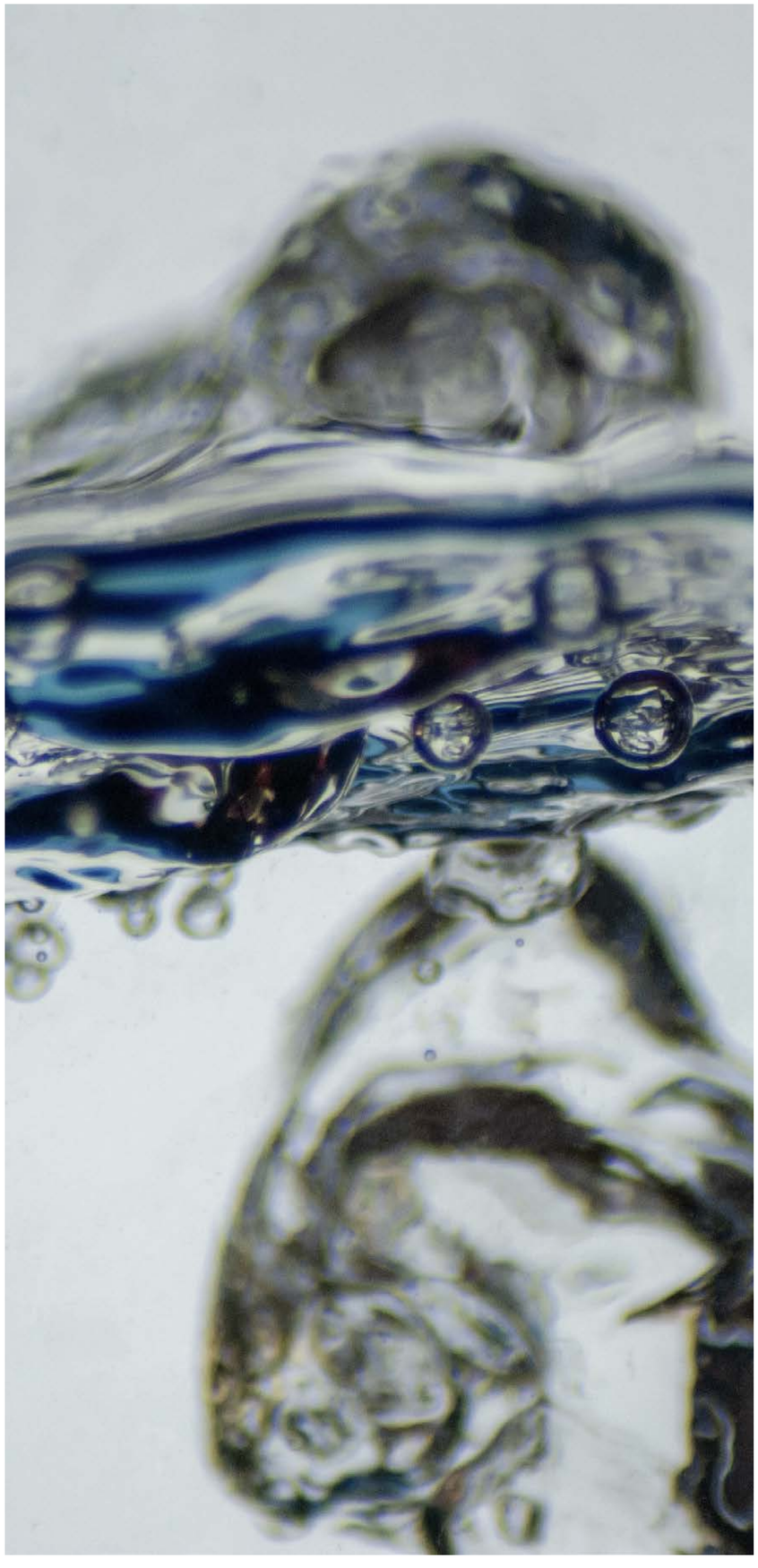

Source: Loughborough University. WEDC Developing knowledge and capacity in water and sanitation GUIDE 13 wedc.lboro.ac.uk/knowledge Managing hygiene promotion in WASH programmes

Figure 2. Diagram of respiratory transmission routes




Other good hygiene measures target reducing micro-organism growth, either through regular changing of sanitary protection during menstruation or by reducing reservoirs for micro-organism vectors around the home (such as stagnant water for mosquito breeding). This report focuses largely on domestic settings and hygiene among the general public, rather than highly specialised settings such as hospitals, which also target the interruption of similar transmission routes.

The importance of different transmission pathways varies between different pathogens and settings. For example, in high-income settings with clean water and effective sanitation systems, targeting a single hygiene transmission pathway for a particular pathogen (Figure 1) might prove extremely effective, but less so in a LMIC setting without that same infrastructure because multiple other transmission pathways may remain, says Ian Ross, economist and PhD student, London School of Hygiene and Tropical Medicine, UK.



# Benefits of hygiene interventions

Poor WASH increases death rates and ill health, and creates greater demand for healthcare interventions. In particular, there is good evidence that handwashing reduces morbidity and mortality from diarrhoea in LMICs[26] and some evidence that it reduces them for acute respiratory infections.[27,28,29]

It is also likely that poor hygiene impacts quality of life and future productivity, as these appear to be obvious consequences of ill health, although experts say that this is far harder to quantify. At present there is more evidence about the economic benefits and return on investment for water supply and sanitation, than there is for hygiene, Mr Ross explains.

For hygiene, most evidence is for handwashing. Cost-benefit analysis suggests a two-to-one return on investment for handwashing promotion interventions is achievable, even after accounting for sub-optimal levels of uptake and sustained practice.[30]

The best-quality evidence for the cost-effectiveness of an actual hygiene-promotion initiative to increase hygiene comes from a study targeting the main carers of young children in Burkina Faso.[31] Mr Ross explains that the initiative involved health workers discussing hygiene with the target group opportunistically, through monthly house-to-house visits by community volunteers, a programme to promote handwashing in primary schools and awareness raising using a specifically commissioned radio play. The study found that the cost to the health service of delivering the initiative was US$59 (at 2019 prices) for each diarrhoea case prevented, and the wider societal cost, taking into account purchase of soap by families, and so on, was US$89 per case.

Using the results of the Burkina Faso-based study, the Disease Control Priorities study, a global initiative funded by the Bill and Melinda Gates Foundation, places handwashing as a highly cost-effective intervention for child health, on a similar level to oral rehydration therapy and most childhood vaccinations.[32]

While this was a very good study, more are needed and of different types of intervention, Mr Ross says. “The evidence gap is an empirical cost-benefit study of a handwashing intervention in a LMIC.”

The best study published to date uses models of secondary data on costs and effectiveness.[33] “That’s not the same as following an intervention that really happens on the ground,” he explains.

The knock-on impacts of poor hygiene practices include the use of antibiotics, when efforts are already focused on reducing their use to tackle the growth of antimicrobial resistance (AMR). The overuse of antibiotics in LMICs to treat both people and animals, combined with poor public infrastructure in terms of sewage and water supply, has been described as the “perfect storm” for the development of AMR.[34]

# Why a life-course approach?

It is becoming increasingly clear that a scattergun approach will not be effective, as poor hygiene is a complex problem that requires a holistic strategy that engages and empowers local populations. Local environmental factors such as population density and availability of water and sanitation need to be taken into account, as interventions must be sustainable in terms of maintenance, the use of resources and the disposal of waste.

Looking at hygiene through a life-course lens could form part of a smarter approach that imbeds good hygiene behaviour from childhood to gain the most cumulative benefit, and reinforcing it throughout the life-course to boost good hygiene practices if it starts to wane.

A life-course approach to health aims to maximise the effectiveness and impact of interventions on a person's life by promoting a healthy start and then targeting their needs at critical periods throughout their lifetime. The approach focuses on the causes rather than the consequences of ill health by encouraging good behaviours, but recognising the contribution of other factors, including environmental, occupational and prenatal, from an early age using targeted interventions at key life stages.[35] The life-course approach in health and in epidemiology has its origins in preventing or reducing the impact of non-communicable diseases. It is based on a recognition that targeting people most at risk of conditions such as cardiovascular disease or diabetes in late adulthood—once they start to exhibit symptoms or show risk factors—is too late to effectively ameliorate the growing burden of disease. A better approach is to identify the determinants of disease across the entire life-course and implement appropriate interventions at every stage to reduce an individual's risk of developing these conditions.[36]

Poornima Prabhakaran, deputy director of the Centre for Environmental Health at the Public Health Foundation of India, whose doctoral research at the University of Bristol in the UK looked at a life-course approach to chronic diseases, says that the roots of the approach in the study of chronic diseases stem from the Barker hypothesis[37] which revealed an association between hypertension and coronary heart disease in middle age and early life factors, specifically sub-optimal intra-uterine nutrition manifesting as low birth weight.

Impaired nutrition during pregnancy was related to a structural and physiological changes in the foetus that had implications for that child's health in later life, says Dr Prabhakaran. This was widened to consider the developmental origins of disease that includes influences both during pregnancy and in post-natal life.

In the context of hygiene and child health, it is about the psychosocial environment that a pregnant woman is in. Dr Prabhakaran says: "It may be that she is already vulnerable living in a suboptimal WASH environment during her pregnancy and because of that, it is likely that her child, when it is born, is placed in a suboptimal situation.

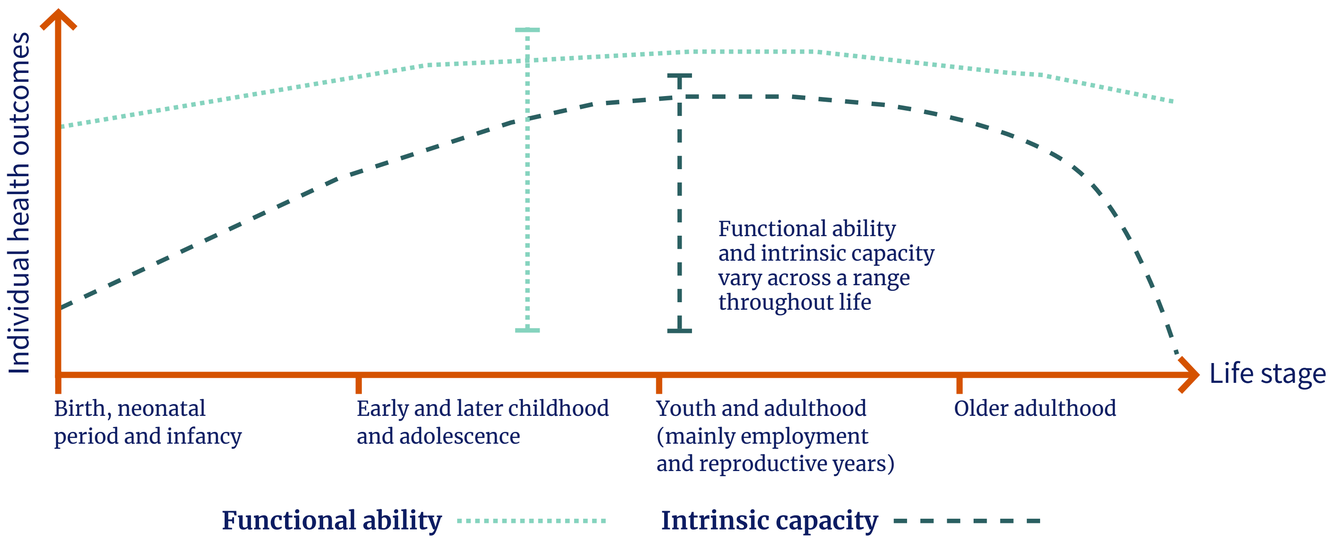
"A child with low birth weight is more vulnerable to infections, and if there is a sub-optimal WASH situation at home, that creates further vulnerability to infections, whether that is a waterborne, foodborne (from less hygienic cooking and feeding practices) or respiratory infections." Once set on this growth trajectory in sub-optimal physical and psychosocial environments, future risks to the child at different life stages can have a cumulative effect on health and disease in later life. Therefore, a life-course approach to hygiene can provide a long-lasting framework for preventive rather than curative care. When the influences from developmental stages in early life are married with exposures that occur later during childhood, adolescence, and adulthood, this becomes the life-course approach, experts say. These exposures can be wide ranging, including social or environmental risk factors, and it is their cumulative effect on health over the long term that is important.

The WHO acknowledges that a life-course to approach to health can help countries to address critical, interdependent factors affecting health and sustainable development in a holistic manner, in the process helping them realise the sustainable development goals (SDGs) agreed by world leaders in 2015 to address challenges including poverty and inequality.[38]

While to date most of the focus to the benefits of a life-course approach has been on non-communicable disease and ageing populations in high-income countries, the WHO argues that the life-course approach to health "can be extended to all age groups, health topics and countries by building on a synthesis of existing scientific evidence, experience in different countries and advances in health strategies and programmes. Aligned with the SDGs and UHC [universal healthcare], a life-course approach can facilitate the integration of individual, social, economic and environmental considerations."

The WHO presents a conceptual framework for a life-course approach (Figure 3) with a main outcome of functional ability, defined as the sum of the individual and environmental attributes that enable a person to be or do what they have reason to value.[39]

## Figure 3. WHO conceptual framework for a life-course approach to health




**Social and enviromental determinant of health**

Families and communities, health services and systems and multisectoral factors related to sociocultural norms, economics, politics, physical enviroments and sustainable development

**Principles in practice for the realisation of rights**

Apply a human rights-based, gender-responsive and equality-driven approach

# A life-course approach to hygiene

A life-course approach to hygiene has broad relevance and many important ramifications, impacting many of the SDGs, most significantly SDG 6 ("Ensure availability and sustainable management of water and sanitation for all"), SDG 3 ("Ensure healthy lives and promote well-being for all at all ages") and SDG 5 ("Achieve gender equality and empower all women and girls"). It is also likely that it would have a positive influence on many others, including SDG 9 ("Build resilient infrastructure, promote sustainable industrialisation and foster innovation"), SDG 10 ("Reducing inequality within and among countries") and SDG 11 ("Make cities inclusive, safe, resilient and sustainable").[40]

The expectation is that when healthy behaviours, such as hygiene practices, are introduced early in life and then repeatedly reinforced, they become routine, and the returns are maximised, both by limiting ill health and the accumulation of risk throughout life and by contributing to social and economic development.[41] Over time, as hygiene behaviours normalise, there should be a building of intrinsic reinforcement from parents, family, peers and society as a whole.

Existing interactions that create opportunities for hygiene interventions include maternal and child health programmes, education programmes in pre-school childcare settings and schools, occupational and health promotion activities during adulthood, and opportunistic interactions with health services (Figure 4).

However, Dr Luby cautions that as the WHO conceptual framework acknowledges,[42] it is important not to assume that hygiene interventions such as handwashing are only dependent upon knowledge and skill.

"I think there's a lot of behaviour change input that implies that [knowledge and skill are the only important factors]," he says. "Let's consider the typical woman in rural Africa who has to walk 40 minutes to collect water, maybe carrying 15 to 20 litres on her head. If she tries to follow the WHO recommendations for hand washing, she will do nothing but collect water in all of her waking minutes. The broader underlying issue is this is really not about knowledge and it's not about skill acquisition; it's really about creating, if we want to improve hand washing, per se, facilitatory environments."

***"I think a life-course perspective is a helpful one because hand washing has different benefits at different points in the life-course,"*** says Stephen Luby, professor of medicine (Infectious Diseases and Geographic Medicine) and director of research at the Stanford University Center for Innovation in Global Health. ***"We also have interactions with different agencies at different points in the life-course, so it allows us to implement this."***

Figure 4: Opportunities to boost hygiene practices over the life-course

| Life stage | Influencers |
|---|---|
| Childhood | Parents/caregivers<br>Nursery and school<br>Wider family and friends<br>Maternal and healthcare services<br>Public health initiatives<br>Society and media |
| Adolescence | Parents/caregivers<br>School and university<br>Wider family and friends<br>Healthcare services and public health initiatives<br>Society and media |
| Adulthood | Work environment<br>Wider family and friends<br>Healthcare services and public health initiatives<br>Society and media |
| Older person | Wider family and friends<br>Healthcare services and public health initiatives<br>Society and media |

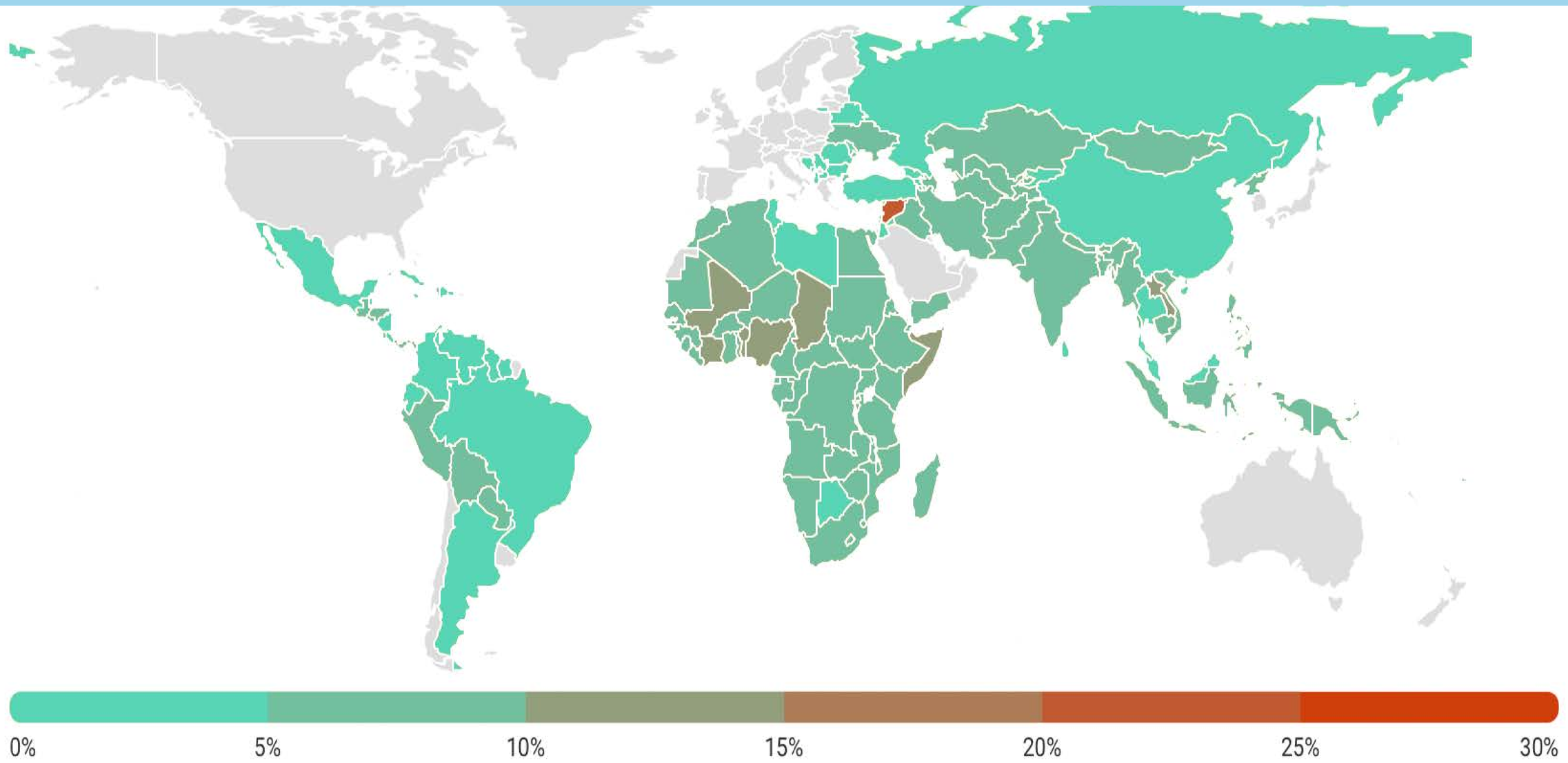
Chapter 1

# Childhood and hygiene: a focus on diarrhoea

# Burden of diarrhoeal diseases

Diarrhoeal diseases are the fifth most common cause of loss of healthy years of life to early death or disability (disability-adjusted life years—DALYs) across all age groups,[43] but are a major killer in young children.[44] This burden means that improved hygiene practices, amongst other measures, can play a major role in alleviating ill health and mortality, especially in children. Every year diarrhoeal diseases kill around half a million under fives[45,46] — around 8% of deaths — in this age group (see Figure 5).[47] The majority of deaths from diarrhoea occur among young children living in South Asia and sub-Saharan Africa.[48,49] Only birth complications and respiratory diseases kill more children under 5 globally.[50] Diarrhoeal diseases, which can last for several days, deprive the body of essential water and salts. In the past, severe dehydration and fluid loss were the main causes of diarrhoeal deaths, but other causes such as septic bacterial infections are responsible for an increasing proportion of diarrhoea-associated deaths.[51]

Figure 5. Percentage of deaths caused by diarrhoea in children under five years of age, 2017




Source: WHO Maternal Child Epidemiology Estimation, 2018

# Causes of diarrhoeal diseases

Diarrhoea is most commonly caused by infection with viruses or bacteria, but intestinal parasites can also be responsible. A huge number of pathogens are implicated in diarrhoeal diseases, with rotavirus and *Escherichia coli* most likely to be responsible for cases in children under five. Other important pathogens in children include the protozoan parasite cryptosporidium and Shigella bacteria, which are responsible for dysentery.[52,53]

The mouth is the usual entry point for these pathogens, which can be ingested in contaminated food and water, or from unclean hands following contact with contaminated environments, animals and faecal matter.[54]

The association between poor foetal nutrition and heightened risk of cardiovascular disease and diabetes are long established (Barker's hypothesis or fetal origins of disease), but it is now known that an adverse environment, including poor nutrition and infection, during early life not just *in utero*, will have a detrimental impact on these conditions (developmental origins of health and disease).[55]

In low-income countries, children under three years of age experience on average three episodes of diarrhoea every year.[56] Each episode deprives the child of the nutrition necessary for growth and development.[57] Malnutrition is considered to be the most common cause of immunodeficiency worldwide,[58] and it is estimated that 43% of children under 5 years in LMICs, are at an elevated risk of poor development because of stunting or extreme poverty, and that this could reduce their annual earning potential as adults by around 25%.[59]

UNICEF highlights that many deaths from diarrhoeal diseases could be prevented through basic interventions, which include immunisation against rotavirus, breast feeding (which provides a safe and clean food source), and, most importantly, safe drinking water, sanitation and hygiene.[60]

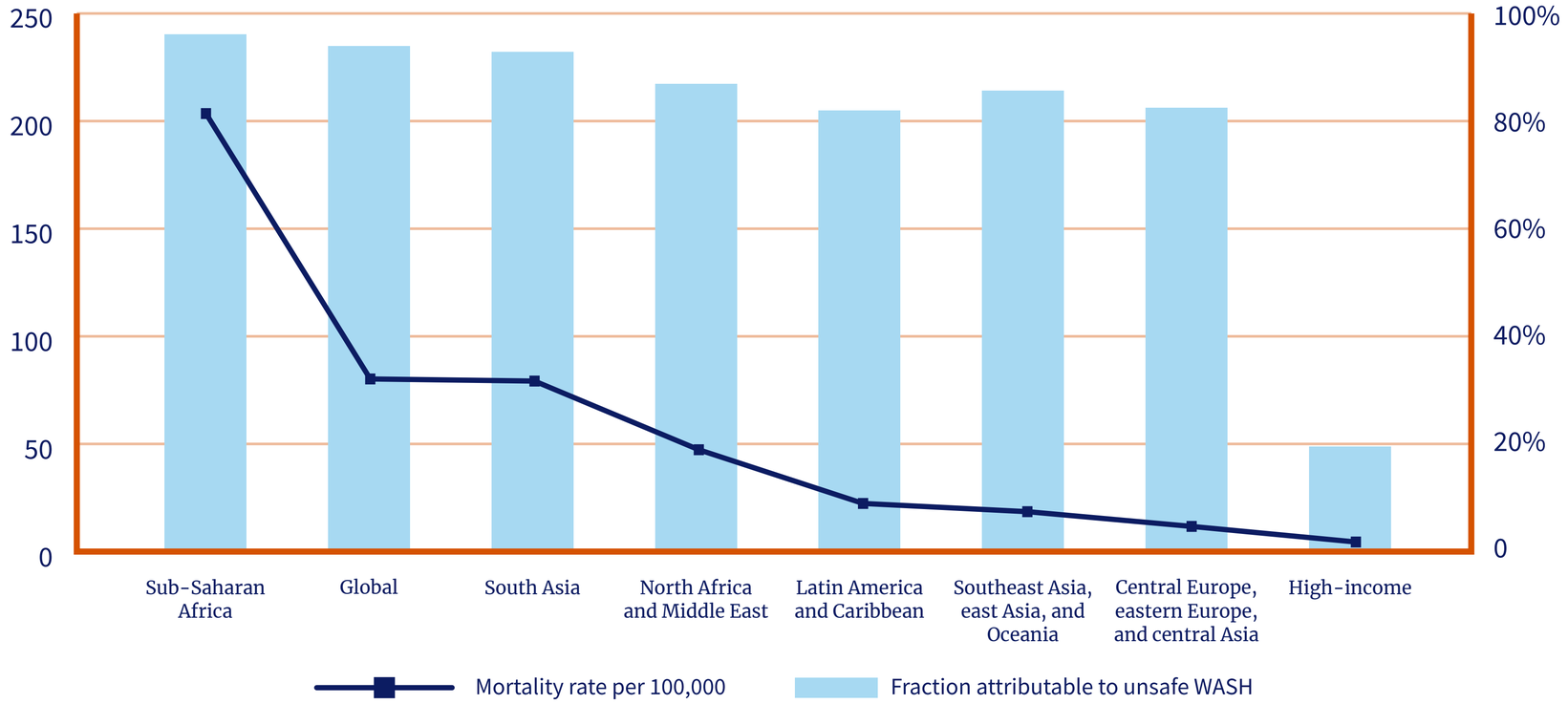
# Preventing diarrhoeal diseases through WASH

Among children under five, 94% of mortality from diarrhoeal diseases is estimated to be attributable to unsafe WASH. The highest mortality rates are seen in LMIC regions, where rates can be 200-fold higher than in high-income countries (Figure 6 and Table 1).

Children are likely to benefit most in terms of reduced diarrhoeal diseases from improved WASH, but other age groups will also benefit. Around 60% of diarrhoeal deaths in LMICs across all age groups—a total of 829,000 deaths and 49.8m DALYs—can be attributed to inadequate WASH.[61]

Handwashing with soap can reduce transmission of diarrhoeal diseases and, to a lesser extent, respiratory infections.[64] Systematic reviews suggest that hand washing with soap can lead to a 23% to 40% reduction in risk of diarrhoeal diseases (the lower estimate adjusts for unblinding of studies)[65] and a 16% risk reduction for respiratory infections.[66]

Figure 6. Mortality from diarrhoeal diseases in under 5s by region, and fraction attributable to unsafe WASH, 2017




Source: Adapted from Troeger CE, Khalil IA, Blacker BF et al. Quantifying risks and interventions that have affected the burden of diarrhoea among children younger than 5 years: an analysis of the Global Burden of Disease Study 2017. The Lancet Infectious Diseases 2020; 20 (1): 37-59.

Table 1. Burden of diseases associated with not handwashing with soap [62,63]

| | | Diarrhoeal disease | | | Respiratory disease | | |
|---|---|---|---|---|---|---|---|
| **Region** | **% of population washing hands with soap after potential faecal contact** | **Proportion of disease due to lack of handwashing with soap** | **Deaths** | **DALYs (1000s)** | **Proportion of disease due to lack of handwashing with soap** | **Deaths** | **DALYs (1000s)** |
| **Global** | 26% | 12% | 165,200 | 9,919 | 13% | 370,065 | 17,308 |
| **High-income countries** | 51% | 8% | 2,409 | 65 | 9% | 36,888 | 516 |
| **LMICs** | 22% | | | | | | |
| Americas, LMICs | 36% | 10% | 2,227 | 183 | 11% | 25,022 | 683 |
| Eastern Mediterranean, LMICs | 21% | 12% | 15,013 | 1,130 | 13% | 29,903 | 2,070 |
| Europe, LMICs | 25% | 11% | 537 | 72 | 12% | 9,252 | 374 |
| South-East Asia, LMICs | 28% | 11% | 56,419 | 2,656 | 12% | 94,304 | 3,775 |
| Sub-Saharan Africa, LMICs | 8% | 13% | 85,166 | 5,516 | 15% | 134,199 | 8,625 |
| Western Pacific, LMICs | 17% | 12% | 3,347 | 298 | 14% | 40,802 | 1,266 |

# Infrequent handwashing as a behavioural issue

Despite the evidence of the impact of handwashing, there is huge room for improvement in this simple intervention. Around 74% of the world's population have access to handwashing facilities with soap and water, but it is estimated that handwashing with soap after faecal contact only occurs in about 26% of events globally (see Table 1).[67,68] While the frequency of handwashing is lowest in regions with poor access to handwashing facilities, even in high-income countries where access to handwashing facilities is reported to be "near-universal" people are estimated to only wash their hands with soap after about 51% of potential contacts with faecal material.

In LMICs in Africa, even among the small proportion who have access to some form of handwashing facilities at home (18%), only 14% are likely to wash their hands after potential contact with faecal matter in this setting.[69] However, Dr Luby emphasises that in LMICs lack of easy access to water and soap is the key reason for lack of handwashing. As seen in Table 1, the figure for washing hands with soap after faecal contact in sub-Saharan Africa is even lower, at 8%, reflecting poorer access to water and sanitation facilities across the population.

Mr Duncan also highlights lack of access to soap as a barrier: "Getting access to soap is a major challenge in many regions. There are some small villages where there are no markets even; they work on a barter economy. If people are not educated as to the importance of using soap, there is no demand for it, so there just isn't any."

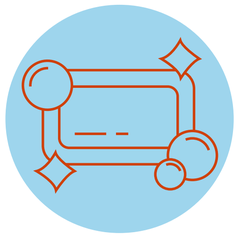
A systematic review published in 2020 looked at intervention and observational studies across 44 countries to examine the determinants of handwashing with soap.[70] Most of the countries were middle income (60%). Importantly, there was moderate-quality evidence that knowledge about health and disease (for example, about how diseases are transmitted) did not have an impact on handwashing behaviour.

The nine determinants for which there was good quality evidence of a positive impact on handwashing behaviour are listed in Table 2. Interventions that addressed the determinants of handwashing behaviour are more likely to be successful in changing it.

## Table 2: Determinants of domestic handwashing with good quality evidence of a positive influence

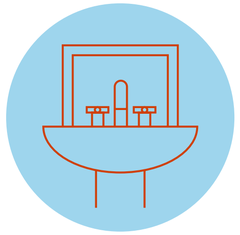
Having a young child in the family

Having an improved latrine

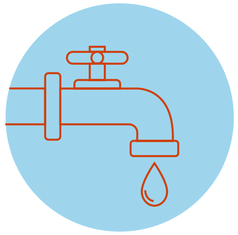


Having a handwashing facility with soap and water present

Having handwashing facilities that are conveniently located close to the kitchen and toilet



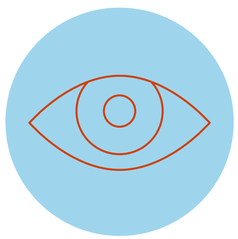
Having handwashing facilities that are desirable and user friendly (for example, including a mirror, basin or soap holder; being nicely coloured)



Having piped water or water source close to the household

Having soapy water

Living in certain geographic regions



Having more than one person present in a public bathroom (that is, the feeling that you are being observed)

Source: Adapted from White S, Thorseth AH, Dreibelbis R, et al. The determinants of handwashing behaviour in domestic settings: An integrative systematic review. Int J Hyg Environ Health. 2020;227:113512

# Prioritising WASH in health facilities and schools

In 2017 the UN estimated 3bn people lacked basic handwashing facilities at home.[71] While the situation has improved by about 13% since 1990,[72] that is still a startling statistic. Furthermore, almost half (47%) of schools worldwide lack handwashing facilities with available soap and water,[73] and one in four health care facilities lack basic water services with the proportion lacking hand hygiene and health care waste facilities being even greater.[74]

The rewards of reversing such a broad deficiency would be major. "Hand washing with soap and water continues to be the lowest cost approach that we have, and the children who die of diarrhoea are overwhelmingly concentrated among the bottom decile [of the global economy]," says Dr Luby.

Rather than focusing on poor households to set up hand washing stations within their home, there are other places that should be prioritised as well, such as healthcare facilities, experts say.

"Forty per cent of healthcare facilities in Bangladesh do not have running water inside, and that's pretty typical across low-income countries. This is the place where people are coming in who are sick, who have infectious disease," Dr Luby says. "This is a place where we know we can save lives with improved hygiene, and we don't have these facilities structured to have running water and soap. These are also places that are within reach of government policy."

Episodes of care delivered at healthcare facilities also offer an ideal opportunity to improve hygiene behaviour throughout the life-course, further underlining the importance of providing WASH infrastructure and training health workers in promoting hygiene practices.

## WASH matters for neonatal and maternal health

Evidence shows that lack of access to WASH in healthcare facilities may significantly compromise safe childbirth and access to primary health care.[75] A 2016 review of healthcare facilities in four East African countries found that fewer than 30% of delivery rooms had access to water.[76] Inadequate WASH services contribute to neonatal and maternal mortality through weak infection control and prevention, and discourage pregnant women from institutional delivery.[77] Traditionally a variety of harmful substances, including animal dung, may be applied to the umbilical cord, which can increase infections,[78] whereas a clean birth, involving handwashing and use of the antiseptic reduces neonatal mortality and incidence of cord infections.[79,80]

Globally, infections cause about 11% of maternal deaths (and significantly more deaths in LMICs) and are also a significant contributor to many deaths attributed to other conditions.[81] The risk of early neonatal sepsis increases with maternal infection.[82] Early neonatal sepsis causes about 8% of all neonatal deaths, but the proportion of late neonatal deaths due to sepsis is four times higher.[83]

Inadequate WASH in healthcare facilities also poses an economic burden in the form of increased healthcare costs and decreased wages due to missing work to take care of sick family members.[84] In 2018 the UN secretary-general, António Guterres, issued a global call to action to elevate the importance of and prioritise action on WASH in all healthcare facilities.[85]

According to the experts that we interviewed, the other places to prioritise action on WASH—specifically handwashing—are schools, shared toilet facilities and food vending locations, as these are venues where handwashing could have the most impact on reducing transmission of infection.

# Improving infrastructure and behaviour in schools and health centres

Whereas initiatives to improve handwashing in high-income countries need to focus on behaviour, the interventions used in LMICs need to be two pronged, by encouraging handwashing behaviour while improving infrastructure to enable it. Many LMICs are using and adapting a UNICEF-backed three-star rating programme, which encourages simple WASH infrastructure improvements and the adoption of good hygiene behaviour into daily routines in schools.[86] The programme's approach is described as "simple, scalable and sustainable":

### No star:

Zero, minimal or high-cost WASH facilities and no effective programmes for improving hygiene behaviour or maintaining existing infrastructure.

### One star:

Implementing daily routines to promote healthy habits such as supervised group hand washing with soap (normally before the school meal), supervised cleaning of toilets, the provision of soap and water and no open defecation, daily supervised use of drinking-water bottles by all children.

### Two stars:

Incremental improvements, including hygiene education and facilities to promote hand washing with soap after toilet use, improved sanitation facilities, plus facilities and education for menstrual hygiene management, and low-cost point-of-use water treatment introduced in schools.

### Three stars:

Facilities and systems upgraded to meet national standards.

The Philippines started such a programme in 2016; after one year, around 70% of schools were participating and reporting progress.[87] The number of schools complying with five crucial indicators necessary to achieve one-star status—access to safe drinking water, availability of sanitary pads, gender-segregated toilets, supervised daily group handwashing and handwashing facilities with soap—doubled within a year, from 9% in 2017-18 to 18% in 2018-19. Over the same period the proportion of schools providing handwashing facilities with soap increased from 33.6% to 50.9%, and the proportion providing daily group handwashing activities increased from 26.6% to 37.4%.[88]

After successfully implementing the approach in schools, Madagascar has adapted the three-star system for healthcare centres, and it is now operating in ten of the country's 22 regions.[89] Health facilities have been equipped with ceramic filters to improve the safety of drinking water, as well as handwashing stations and soap to improve hygiene practices. In addition, health personnel have been given training, reminders, and incentives to provide information to patients and families on basic hygiene practices, methods for household water treatment, and the importance of using latrines.

In the same fashion as the school programme, health facilities work their way up to three-star status (achievement of national standards) by expanding hygiene promotion activities and improving infrastructure. As of 2018, the programme has reached 590 healthcare facilities, serving 3.6m people, which represents 20% of rural primary healthcare facilities. Healthcare staff in these facilities are better equipped to adopt hygienic practices and had been given the tools and training to promote better health behaviours in the community.

# Teaching children about hygiene in schools is key to the life-course approach

Improving WASH in schools is particularly important because there are wider benefits. Not only is there the opportunity to increase the frequency of handwashing within schools, doing so encourages children to practise at home and to instil good behaviours for life. “You can make this a place where children have a model for having the infrastructure and privacy to care for themselves with the availability of soap and water. You integrate that into the hygiene curriculum that’s taught at school,” Dr Luby says.

Dr Prabhakaran, who develops WASH health modules for school health programmes in India, trains teachers to deliver them and assesses their impact, agrees.

***Children are “very impressionable” and can be “big change agents”, taking their positive handwashing behaviour home to encourage improved hygiene among other family members she says. However, despite efforts to improve WASH infrastructure within schools in India, Dr Prabharakan says that this remains a problem.***

Some schools in India are run by the Department of Education and others by the municipality. The state-run schools are generally better funded and so tend to have some WASH infrastructure, which could be a piped system and washbasins (albeit unlikely to be continuous), while others have tippy taps, which provide a hands-free way of handwashing without piped water.[90] Tippy taps require filling regularly, either from hand pumps or reservoirs.

Children learn the critical times for handwashing (such as before eating and after defecating) and the basic handwashing steps through the standard school curriculum delivered by teachers, says Samayita Ghosh, a Senior Research Associate at the Public Health Foundation of India’s Centre for Environmental Health who works with schools around Delhi. A hygiene programme developed by the Public Health Foundation of India to build on these basics is also delivered by teachers. Ms Ghosh’s role includes providing teacher training about hygiene, assessing pupil practice of hygiene measures such as handwashing and identifying any barriers.

Ms Ghosh says that access to clean water at home is often an issue, particularly for pupils living in informal settlements where it may have to be purchased, and parents’ misconceptions about handwashing can confuse the messages that children are learning at school.

Ms Ghosh adds that there are various misconceptions and complications that can lead to confusion around messaging related to handwashing (Table 3).

## Table 3: Misconceptions about handwashing in India

### Liquid soap

This is the type of soap that should be used for handwashing rather than bar soap. This misconception has arisen due to extensive advertising of liquid soap products.

### Focus on aesthetics

Teachers may focus on stopping children wearing nail polish and targeting visibly dirty hands, rather than encouraging handwashing before eating and after using the toilet.

### Hath dhona

In Indian culture there is the concept of hath dhona, the practice of washing your hands with water, as opposed to cleaning your hands with soap, so messages about handwashing messages can get confused.

Source: Personal communication with Samayita Ghosh, senior research associate at the Centre for Environmental Health, Public Health Foundation of India.

# Nudges for embedding better handwashing behaviour in children

At school, children are taught about the intensity of germs on different surfaces and the subsequent variation in exposures in different situations: for example, the differences between eating food at home and from a street vendor, and the differences between touching surfaces on public transport and at home. The children are then asked when it is more important to wash their hands. Children are told to prioritise handwashing with soap and water, and asked what they would do if none is available.

***"We show them pictorial representations of the impacts of different kinds of cleaning agents to show to what extent there is a decline in the number of germs on their hands," Ms Ghosh says.***

If there is no handwashing soap available at home, they are encouraged to use a squeeze of liquid or a pinch of powder detergent. The potential to use different water sources if there is no bottled or piped clean water available is also discussed, including the comparative contamination levels of different water sources, such as rainwater, recycled or grey water and surface water.

Others are trying novel approaches to boost hand hygiene practices in children.

For example, nudge theory shows how indirect encouragement and enablement can change behaviour.[91] In the context of handwashing, use of paved or painted pathways to connect toilets to handwashing stations, as well as the use of shoeprints and handprints on school infrastructure, have been shown to have an impact.[92,93] A proof of concept study found that these approaches increased the frequency of handwashing after toilet use from 14% to 64% in rural primary schools in Bangladesh.[94] The cost of the intervention was $161 per school, compared to the cost of an high intensity hygiene education programme, estimated at $206 for the first month and $53 for each subsequent month.[95] A subsequent trial in 20 primary schools found that after five months handwashing was as high in schools randomised to the nudge interventions as it was in schools that had delivered a four-week high intensity education intervention.[96] Nudges could have a potential role in continuing to reinforce positive hygiene behaviour following high intensity education, however their effectiveness in this capacity has not been assessed. Such nudge techniques can also be implemented in schools and homes in high-income settings to promote handwashing among children.[97] Making handwashing more fun, such as by encouraging singing with handwashing, and providing a personalised handwashing station, including using a favourite handwash or an eye-catching towel, may also encourage handwashing.[98] Dedicated apps for children that teach and reinforce handwashing are also available, such as Ella's Handwashing Adventure, which encourages players walking the main character through five handwashing steps.[99]

# Addressing issues of limited access to water and soap

Research has shown that as the distance that must be travelled to collect water increases, less water is collected. This highlights that, given the need for relatively large quantities of water to allow for regular handwashing, water collection points need to be accessible and in close proximity to a person's home, ideally with a collection time of within three minutes (Figure 7).[100]

In large parts of rural Africa it is still necessary to walk 5-10 km to a borehole where you can collect water and take it back for home use, says Joy Ruwodo, director of public affairs for the Ending Neglected Diseased (END) Fund Africa Region. "If you're carrying water, your priorities are drinking and cooking." Dr Luby says that data from LMIC countries show that where water is scarce and the recommended perfect hand washing is not achievable, incomplete or suboptimal handwashing with less water or without soap has some effect. (Figure 8)

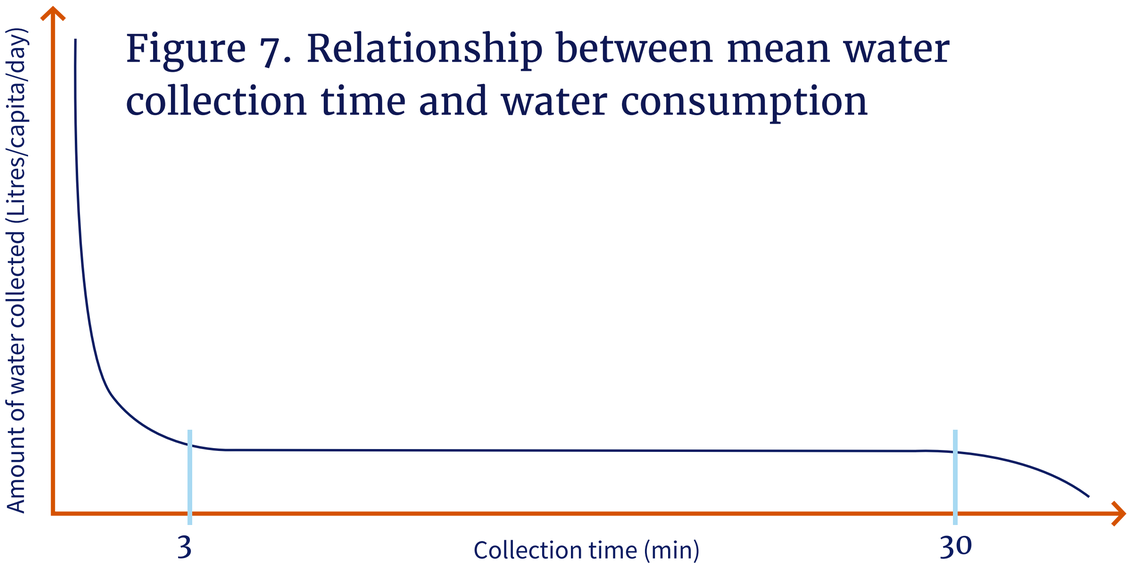



Figure 7. Relationship between mean water collection time and water consumption

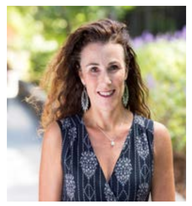
Source: Cairncross S and Feachem R. Environmental Health Engineering in the Tropics. 2nd edition. John Wiley and Sons, Chichester, 1993

For example, a study conducted by Dr Luby in Bangladesh found that children whose mothers practised handwashing with water alone before preparing food experienced much less diarrhoea than children whose mothers did not handwash at all.[101]

Soap may not be always available in low-income settings, as it is expensive relative to household income, and households may not want to leave soap at a common handwashing place in case it is stolen. Studies have shown that making up a bottle of soapy water using detergent can provide an effective handwash.[102,103] One study noted that in Bangladesh the average price of a common bar of soap is US$0.35, whereas a mixture of soapy water kept in a 1.5-litre reused bottle costs US$0.03; using soapy water instead of bar soap could save households approximately US$0.96 per month.[104]

There is also some limited evidence for using something abrasive, such as ash, sand or soil, which have been used traditionally in some LMICs as washing agents.[105,106]

"Soap is a surfactant, so it actually removes organic matter and a lot of the bacteria," Dr Luby says. "Given the choice of no hand washing or one of these alternative agents, then using one of these agents is probably a reasonable thing to do—but there isn't the same strength of evidence as there is for soap, water alone or alcohol gel."



According to Karin Leder, professor of clinical epidemiology and head of the Infectious Diseases Epidemiology Unit at the Monash University School of Public Health and Preventive Medicine in Melbourne, "a reason that ash could work is that some of its effect is from the mechanical rubbing action. Ash usually is alkaline, and this may inactivate some of the pathogens as well."

The white ash from the centre of a fire should have had all pathogens inactivated by the heat, so it should not be contaminated—although one disincentive may be that it does not smell very nice, she adds.

Dr Leder also points out that increasing handwashing practices is less about the comparative effectiveness of available agents and more about effecting behavioural change. "Most children and adults understand the importance of washing their hands, but that doesn't necessarily mean they do it every time," she says. "You've got to motivate people first to want to change, and then you've got to have the cues and the hardware or the soap or the water available, so that if they are motivated, they can actually handwash."

## Figure 8: Summary of options for handwashing

| Intervention | Effectiveness | Washing agent |
|---|---|---|
| Soap and clean water | The gold standard | Soap |
| Alcohol gel | Effective (if sufficient concentration), good when in situations of water scarcity, but expensive | |
| Recycled or grey water with soap | Can be quite effective | Detergent |
| Clean water alone | Less effective than with soap | Ash |
| Rain or grey water alone | Less effective than clean water | |
| Surface water alone | Most potential to be contaminated | Soil or sand |

Effectiveness

Most effective

Least effective

Source: Economist Intelligence Unit analysis.

Chapter 2

# Adolescence and hygiene: a focus on menstrual hygiene

Burden and consequences

Extent of impact

Access to sanitary products

Impact on health and safety

Impact on education

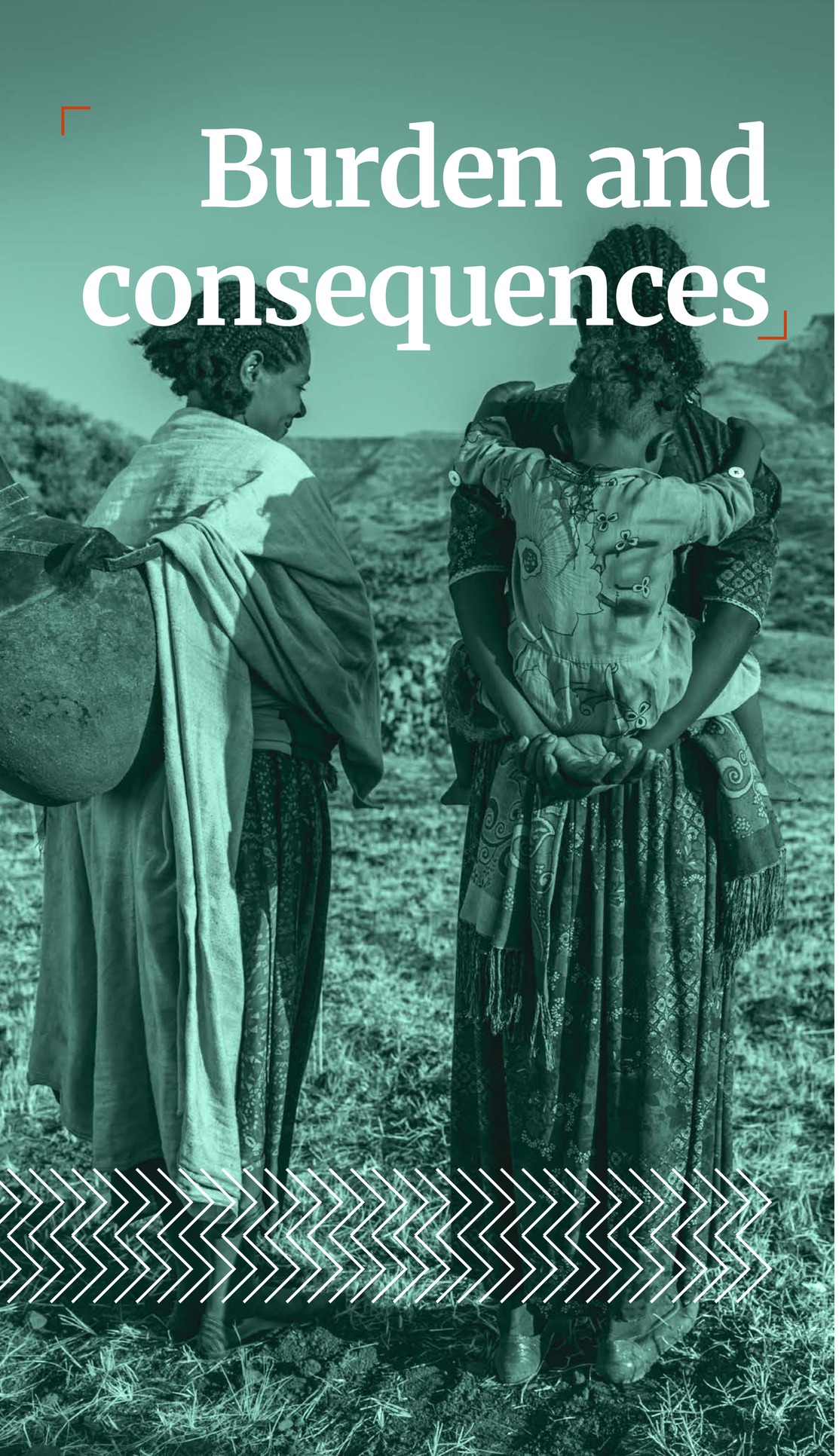
Impact on life-course of girls and women

A lesson from high-income countries on “period poverty”

Life-course approach

New focus: considering menstrual waste management and cups

# Burden and consequences



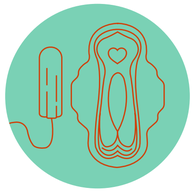
Menstrual hygiene refers to the management of hygiene associated with menstrual bleeding, a normal bodily function.

It is an under-researched area, considering that around 1.9bn women—some 26% of the world's population—are of menstruating age, spending around 65 days per annum managing menstrual blood flow.[107] Menstruation and menstrual practices are still subject to a multitude of social, cultural and religious restrictions that act as obstacles to better menstrual hygiene management.[108]

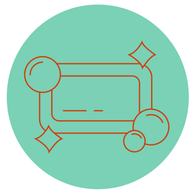
According to EIU analysis, if a woman menstruates every month from 13 to 51 years of age, they will have to manage 468 periods over 39 years. Assuming that these periods last for an average of five days, women spend 2,340 days—or 6.4 years of their lives—menstruating (not taking periods of pregnancy into account). Other estimates have put the figure at seven years.[109]

Regardless of the actual figure, menstrual hygiene is an important consideration for girls and women. If girls, adolescents and women change their sanitary protection products (or other materials, such as rags, the use of which is common in LMIC countries) four times a day, each individual will require 9,360 changes of sanitary protection in their lifetime, and the further need to interact with WASH facilities to support better hygiene practices. In the past 50 years fertility rates have fallen from more than 5 children per woman to 2.5, owing to greater availability of contraception and societal changes.[110] This means that women are spending less time pregnant and consequently experiencing a greater number of menses during their lifetime.

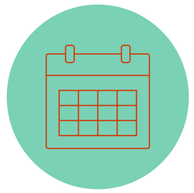
According to the WHO/UNICEF Joint Monitoring Programme for Water Supply Sanitation and Hygiene definition, adequate menstrual hygiene means that women and adolescent girls:



Are able to use clean menstrual management material to absorb or collect menstrual blood and which can be changed in privacy as often as necessary for the duration of a menstrual period



Are also able to use soap and water for washing the body as required, and have access to safe and convenient facilities to dispose of used menstrual management materials



Have an understanding of the basic facts linked to the menstrual cycle and how to manage it with dignity and without discomfort or fear.[111,112]

Targeting improvements in the management of menstrual hygiene will also contribute to meeting several SDGs. The related SDGs are SDG 4 ("Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"), SDG 5 ("Achieve gender equality and empower all women and girls") and SDG 6 ("Ensure availability and sustainable management of water and sanitation for all").[113]

# Extent of impact

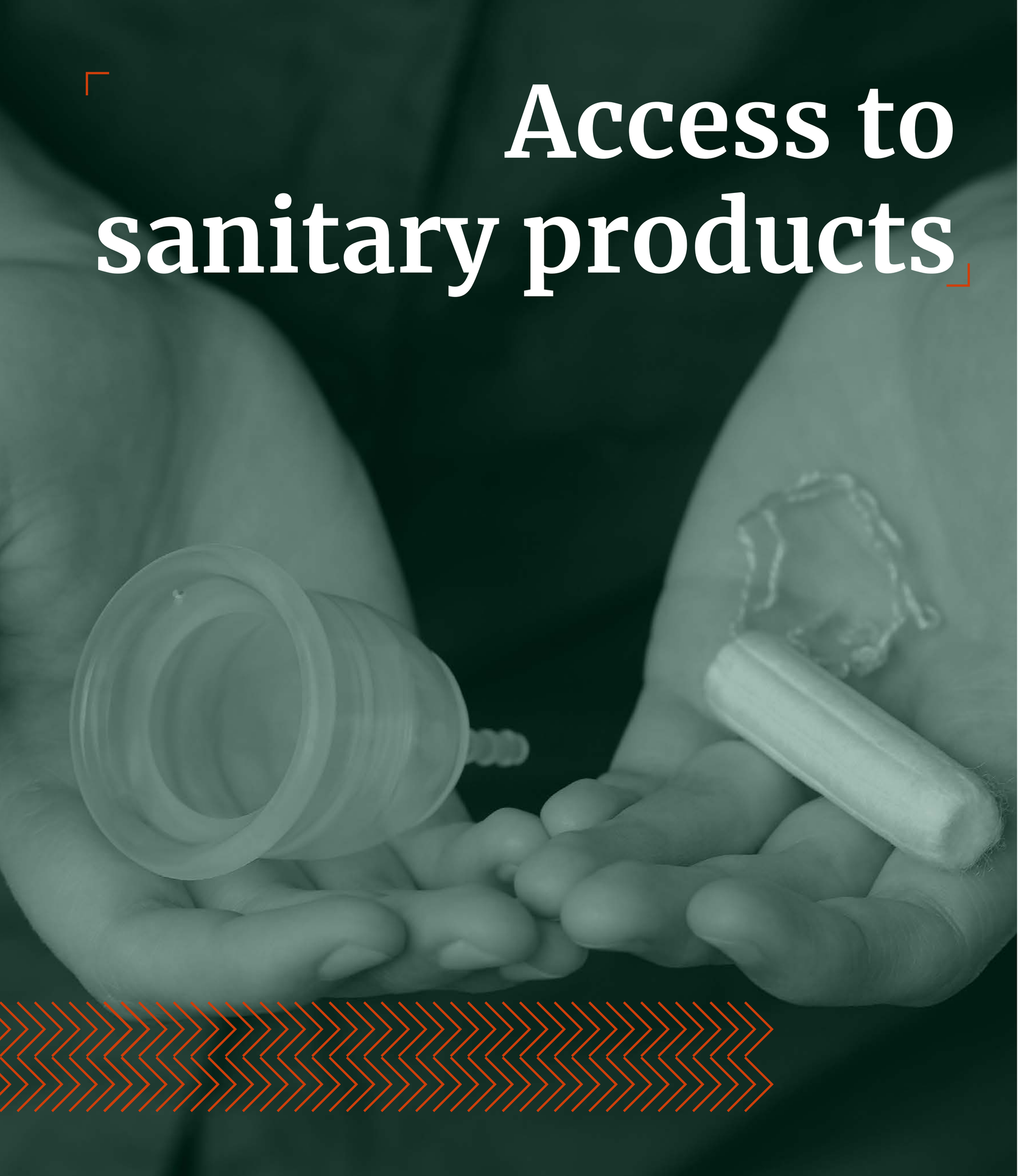
While menstrual hygiene issues impact girls and women across the globe, they have the biggest impact in LMICs. Similar challenges have been observed across countries, although the relative contribution of different issues varies across communities and settings.

According to Julie Hennegan, a research fellow with the Maternal, Child and Adolescent Health Program at the Burnet Institute in Melbourne, Australia, and an adjunct research associate at Johns Hopkins Bloomberg School of Public Health in the US, unmet menstrual needs include access to comfortable and preferred menstrual materials and products (which may be restricted by poverty and supply challenges), as well as access to satisfactory spaces for changing or disposing of materials, limited by sanitation infrastructure.

Menstruation is a topic of taboo and stigma across countries, and variable restrictions also impact women's lives—for example, in Nepal, harsh restrictions around movement during menstruation have been tackled with recent legal efforts.[114]

***"Menstrual hygiene management is a very frequent part of life for a large number of people, and so the cumulative exposure to having unmet needs can add up significantly over time," Ms Hennegan says.***

# Access to sanitary products



Girls, adolescents and women need access to effective, safe and affordable menstrual products.[115]

Most women in LMICs will often use rags, which they launder and reuse at least some of the time because of the high cost of disposable pads and tampons.

A recent analysis of survey data from ten countries (Uganda, Kenya, Ethiopia, Ghana, Burkina Faso, Niger, Nigeria—specifically the cities of Lagos and Kaduna—Democratic Republic of Congo—specifically the capital, Kinshasa, and Kongo Central—Indonesia, and India) found that exclusive use of menstrual pads ranged from 9.7% in Niger to 87.7% in Indonesia.[116] Less than half of women reported using pads alone or in combination with other methods in Ethiopia, Burkina Faso, Niger, Kaduna, Kongo Central, and Rajasthan in India, with over half reporting using only cloth in Burkina Faso, Niger, and Kaduna.[117]

While use of cloth was common in places with low pad use, other alternatives included cotton wool, tissue or newspaper (used by one in four women in Kongo Central), foam, and, in Ethiopia, even a bucket.[118] A relatively high percentage of women reported using nothing to manage their menses in Ethiopia (11.1%), Niger (4.3%) and Burkina Faso (3.7%).[119]

# Impact on health and safety

The availability of hygiene facilities also has an impact on health and safety. A lack of safe WASH facilities and private or enclosed toilet facilities increases the vulnerability of women and girls to harassment and crime when they need to change their sanitary protection.[120]

The experts we spoke to told us that gendered and private facilities are important in LMICs, as they allow women to not only feel safe using toilets, but also to be comfortable changing their sanitary protection, and able to wash pads and clothing, if necessary. Women in LMICs often choose places other than communal latrines to change their sanitary protection, such as the kitchen or their bedroom,[121] says Kelly Alexander, senior learning and influencing advisor on WASH and water resource management for CARE, an international humanitarian organisation, in the US. This could be “anywhere that they could find privacy and safety”, she adds.

Privacy is also an issue for women needing to launder their reusable pads and clothing. Some refugee camps are introducing new practices to support better menstrual hygiene practices. For example, refugee camps in Cox’s Bazar in Bangladesh have introduced some gendered water collection points to enable women to access water more easily (previously they “always had to go to the back of the line” behind men, says Ms Alexander), in addition to some safe spaces where they can launder and dry their reusable pads and clothes. Similar safe spaces have been implemented in refugee camps in Malawi, too.

For good hygiene and to protect their health, all women using reusable rags should dry them in the sun to take advantage of the antimicrobial properties of UV light. However, laundering is often done without soap or with unclean water, and social restrictions and taboos can mean that drying may be done indoors rather than in sunlight or open air.[122]

A proportion of urogenital tract infections are likely due to poor menstrual hygiene management rather than sexual transmission, although the extent is unclear.[123] In particular, bacterial vaginosis and vulvovaginal candidiasis can be related to poor personal hygiene and hygiene of materials used for absorbing menstrual blood. Both these conditions have been linked to increased risk of HIV infection,[124,125] and bacterial vaginosis also with adverse pregnancy outcomes.[126]

# Impact on education

Menstruation impacts the education of girls across the globe, including their attendance, engagement with lessons and the likelihood that they will complete their formal education. However, the extent of absenteeism related to menstruation is extremely difficult to measure, as school absences are influenced by numerous other factors, including gender bias, economic pressures and early marriage, according to experts we interviewed. Attendance data often do not capture true reasons for absences, nor do they capture absences for part days, says Ms Alexander.

Girls may be absent due to menstruation because they do not have access to sanitary products, toilets or water, which makes it difficult to support good hygiene practices, associated pain or heavy bleeding.

Cultural expectations are also a factor. In many countries, there is an expectation that girls avoid religious and other social activities, contact with males, or even any interaction outside the home during menstruation.[127] Those girls that do attend class may not participate or concentrate as well, Alexander adds, because they are anxious or embarrassed that their pad might show or that they may have a leak and stains. A quarter of menstruating girls in India reported missing school during periods,[128] and one in five adolescent girls in Uganda (median age 16) reported missing at least one day of school, during their most recent period.[129]

Studies show that schools that implement measures to provide education about menstruation and free sanitary pads to schoolgirls can help to improve school attendance. In Uganda, for example, schools that implemented such interventions had 17% higher attendance levels than schools that did not implement the intervention. Attendance rates still fell in both sets of schools but reasons for declining attendance of girls are complex including, household responsibilities, early pregnancy and marriage and prioritisation of boys' education.[130] A small study of a similar intervention in Ghana found that attendance improved by 9% after five months.[131] According to Ms Alexander, her experience in the field suggests that even simple initiatives, such as providing a room at school for girls to rest if they are having cramps, as has been implemented by CARE in Ethiopia, can reduce absenteeism. Menstruation even has an adverse impact on girls attending school by affecting their concentration and engagement, Ms Hennegan points out, although to what extent is still unknown.[132]

# Impact on life-course of girls and women

In many countries such as Kenya, Ethiopia, Bangladesh, and Nepal, there is a view that starting menstruation means that girls are ready for marriage so they drop out of school because they are married off, according to experts we interviewed.

Monitoring data from CARE projects in Zimbabwe and Somalia also found that absenteeism among both girls and female teachers was lower in schools that had a reliable water source, according to unpublished findings from projects implementing activities on Climate Change Resilience in schools, says Ms Alexander.

Many female teachers have to collect water for their home; having a water source at their place of work means that they can access water far more easily, she says. “It was one less thing that they had to deal with.”

“When there’s running water in the school, it helps the girls in multiple ways,” says Ms Alexander. “They can bring water home; maybe it’s because they can wash their hands, or perhaps it is because the latrines are cleaner. It should be obvious that having a water supply makes people more comfortable in their environment.”

There has been little research into how disruption of education, work and social interactions related to menstruation impacts on the life chances of girls or what the related the economic impact is for them, their families and the wider economy, Ms Hennegan says. This is partly because it is difficult to measure.[133]

“The big economic benefits from menstrual hygiene are likely to be in quality of life, such as dignity and whether needs are met, which researchers have recently started measuring but not yet valuing monetarily,” says Mr Ross.

“We’re talking about a significant effect on a suite of different outcomes, all of which likely contribute to your broader life chances and engagement, but demonstrating that effect scientifically—that’s a big effort,” Ms Hennegan explains. Research into menstrual hygiene is “woefully underfunded”, she adds, so researchers have to focus on short-term outcomes to access funding. To enable longer-term studies, a better understanding is needed of how menstruation is interlinked with other issues, such as gender inequality, poverty and access to resources. What we do know is that working women often have to take time off during menstruation owing to a lack of WASH facilities and of privacy for changing their sanitary protection at the workplace, experts we interviewed said.[134,135] While empowered women and dignified work are critical to better business, there is even less data on the impact of period poverty on the workplace and psychosocial impacts than there are for educational settings.[136,137] Much of the data that are available are related to women in high-income countries, rather than those in lower-income countries who are unlikely to be paid if they miss work. For example, menstruation was found to be responsible for an average of 1.3 days off work and 8.9 days in lost productivity per year for female workers in the Netherlands.[138]

According to Dr Nabarro, the impact is even worse in LMICs, where female staff may take four or five days off per month because there are no WASH facilities.

A multinational consumer goods company noticed this among female workers in their tea plantations and provided facilities for them, he says. But, he adds, “there are hundreds of millions of other women who are working in poor countries in awful circumstances, who’ve just got no facilities for their menstruation. It’s really, really bad. It’s one of the most neglected areas of human life.”

Problems with access to sanitary products, arising from their unaffordability, can also be an issue for women in low-income groups in high-income countries.

## A lesson from high-income countries on “period poverty”

Scotland is the forerunner in efforts to tackle “period poverty”, being the first country in the world to give girls and women a legal right to free sanitary products. At the end of November 2020 the Scottish Parliament unanimously passed the Sanitary Products (Free Provision) (Scotland) Bill, which gives a legal right of free access to sanitary towels and tampons in public buildings, such as community centres and libraries, and makes it mandatory for education institutions to provide them.

Free sanitary products have been available from some schools, universities and public buildings since 2018, in response to attention drawn to the issue by the health spokesperson for the Scottish Labour Party, Monica Lennon, who tabled the bill and has also conducted a three-year campaign for free sanitary products.[139] Ms Lennon argued that research showed that one in seven girls in the UK had struggled to afford sanitary products, and that one in ten had been unable to afford them. [140,141]

“When you go into a public building, toilet roll is there free at the point of need. It should be the same for period products. It’s a normal bodily function, a fact of life and the alternative is that people bleed through their clothing,” she said. “I know how big a difference it will make to the lives of women and girls and everyone who menstruates in Scotland, and will hopefully inspire similar action in other parts of the world.”[142]

Other countries and regions, including England and the state of Victoria in Australia, have already followed Scotland’s lead and are making free sanitary products available in publicly funded schools.[143,144]

The campaign for free sanitary products in Scotland has also put an increased focus on menstrual wellbeing and education there, including a recognition that the school curriculum has been lacking in terms of arming girls with knowledge about their menstrual cycle, Lennon has said. [145]

But period poverty is not the only menstrual hygiene issue affecting girls and women in high-income countries, points out Julie Hennegan, a research fellow at the Burnet Institute in Melbourne, Australia, and adjunct research associate at Johns Hopkins Bloomberg School of Public Health in the US. Like those in low- and middle-income countries, girls in wealthier countries have to deal with a persisting stigma around menstruation, which is reflected both in how it is talked about and in women and girls’ desire to keep the fact that they are menstruating hidden, menstrual pain and heavy bleeding, and toilets that are not designed for sanitary protection other than single use disposable pads. “All of these [issues] are still very present in high-income countries,” she says.

# Life-course approach

Improving menstrual hygiene management is complex. It crosses over many domains outside of the availability of WASH facilities and hygiene practices, including cultural, religious and social perceptions, sexual discrimination, economic attainment, the environment, sustainability, and female empowerment. Regardless, girls and women need access to appropriate sanitary products, the use of safe and private places to change their sanitary protection and maintain hygiene, and supportive environments around them at home, school and work.

According to the experts we spoke to, tackling these issues begins with education of girls themselves, to ensure that they understand how to manage menstruation, what choices are available for doing this, and to dispel myths around menstruation. “Many girls are utterly unprepared for their first period, so it becomes a traumatic experience,” says Mr Duncan. “Capacity to get the girls the knowledge they need is challenging. Those living in poverty are likely to use cloth pads, and they need a clear understanding of how to use them hygienically, how to wash and dry them properly.”

Programmes providing information to girls on menstrual management are being run in some LMIC countries. The content varies, but is likely to include:

The different sanitary protection options and how to use them, clean them and dispose of them

What menstruation is and how the person in question should look after herself (that is, firstly, that her body is maturing—and not that she is ready for marriage—and, secondly, managing potential symptoms such as pain, and the significance of different blood flows and discharges)

The importance of good personal hygiene and disposal of sanitary waste

What a woman can do during her period (tackling taboos)

Menstruation is not a subject that engenders openness, and there many misconceptions around it, so ensuring that girls are equipped to deal with it is a subject that should be addressed specifically within schools, experts say. However, despite an increasing focus on this, there is still a long way to go in many countries. For example, in Bangladesh, only 6% of schools provide education on menstrual hygiene management.[146]

Where school programmes do not exist, adolescent girls will generally learn about menstruation from older female family members, usually their mother. In Bangladesh it is reported that the mother is the primary source of information about reproductive health for 62% of girls, with 78% reporting that their mother was the first person that they talked to about getting their first period.[147] Girls who had little or no communication about reproductive health with their mothers tended to obtain information from friends and the media, although it is unclear whether media use is a consequence or a driver of poor communication between girls and mothers in terms of menstruation.[148]

In many cases where the mother is the primary source of information, conversations do not take place until a girl starts menstruating, which can mean that her first period is a frightening experience. Mothers provide factual information about menstruation, but it is often framed in the context of protecting them from pregnancy and so may use fear or scare tactics.[149]

The education of wider society is also important to ensure that girls are supported at home, at school and in the workplace. While in the past menstruation has been seen firmly as a female issue, in recent years there has been more of a focus in schools on educating boys and male teachers about menstruation.

“Certainly, educating them to the point where they are allies about this, rather than stumbling blocks is obviously going to be really important,” says Ms Hennegan, but that education has to be go further than just the mechanics of menstruation as that can be “sensitising”. “We have evidence from other spaces like HIV, that just giving people information about HIV doesn’t reduce stigma for people experiencing it. We have to apply the knowledge that we have from other spaces and be smart about the way that we address this in menstrual health.”

Men, who generally hold the purse strings in LMIC households, are increasingly being brought into conversations about menstruation in interventions targeting communities in countries such as in Malawi, Ghana, and India, says Ms Alexander. She says that CARE has specifically been working on elevating understanding of the needs of menstruating girls and women at a household level—and importantly addressing taboos about women's mobility, and women working in agriculture and outside the home. Husbands and wives have rarely had conversations about menstruation, and there is openness on all sides to address misconceptions on the subject and find collective solutions for women and girls.

## New focus: considering menstrual waste management and cups

While it is clear that ready access to sanitary products is a necessity for all girls and women, there is no single silver bullet answer, in terms of menstrual products, when it comes to ensuring provision in LMICs. A growing area of debate, though, is around menstrual waste management.

When girls have disposable sanitary products, they have the issue of where they are going to dispose of them, and how that impacts sanitation and waste disposal systems. On the other hand, if they use reusable products (such as rags), they face challenges related to successfully laundering items (in terms of water access and access to private spaces for washing and drying).

There is a growing focus on menstrual waste management in school programmes addressing menstrual hygiene, to ensure that sanitary products are disposed of correctly, rather than thrown into toilets (where they block sewerage systems) or open bins (where they attract animals), says Samayita Ghosh, senior research associate at the Public Health Foundation of India's Centre for Environmental Health.

***"We are talking about sustainable hygiene practices and the choices for managing menstruation in school and at home," she says.***

Some schools have incinerators for disposable sanitary products, but girls need to know how to use them, or what to do with sanitary product waste if the school does not have an incinerator or an active dustbin for them. When asked what they would prefer to use, most girls and women will say disposable pads—partly because this is the main option advertised—but the experts we spoke to said that this can have adverse consequences for countries such as India and Kenya, which have huge populations and where disposal of solid waste is already a problem.

It is important to make sure that women are aware and consider all their options, including reusable pads, menstrual panties and cups, says Kelly Alexander, senior learning and influencing advisor on Water+ (WASH and water resource management) for CARE, an international humanitarian organisation in the US.

Despite efforts in Kenya to improve menstrual hygiene (in 2004 the country became the first to remove taxes on sanitary products and in 2010 it became the first nation in the world to provide free sanitary pads in schools) many women still struggle to access sanitary products.[150] Ms Alexander, who was involved in one of the first studies of menstrual cups in Kenya, which offered them to school girls for free, says that they proved surprisingly successful, despite fears they wouldn't be because of taboos around virginity.[151] "My personal theory is because the cup is shaped like a cup and not like a tampon, which is shaped like a penis—that helps," she says.

Ms Alexander and her colleagues ran awareness sessions with parents, and by the end of them mothers were telling their daughters "they will use these things", she says, because it made more economic sense than buying sanitary pads every month, and they were more practical than rags. But some like Julie Hennegan, a research fellow at the Burnet Institute in Melbourne, Australia, and Adjunct Research Associate at Johns Hopkins Bloomberg School of Public Health in the US, point out that while cups are a good option for many, they do not suit all girls and women, as they still require either boiling and sterilisation and are a high-value product for a low-income setting, which raises challenges if they are lost or damaged (such as being melted when boiled to achieve sterilisation).[152]

CARE has been teaching poor and vulnerable women to make reusable pads, which both help them to manage their menstrual hygiene and represent a business opportunity for them. "In Madagascar, where women in some places don't regularly wear underwear, under their skirts, a set of seamstresses came up with their own design for making pads that don't require underwear," says Ms Alexander. "The local hospital started buying them for the women who were giving birth to use them as their postpartum pads."

Chapter 3

# Adults and hygiene: a focus on slums

Growing numbers of people living in slums

Burden of infectious disease in slums

Improving hygiene behaviours in slums

Barrier to hygiene: Slum dwellers pay more for clean water

Improving hygiene in slums through infrastructure development

What's so flash about flush toilets? Implications for LMICs

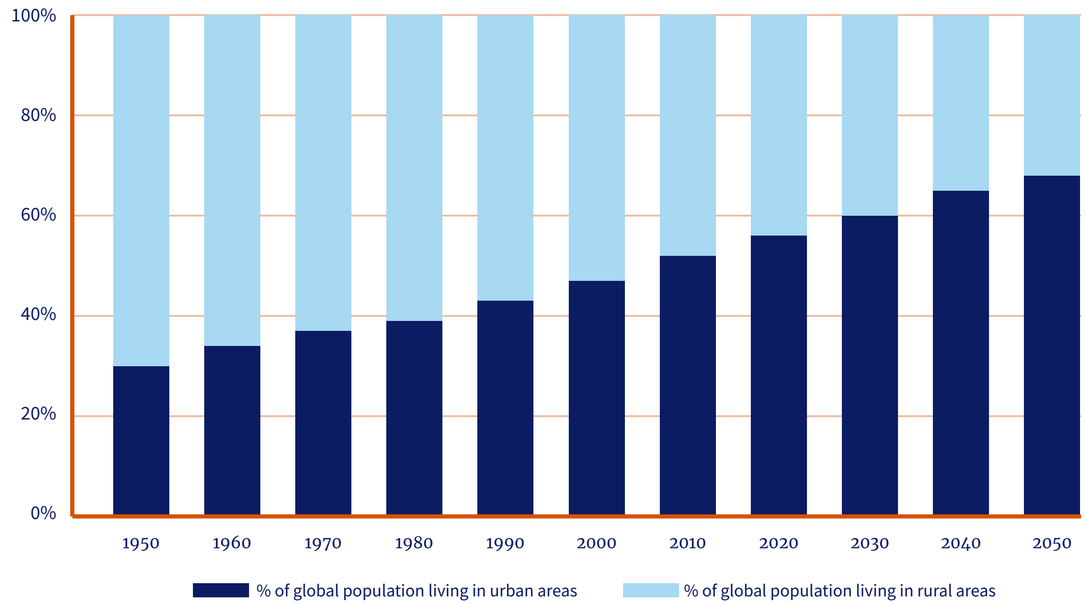
Examples of urban improvements

# Growing numbers of people living in slums

As adults are drawn from rural areas to towns and cities in search of work opportunities and a desire for a better quality of life, the world is becoming an increasingly urbanised place. About 56% of the world's population currently live in an urban area—almost double the 30% that did so in 1950—and this level is set to rise to 68% by 2050 (Figure 9).

Under a life-course approach, good handwashing behaviours should be learned in childhood, but this urban demographic shift has an impact on how people are able to access WASH facilities and practise hygiene behaviours. Currently, opportunities for targeted interventions to reinforce the importance of personal hygiene during adulthood are limited, especially in informal settlements where residents may have limited interaction with health services, alongside unstable work and living arrangements. Those opportunities that do exist generally target women during pregnancy and early motherhood, and are focused on hygiene measures to improve the health and wider outcomes of children. Hygiene initiatives targeting adults in general—and men specifically—are lacking.

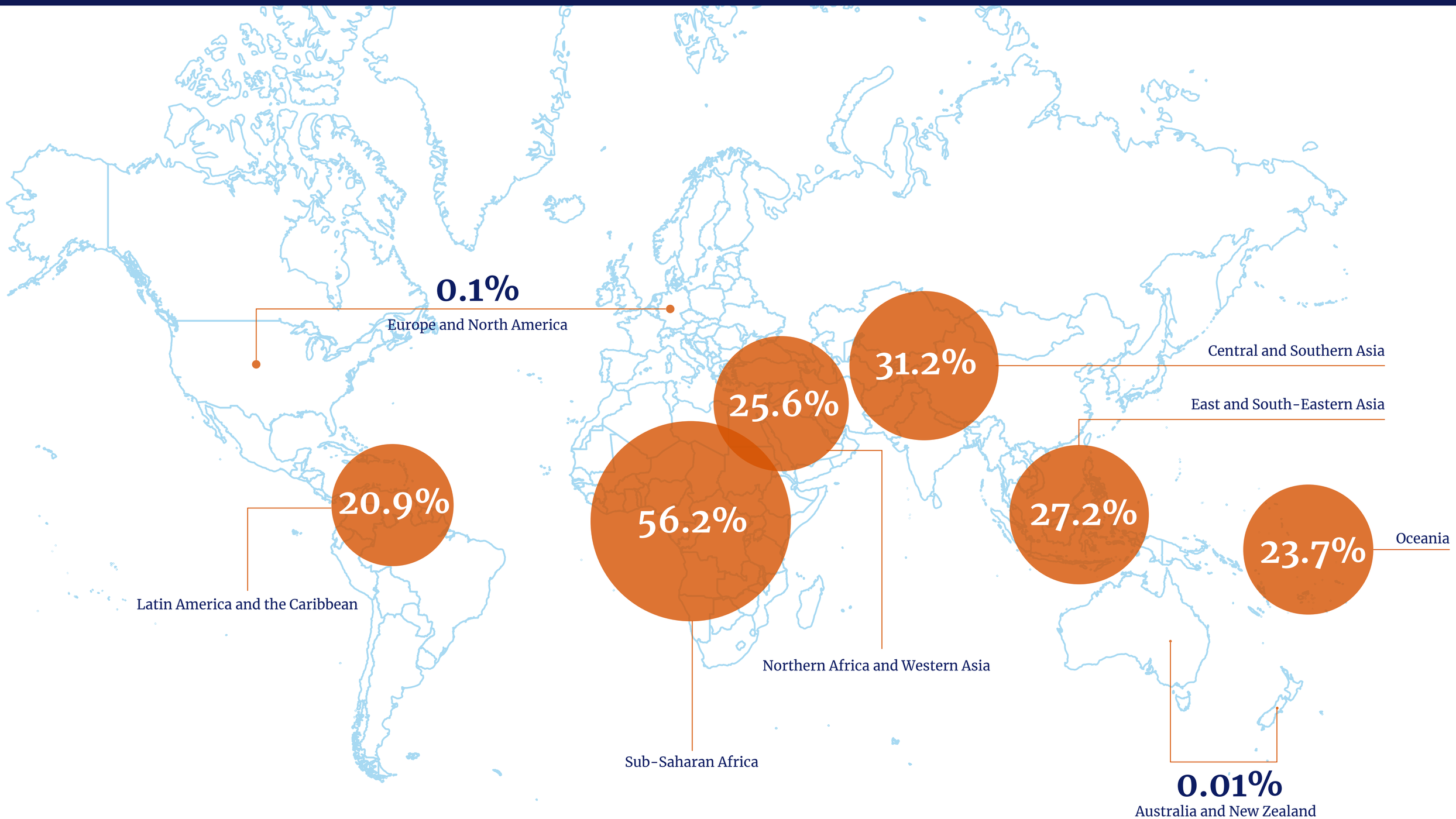
## Figure 9. Urbanisation of the world (past, present and future)




Source: United Nations 2018 Revision of World Urbanisation Prospects.

Over 90% of this urban growth is occurring in LMICs, and the number of residents in urban areas of developing countries is growing by an estimated 70m each year.[153] Over the next two decades, the urban population of the world's two poorest regions—South Asia and Sub-Saharan Africa—is expected to double, suggesting that the absolute number of people living in informal settlements and slums in these regions will grow dramatically.[154] These regions already have the world's highest proportions of urban slum dwellers (Figure 10).

## Figure 10. Share of the urban population living in slums (by region)




Source: UN Habitat, Urban Indicators Database (accessed 18 November 2020).

The UN defines someone to be a slum dweller if they live in a household that has one or more of the following:

Inadequate access to safe water

Inadequate access to sanitation and infrastructure

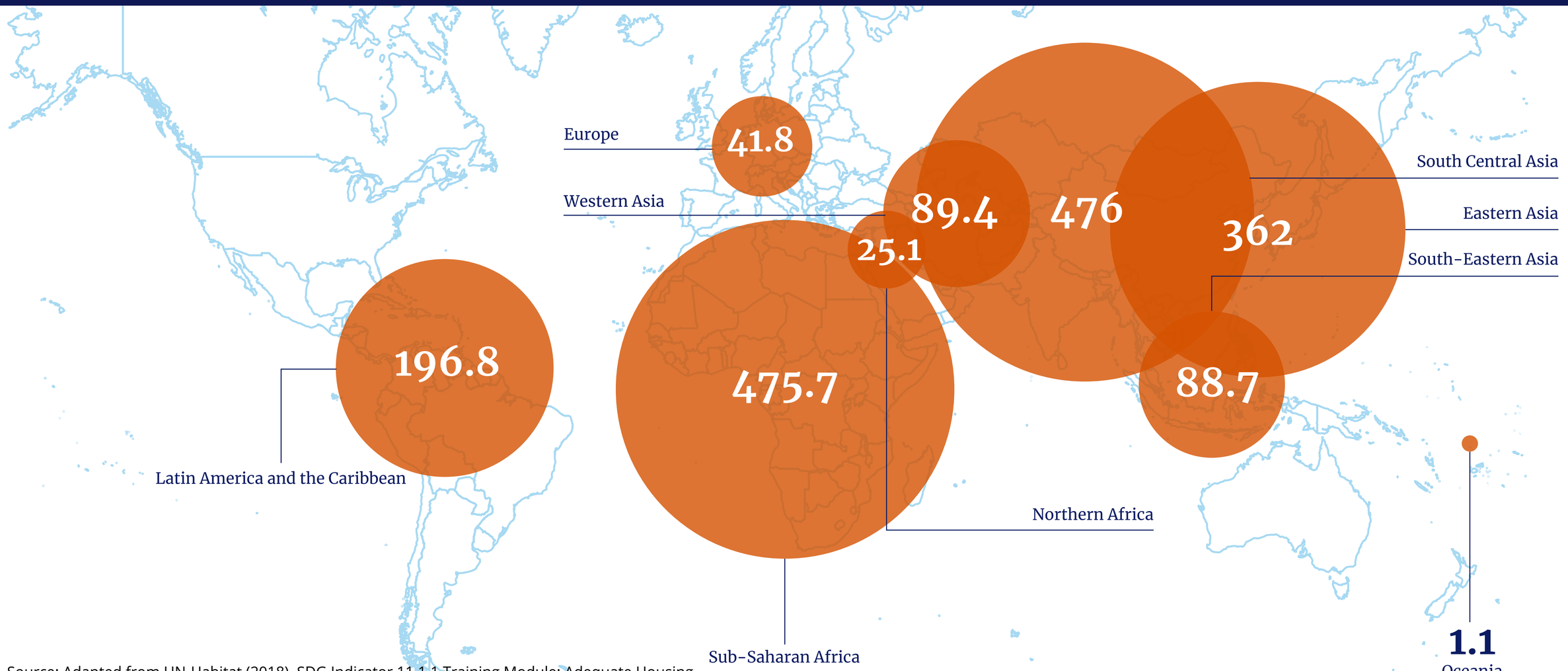
Poor structural quality of housing

Overcrowding

Insecure residential status.[155]

Living in these conditions clearly has implications in terms of people's ability to perform hygiene behaviours such as handwashing. According to the UN definition, around a quarter of world's population lives in slums, the majority in LMICs.[156] While the proportion of the urban population living in slums in LMICs has actually fallen, from around 39% in 2000 to 30% in 2014, the absolute numbers of residents living in slums has continued to grow, partly due to accelerating urbanisation, population growth and the lack of appropriate land and housing policies.[157] It is estimated that more than 880m urban residents live in slum conditions today, compared with 792m in 2000 and 689m in 1990.[158] This trend is expected to continue (see Figure 11 which shows the anticipated absolute slum populations by region in 2025).

## Figure 11. Projected slum populations by region in 2025 (millions)




Source: Adapted from UN-Habitat (2018). SDG Indicator 11.1.1 Training Module: Adequate Housing and Slum Upgrading. United Nations Human Settlement Programme (UN-Habitat), Nairobi.

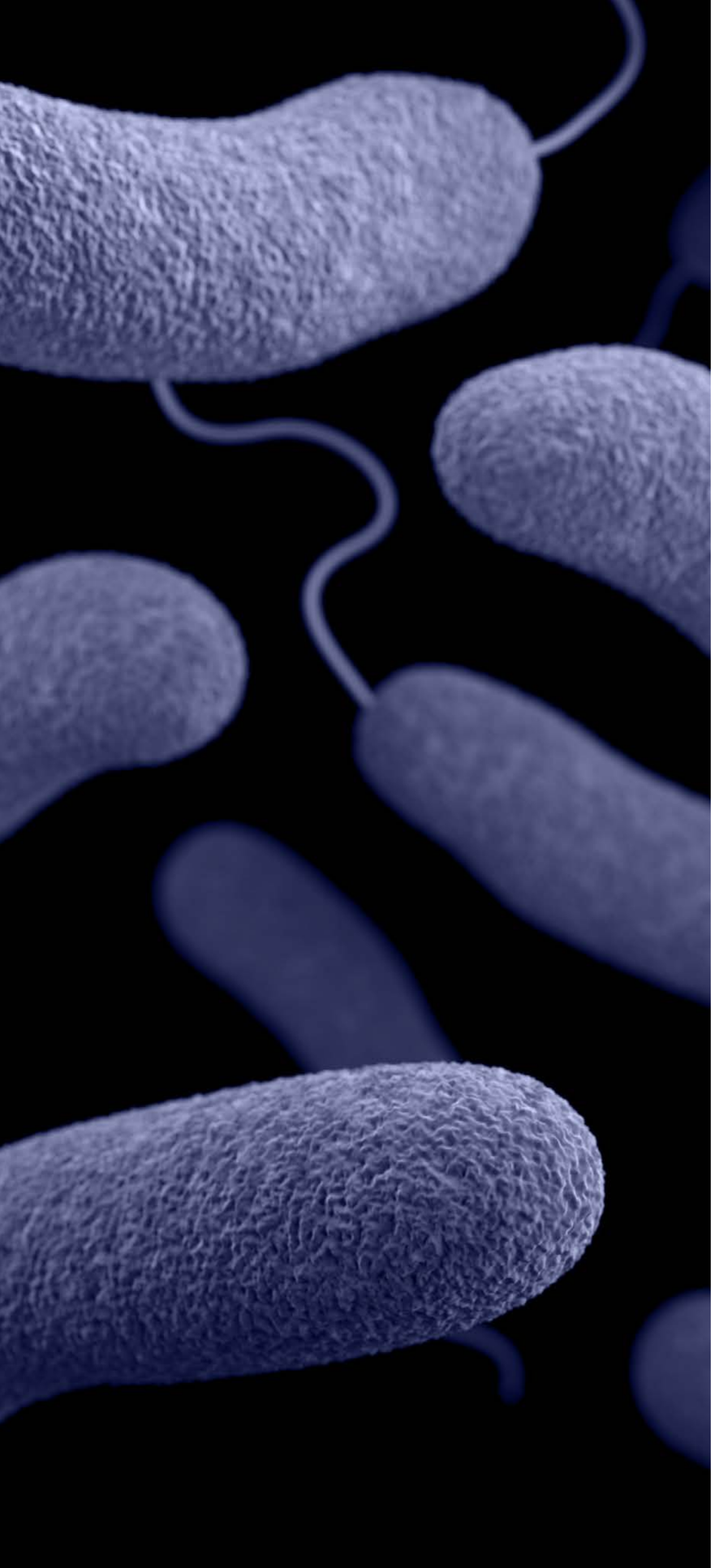
However, some experts say that official slum population estimates do not reflect the reality on the ground. Jason Corburn, professor at the School of Public Health and Department of City and Regional Planning, and director of the Institute of Urban and Regional Development at the University of California Berkeley, says that the UN definition for a slums or informal settlements is “quite narrow”.

Mr Corburn says that many more people are living in unsecure or dangerous conditions—such as informal self-built communities, pavement dwellings and housing not made of stable materials—and lack access to clean water and effective sanitation, which reduces their ability to engage in hygiene behaviours. “All these create hygiene and health issues,” he says.

“Even in the wealthiest parts of Europe or North America, we have communities that are not connected to the water and sewerage systems required to support basic hygiene behaviour,” says Mr Corburn.

***“Why have we as a society allowed this lack of life-supporting infrastructure for the millions who are increasingly living in these urban conditions?”***

Upgrading slums helps to reduce social inequalities by improving the physical living conditions, quality of life, and access to services and opportunities for slum dwellers; it also can bring economic benefits to the wider community.[159]



# Burden of infectious diseases in slums

Better infrastructure around water access and sanitation also helps to create the environment for better hygiene practices. Conditions in slums make people more vulnerable to communicable disease, and this has an impact on life expectancy. While the poorest 20% of people living in cities—predominantly slum dwellers—struggle to reach 55 years of age, the richest 40% live well beyond 70 years.[160] Similarly, the under-five mortality rate among the poorest 20% of city dwellers is more than double that of the wealthier urban quintile.[161]

Living conditions, particularly overcrowding, inadequate safe water and poor housing, affect hygiene, drive transmission of many infectious diseases. Overcrowding creates the conditions for widespread transmission of infections responsible for tuberculosis, respiratory diseases, pharyngitis, meningitis, scabies, superinfections of the skin and rheumatic heart disease.

Those living in slum areas are susceptible to diseases that rarely affect residents of adjacent affluent areas.[162] Increased rat populations contribute to transmission of leptospirosis and typhus, open sewers contribute to hookworm, leptospirosis, diarrhoea, cholera, dengue, malaria, hepatitis and growth retardation. Mosquitoes thrive in communities living in overcrowded conditions where there is surface water (such as uncovered water butts); by consequence, so can mosquito-borne diseases such as malaria, dengue and Zika virus.[163]

The incidence of some infectious diseases in informal settlements and wider communities in LMICs varies between the sexes. Women are often considered to be at greater risk of diseases caused by many water-based parasites, because, as the primary water fetchers and launderers, they spend more time in contact with surface water, and this is the case in some localities.[164] As primary carers of young children, women are also highly exposed to infection with diarrhoeal pathogens, as they regularly handle the faeces of children likely to be infected. According to the experts we spoke to, women in slums particularly often lack access to safe water for handwashing and sanitation facilities for disposal of child faeces.

A recent meta-analysis found that while patterns can vary locally, there is generally a higher prevalence of hookworm, *Schistosoma mansoni, Schistosoma japonicum* and infectious diarrhoea in males. It is suspected that this is due to men having more exposure to larvae in contaminated soil and water, as they are more likely to work in agriculture and fishing. Women in some countries tend to be less affected, as they are prohibited from swimming and fishing by cultural and religious practices.[165]

The increased prevalence of infectious diarrhoea in males found in this meta-analysis is thought to be due to men being less stringent in their hand hygiene practices. Studies of handwashing practices during the severe acute respiratory syndrome (SARS) and covid-19 outbreaks found that women were far more likely to practise hand hygiene measures than men.[166,167]

# Improving hygiene behaviours in slums

There is very little evidence on the practice of hygiene in slum areas, and what evidence does exist is generally low quality, owing to small sample sizes, drop-outs and methodological issues. Most studies focus on handwashing practices in children, highlighting, as in other settings, that poor handwashing practices are associated with episodes of diarrhoea and stunting in children.[168,169,170] Efforts to improve hygiene practices among carers (in terms of general hygiene, including handwashing at key times and food preparation) are also focused on improving outcomes in children.[171]

Some studies have shown that handwashing interventions may reduce episodes of diarrhoea in children living in slums, but researchers emphasise that handwashing interventions are insufficient alone—action is also needed on "the root causes of childhood infections". For children living in highly contaminated, over-crowded environments with poor access to clean water and sanitation, handwashing may be necessary but not sufficient to reduce the mechanism that leads to growth faltering, researchers have concluded.[172] Likewise, interventions targeting adults' ability to successfully follow hygiene practices, particularly food-hygiene practices, may be limited by the socioeconomic context and contingent on improvements in large-scale infrastructure and material living conditions.[173]

The management of child faeces in slums, which represents a health risk not only to the carer of the child but also to other young children in the household, presents a particular challenge. A study of 851 children aged over five years living in slums in two cities in Odisha, India, found that only 27.4% of children who could walk defecated directly into a latrine.[174] Children who did not defecate in a latrine mainly did so on the ground. Use of nappies or potties was extremely low, at 1.2% and 2.8% respectively. If faeces was removed from the ground, the defecation area was usually cleaned only with water. Most children's faeces were disposed of in the surrounding environment, ending up in household waste, drains or canals, with only 6.5% deposited into any kind of latrine. Handwashing with soap by the carer after cleaning up and disposing of the child's faeces was uncommon, as was cleaning around the child's anus with soap.

As mentioned previously, efforts to improve hygiene practices, particularly handwashing, have generally been focused on children and women. However, research shows a generally higher prevalence of pathogens associated with poor hygiene in men, which has been attributed to a lower adherence to recommended handwashing practices.[175]

Studies suggest that differences in the knowledge and practice of hygiene behaviour between the sexes manifest early in development.[176,177] A survey of 104 children at a primary school in Kolkata, India, found that girls were significantly more knowledgeable than boys about the importance and practices of maintaining personal hygiene, which included handwashing, teeth cleaning, bathing and changing their clothes.[178]

Another study, which assessed the knowledge of 169 children in an urban slum in Indonesia, suggests that differences in knowledge between the sexes translate into practice in childhood. Researchers observed handwashing practices and tested hands for presence of faecal matter and *Escherichia coli (E. coli).* Counts of the latter were lower in those with better handwashing techniques, and girls had significantly fewer *E. coli* bacteria on their hands than the boys did.[179]

As well as poor WASH infrastructure, there are other barriers to good hygiene practices in slums, including access to soap (due to low incomes of residents). Handwashing practice also varies at different critical points. While 81% of 80 children interviewed in a slum in Odisha reported that they practised hand washing before taking food, only 17.5% used soap, and only 61% used soap after using the toilet.[180] While handwashing with soap was acknowledged as being better than using water alone by almost all (96%) of 150 mothers surveyed in the same slum, 28% did not hand wash with soap after the toilet, suggesting cost of or ability to buy soap was an issue.[181] Handwashing with or without soap was practiced by 85% of the women before preparing food and by 77% before serving food.[182]

Improvements to WASH infrastructure have been shown to improve handwashing. For example, researchers observed the handwashing practices of 27 mothers living in a peri-urban community of Lima, the capital of Peru, before and after the installation of piped water and sewerage in the street outside their housing plots. After water and sewerage were connected, mothers were approximately twice as likely to wash their hands immediately after defecation.[183] However, there was no significant difference in the proportion handwashing after cleaning a child, after urination, or before handling food or eating. This emphasises the need for infrastructure improvements to be coupled with initiatives to reinforce handwashing behaviour. Overall, after installation of piped water and sewerage, handwashing with or without soap occurred immediately after 48% of defecation events and within the 15 minutes prior to 8% of handling food events.

Ms Ghosh has been involved in projects working with people living in slums around Delhi that with have tried to encourage handwashing. At the outset there was a lot of resistance to the messaging, she explains. “They thought what they were doing was correct, and that there was no need for change. They thought that keeping their housing space tidy, covering their food, and their personal hygiene measures were enough,” she said. “There was resistance towards even listening to the hygiene drivers and understanding what those critical times when they need to wash their hands are.”

Over time, the situation has improved slightly, although there is a long way to go, says Ms Ghosh. “I will not vouch for them complying with the messaging of the importance of washing their hands at all critical times, but they have a reception of those messages.”

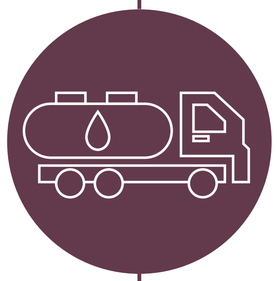
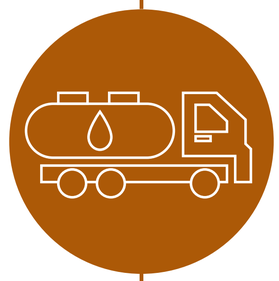
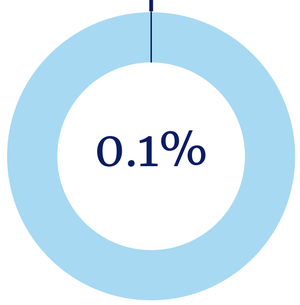
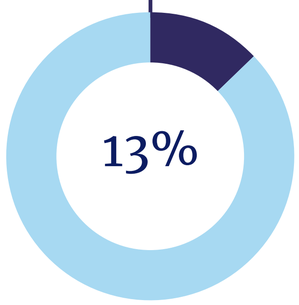
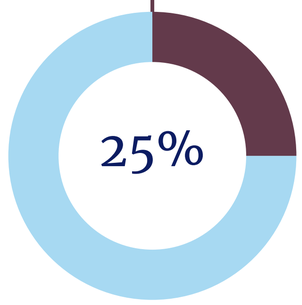
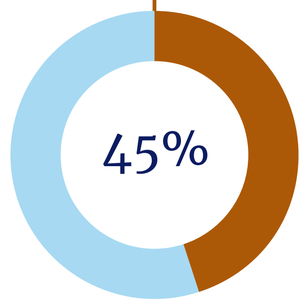
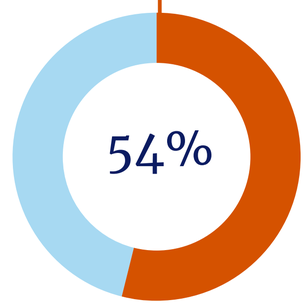
## Barrier to hygiene: Slum dwellers pay more for clean water

Many people living in slums do not have access to clean water or sanitation, which makes it challenging to achieve better hygiene behaviours. Experts say that this lack of infrastructure touches on issues such as unaddressed poverty, segregation, racism and vested economic interests.

While wealth is growing, so is inequality, and there are “incredible economic incentives and interests at play” to keep the status quo and to keep people disconnected from urban infrastructure, says Mr Corburn. This includes informal cartels that deliver water or energy and sell it at a very high price, and also control access to shared latrines.[184,185] “Somebody has a lock on that door, and you pay, whatever it might be, per use. Everything has a cost. If someone has to clean that pit latrine, it doesn’t just operate by itself, somebody has to deliver the water,” he says. “There are economic incentives because people are willing to pay, even the poor are willing to pay, if it’s a quality and safe service.”

People who live in slums are paying a “poverty penalty”, which means that they pay much more per litre of water, or per disposal per unit of energy, than wealthier people. “This is another barrier to hygiene, because their costs are 10 to 100 times more, depending on where you look around the world for those basic services,” says Mr Corburn. “They’re paying an informal service, they’re paying for a poor-quality service, they’re paying for polluted water and they have to store it, which you don’t have to do in other places.”

## Cost of water for 50 litres of water per day (the WHO-recommended household level)

| Region | UK | Maputo, Mozambique | Accra, Ghana | Antananarivo, Madagascar | Port Moresby, Papua New Guinea |
|---|---|---|---|---|---|
| Conventional supply |  |  |  |  |  |
| Cost per 50 litres | $0.10 | $0.12 | $0.62 | $0.69 | $2.53 |
| Percentage of typical low daily salary |  0.1% |  13% |  25% |  45% |  54% |

**The poor pay more for clean water**

Source: Wateraid. Briefing Water: At What Cost? The State of the World's Water, 2016.

# Improving hygiene in slums through infrastructure development

Poor or non-existent infrastructure for clean water and sanitation is a key barrier to improving hygiene and hygiene practices in slum communities, but improving it is challenging. Some experts want to see better alignment between government departments to improve all elements of WASH, including hygiene, to tackle infectious diseases.

One problem, highlighted by Ms Ruwodo, is that in many countries the government ministry responsible for health is usually a separate entity from the ministry responsible for water and sanitation. “A more coordinated strategy is required, where health ministries could work with local implementing partners to undertake disease mapping,” says Ms Ruwodo. “That mapping could then inform decisions made by water and sanitation departments around where to invest in WASH infrastructure and hygiene.

How can we eliminate certain infectious diseases if we don’t take steps towards breaking transmission? That can only happen through WASH interventions.”

In some cases, residents of slums are squatting, meaning that there is little motivation for landowners or governments to invest in improving infrastructure in these areas. But this is not unsurmountable. “What we’ve learned from Latin America is that people will remain as renters and squatters if the infrastructure is there,” says Mr Corburn. “In many cities in Latin America, even in the informal sector, 90%-plus have water and sewers—it’s not always well connected or functioning, but it’s a much higher percentage than in Sub-Saharan Africa.”

Slum improvement initiatives that have generated improvements in health and wellbeing share three characteristics:

Residents are involved in the co-creation and implementation of projects

A desire to improve public health is a central objective (that is, the prevention of disease rather than its treatment)

Initiatives have been co-financed by multiple sources

Examples of initiatives that encompass these values include the National Slum Upgrading Programme in Indonesia, which aims to eradicate slums and provide 100% coverage of water and sanitation; a project to improve living conditions in informal settlements in the Argentinian capital, Buenos Aires, through improving infrastructure, housing, public spaces, community facilities and economic development; and a project targeting rapidly growing settlements on the periphery of Karachi, Pakistan.[186,187,188]

NGOs, private developers or donors cannot build this kind of infrastructure alone; it requires government buy-in and investment, says Mr Corburn. “If government and utilities are invested in putting in that infrastructure, they will also be invested in ensuring that these communities are improved, and that people who live there won’t be displaced.”

People praise Sir Joseph Bazalgette as the engineer who created the sewer network in London in the 1800s (see Box: What’s so flash about flush toilets? Implications for LMICs). But Dr Luby disagrees: “In my opinion, it was really parliament that acknowledged that there were almost 200 independent water authorities and a problem with collaboration. Politically, they were able to centralise authority in one, and generate the revenues to make it happen.”

The creation of London’s sewer system offers lessons for poorer countries. In LMICs there is “a mish-mash” of water and sewerage authorities rather than a central organisation, and huge political and economic barriers to building and running these systems, says Dr Luby.

Since sewers were transformed in nineteenth century London and cholera cases fell as a result, we have learned a lot more about what causes diseases, and these are not tackled simply by reducing exposure to germs, says Mr Corburn. “Social inequalities are actually at the core of health inequalities, even if you have water and sewer [systems] and you live in a wealthy country,” he says. “The social inequalities cause stressors in people’s lives from *in utero.* We talk about the life-course, which means as we age those stressors are what’s contributing to susceptibility to infectious disease and the rise of chronic illness. Those hormones that get released in stressful situations when you’re living in deprivation, or when you’re living in a segregated community, whether it’s in London, or Lagos. That is as, or more important, than the behavioural things. If we also can’t reduce those stressors, we won’t change the biology, even with the clean water and with toilets.”

## What's so flash about flush toilets? Implications for LMICs

Sewage systems around the world are modelled on the design that was implemented in London by Sir Joseph Bazalgette in the late 19th century. Bazalgette built large super-tunnels to connect smaller sewers that were dumping raw sewerage into the River Thames, which runs through the centre of the city. The new system virtually eliminated the cholera outbreaks that had ravaged the city.  The modern flush toilet also has its origins in England. In 1592 Sir John Harington invented a water closet with a raised cistern and a small downpipe through which water ran to flush the waste. Then, in 1775, Alexander Cummings, a watchmaker, developed the S-shaped pipe under the toilet basin to keep out foul odours.[190]

However, while such designs have worked for London, which is not a dry city, they have not in many water-stressed LMIC urban areas where water is not available 24 hours per day, even where it is piped.

Humans produce significant amounts of waste. In a year, one person produces about 500 litres of urine and 50 kg of faeces. To flush away these excrements, a flush toilet requires an average 12,000 litres of water per year.[191] These large amounts of water required become severely contaminated with small amounts of faecal pathogens, meaning that they need to be collected and cleaned, which requires expensive sewage and treatment systems.

"If we think about very densely populated dry cities, those designs do not work. One of the things that we need to do is to realise that after nearly 200 years, we shouldn't be using a technology that was developed for a very different context, and this is hard because civil engineering tends to be a very conservative profession," says Stephen Luby, professor of medicine and director of research at the Center for Innovation in Global Health at Stanford University in the US.

Dr Luby points out that some exciting work around water-sensitive cities, what the Chinese call "sponge cities", to think about how we can use water more effectively. A sponge city does not allow water to filter through the ground, but absorbs the rain water, which is then naturally filtered by the soil and allowed to reach the urban aquifers. This allows water to be extracted from urban or peri-urban wells and treated so that it can supply a city.[192]

"It's not just the toilet," says Dr Luby. "We need to rethink the whole sanitation system and put some of our best thinking around strategies to separate the faecal stream of densely-populated, low-income communities from the environment."

This is not a simple problem, experts emphasise, because municipal water supplies and sewers are expensive to build and complex to maintain.

# Examples of urban improvements

## Singapore's transformation to one of the world's most cleanest cities[193]

In the 1960s Singapore had two types of toilet system: squat toilets, where household waste was collected in a bucket under a hole in a squat toilet, covered with soil to minimise the odour and collected mainly at night to be transported to collection centres; and pit latrines shared by a number of families. There were frequent outbreaks of typhoid fever and diarrhoea.

The Deep Tunnel Sewerage System led to an improved sewerage system, and this along with a focus on water recycling technologies has turned once polluted rivers into a sustainable water supply. The Housing Development Board worked to improve public housing which now came with flush toilets.

"Singapore did not just focus on toilets; they improved housing, they improved the whole system," says Stephen Luby, professor of medicine and director of research at the Center for Innovation in Global Health at Stanford University in the US. "They upgraded those entire neighbourhoods to housing standards that were healthier. [But] obviously Singapore has a lot of wealth, and there was a strong state able to do it, and that's not the case in the slums of Sub-Saharan Africa, South Asia or Latin America."

## Condominial water and sewerage in Brazil[194,195]

The condominial approach to the construction of water and sewerage networks was developed in Brazil during the 1980s as a response to the challenges posed by expanding services into peri-urban neighbourhoods. It has been successfully applied to urban neighbourhoods as diverse as the Rocinha favela in Rio de Janeiro and the affluent Lago Sul and Lago Norte districts of the capital, Brasilia.

Whereas conventional systems essentially provide services to each housing unit, condominial systems deliver services to each housing block or any group of dwellings that could be termed a neighbourhood unit or "condominium". The public network therefore does not need to run through every plot of land or be present in every street, but merely to provide a single connection point to each city block so that the required length of the network is considerably shorter (about half the length for sewerage and about a quarter of the length for water service). Condominial branches serve the buildings on the blocks.

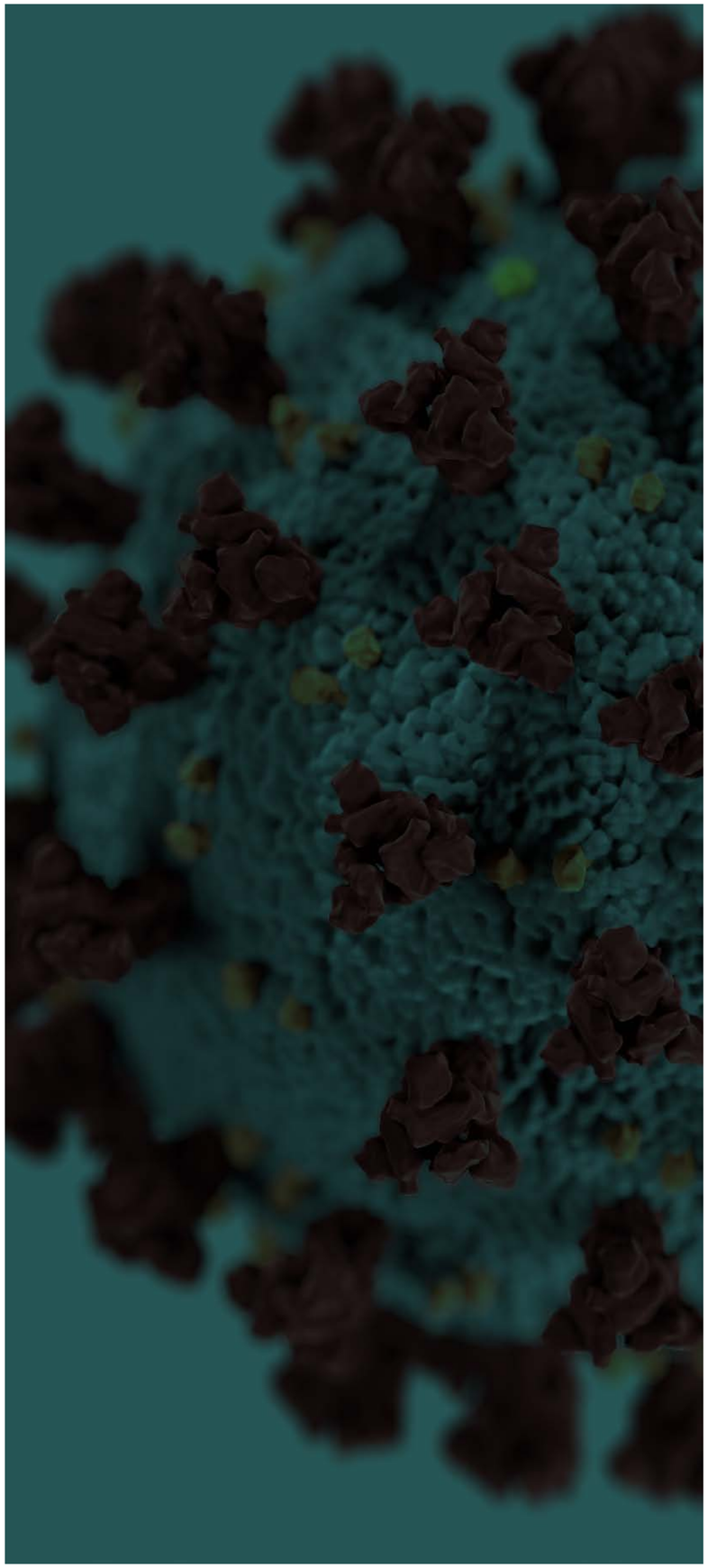
In such a system there is a much closer relationship between service providers and users. Members of the condominium commit themselves to actions ranging from education to direct participation in the design, construction and/or the maintenance process. The approach also enables water and sanitary services to be expanded at very low financial cost to the utility company.

***"It wasn't just about the infrastructure, it was about planning, it was about the maintenance and management, which of course, we know is part of proper well-functioning infrastructure," says Professor Jason Corburn.***

In 2009 Elinor Ostrom, a US economist, was awarded the Nobel Prize for Economics for her work demonstrating how local property can be successfully managed by members of a society without any regulation by central authorities or privatisation—this project was an example used by Ms Ostrom.[196]

Chapter 4

# Older people and hygiene: a focus on respiratory infections



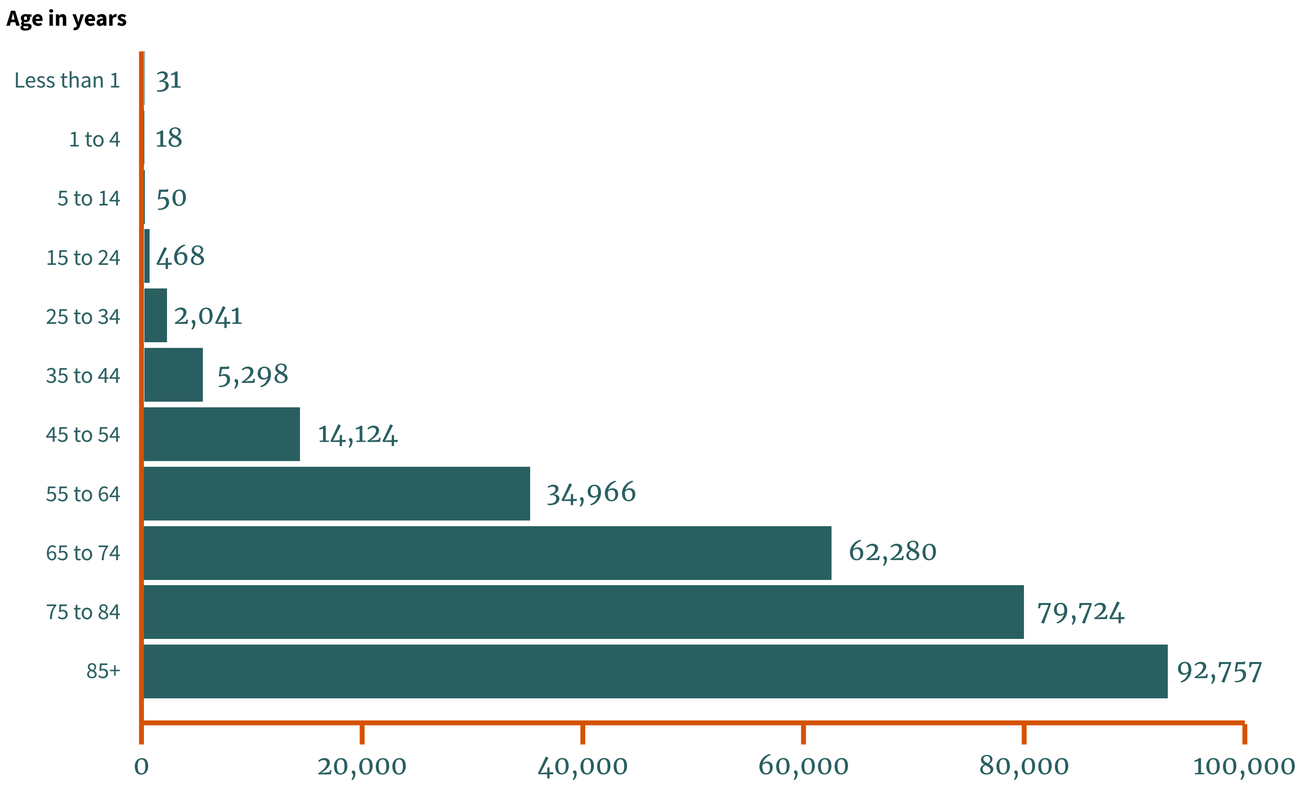
# A focus on respiratory infections

2020 marked the importance of hygiene standards for preventing respiratory infection. The particular risks posed to older people by respiratory disease is being seen in the covid-19 pandemic, as they have made up the majority of deaths (Figure 12). For example, until December 23, 2020, 92% of covid-19 deaths in the US had occurred among those aged 55 or older, and only 0.2% in the under-25s.[197]

While it can be expected that older people should have a good knowledge and practice of hygiene behaviours under the concept of a life-course approach, having learned them in childhood, adolescence and adulthood, this is less likely to be the case for the majority of older people at present, particularly those living in LMICs. Few will have received specific hygiene education at school, and subsequent targeted hygiene interventions have tended to be targeted at younger populations, particularly mothers.

The practice of hygiene behaviours by older people may also be hampered by frailty and degenerative disease, with the most frail relying on carers for their hygiene.

## Figure 12: Covid-19 deaths by age in the US (as at December 23rd 2020)




Source: The Heritage Foundation.

# Burden of respiratory disease

Lower respiratory tract infections (LRTIs) were the fourth most common cause of early death and disability (measured as DALYs) globally in 2017, and diarrhoeal diseases were the fifth most common.[198] LRTIs such as influenza and pneumonia accounted for 106m DALYs and diarrhoeal diseases 81m DALYs, about 7% of global DALYs in total.[199] Deaths from LRTIs are highest in the under-5 and over-70 age groups (see Table 4), and most of this burden occurs in countries with low socio-demographic development.[200]

## Table 4: Episodes and deaths in the elderly attributable to lower respiratory infections, 2016

| | All ages | | | | Childern younger than 5 years | | | | Adults older than 70 years | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Deaths | Deaths per 100,000 people | Millions of episodes | Episodes per 1,000 people | Deaths | Deaths per 100,000 people | Millions of episodes | Episodes per 1,000 people | Deaths | Deaths per 100,000 people | Millions of episodes | Episodes per 1,000 people |
| **Global** | 2,377,697 | 32.2 | 336.46 | 45.5 | 652,572 | 103.3 | 68.06 | 107.7 | 1,080,958 | 267.4 | 62.84 | 155.4 |

Source: GBD 2016 Lower Respiratory Infections Collaborators. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory infections in 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet Infectious Diseases 2018;18(11): 1191–1210.

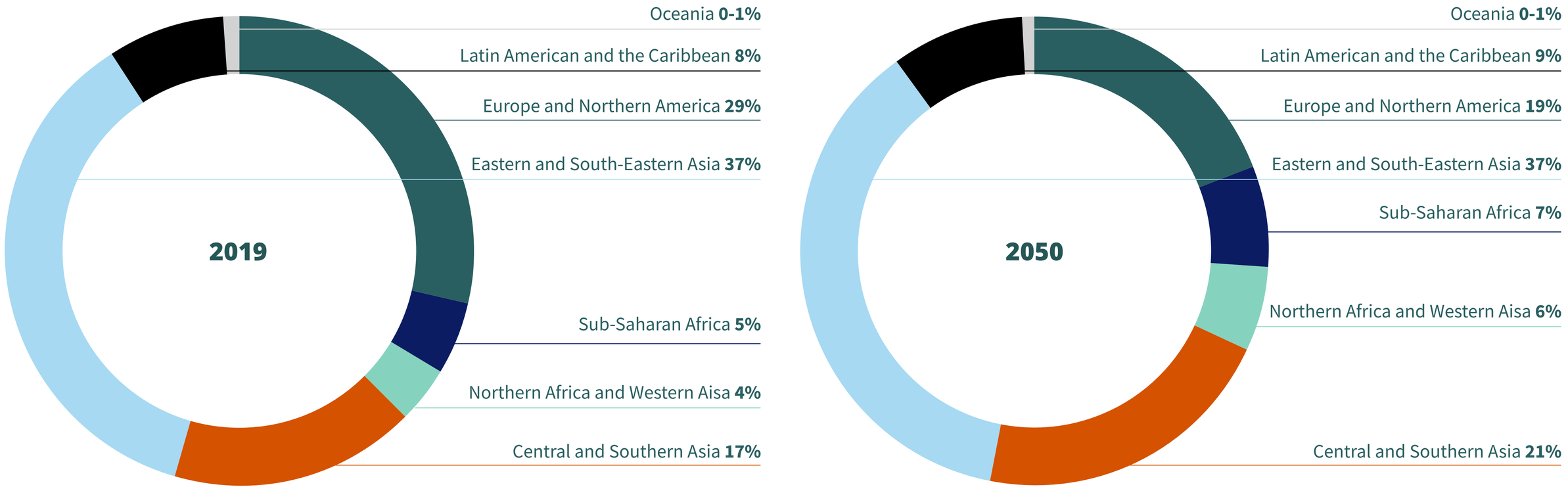
The Global Burden of Disease study estimates that in 2017 lack of access to handwashing facilities with soap and water was responsible for 707,000 deaths globally (188,000 as a result of LRTI), and 38.4m DALYs (10.3m due to LRTI). WASH as a whole was responsible for 1.6m deaths and 84.4m DALYs.[201]

The death rate among the over 70s did not change much between 2000 and 2016, going from 278 to 267 per 100,000 population.[202] However, the ageing global population has meant that the numbers of LRTI deaths among the over 70s increased by 45% (to 1,080,958).[203]

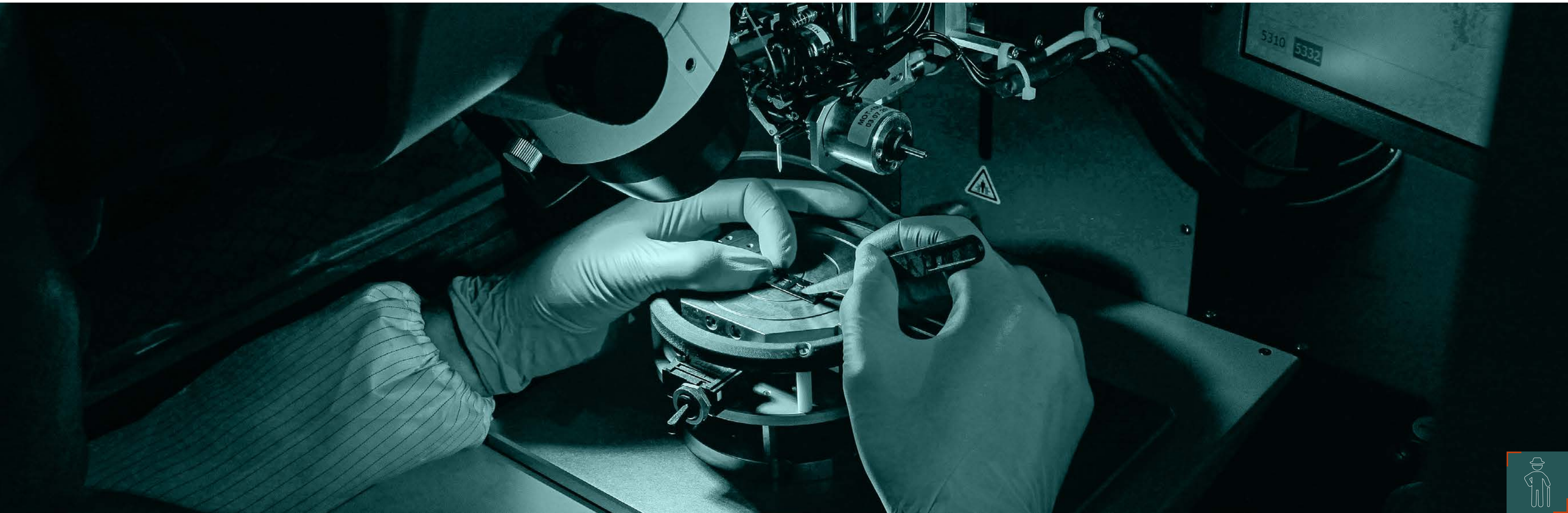
These figures are pre-covid-19, and it is expected that the impact of respiratory infections and poor hygiene for 2020 will be much higher.

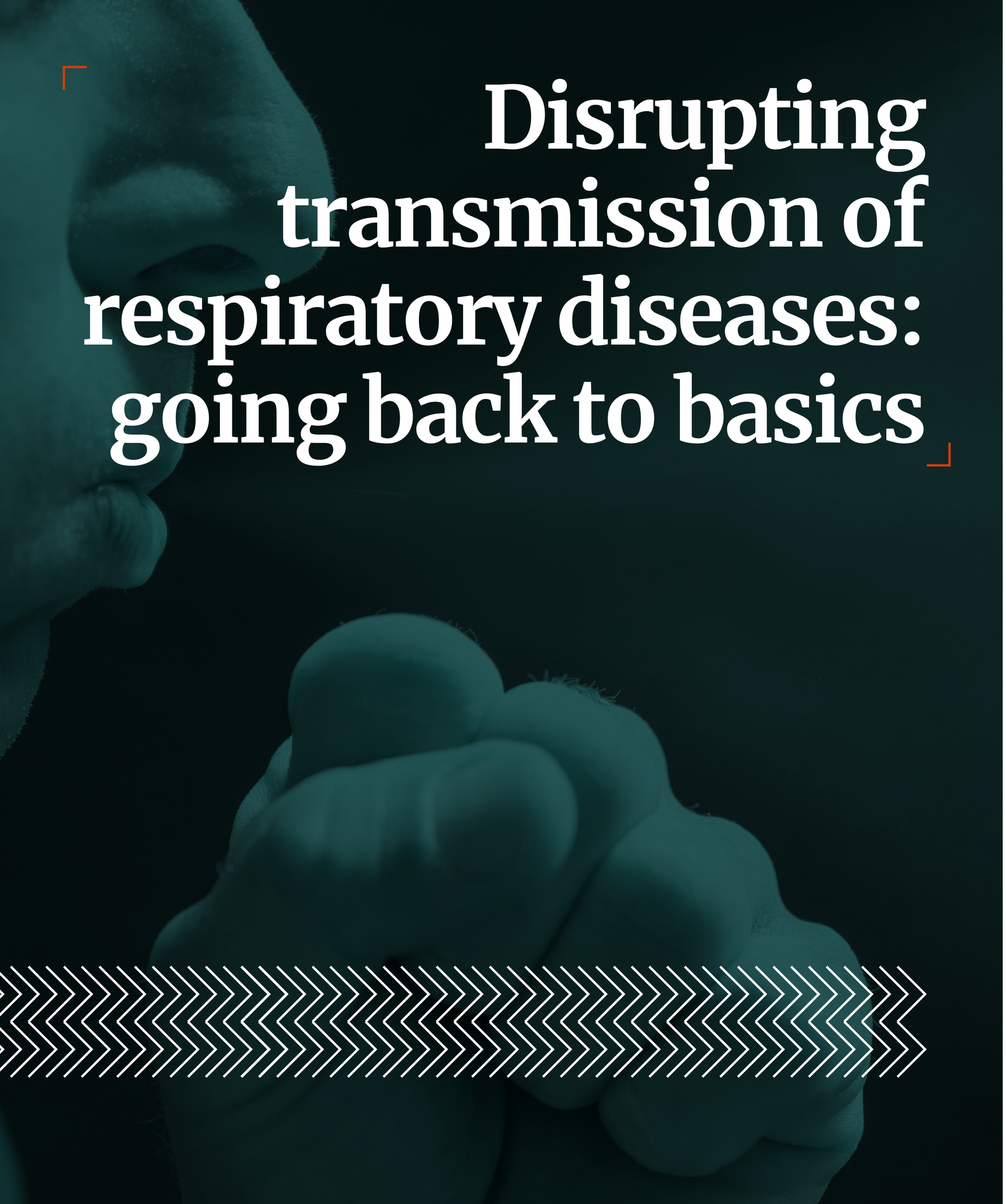
Currently high income countries (like Europe and North America) have a high proportion of the population aged over 65 (Figure 13), but as people in LMICs age, the burden of disease impacting them, including respiratory disease, will also grow. For example, estimates suggest that the infection-fatality ratio for covid-19 is around 2-3 deaths per 1,000 infections in low-income countries. By contrast, a ratio of 6-10 deaths per 1,000 infections has been observed in high-income countries with older populations.[204]

## Figure 13. Distribution of population aged 65 years or over by region, 2019 and 2050 (percentage)




Source: United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019.*





# Disrupting transmission of respiratory diseases: going back to basics

Much of the focus on reducing respiratory infections has been on the use of vaccines, particularly against influenza. However, the emergence of novel coronaviruses causing SARS, MERS and covid-19 has necessitated a renewed focus on hygiene principles to prevent transmission.

“We are really having to bring it back to these basic principles with covid-19 where we don’t yet have good drugs or widely distributed vaccines,” says Dr Leder. “We’re really relying on more old-fashioned preventive approaches that we know are valid.”

These are approaches, which Dr Leder describes as “more intuitive”, perhaps haven’t spiked much interest from researchers or received prominence in the scientific literature before now.

Respiratory pathogens can be transmitted from an infected individual to a susceptible person by a variety of routes including contact, droplets and aerosols, and body fluids such as saliva, mucus and tears.[205]

Droplets generated by an infected person during coughing, sneezing or talking can infect the mucosa of a close contact, either directly or indirectly after landing on the contact’s hand or environmental surfaces. Some pathogens can be transmitted via aerosols, which are generated in the same way as droplets, but remain in the air for longer. Sharing food, utensils, towels or toothbrushes with an infected individual or kissing can spread infection through body fluids such as saliva.[206] Infected individuals can infect others through direct contact, such as a handshake.

Environmental surfaces which can be contaminated with infectious microorganisms are known as fomites, and these pathogens can then be picked up on the hands of someone who touches them. Infection from hand to mouth or other mucus membrane such as the eyes is then possible.

# Disrupting transmission of respiratory diseases: handwashing

“Handwashing, particularly handwashing with soap and water, reduces the ability of respiratory pathogens to be transmitted through droplets on the hands, and also through fomites,” says Dr Leder. “And alcohol-based agents with more than 60% alcohol will probably kill almost any pathogen.”

A systematic review on the impact of hand washing on respiratory transmission found that hand hygiene interventions have the potential to reduce transmission of influenza and acute respiratory tract infections, but effectiveness varies according to setting, context and compliance.[207] For instance, there was moderate- to low-quality evidence of a reduction in both influenza and respiratory tract infection with hand hygiene interventions in schools, greatest in a lower–middle-income school setting. It also found high-quality evidence of a small reduction in respiratory infection in childcare settings and a large reduction in respiratory infection in squatter settlements in a low-income setting.[208]

However, there was moderate to high-quality evidence that in domestic settings a hand hygiene intervention alone did not prevent secondary influenza transmission in households with an index case.[209] Reducing transmission in household settings therefore requires improved general hand hygiene behaviour or enhanced hand hygiene immediately after the development of an index case, the researchers concluded.[210] A more recent systematic review, of which Dr Leder is a co-author, assessed the effectiveness of hygiene interventions on acute respiratory infections in childcare, school and domestic settings in LMICs, reaching similar conclusions.[211] “There is evidence that hygiene measures do decrease respiratory infections, but it is somewhat mixed,” Dr Leder says.

Leder’s review included 14 randomised controlled trials and found low- to moderate-quality evidence that hygiene interventions reduced acute respiratory infection (ARI)-related absenteeism and illness in childcare settings, and in schools moderate- to high-quality evidence of reduced ARI-related absenteeism and laboratory-confirmed influenza but low quality evidence of no impact on ARI illness. In domestic settings, there was high quality evidence of reduced ARI illness and pneumonia amongst children in urban settlements but low quality evidence of no impact in rural settlements, and moderate quality evidence of no effect on secondary transmission of influenza in households.[212]

The majority of research on the impact of handwashing on ARIs has focused on children or practices in healthcare settings, Dr Leder says: she was unaware of any research looking at compliance with and effectiveness of handwashing in the elderly and its impact on ARIs. This may be because of the outcomes often used to assess ARIs in existing research – absenteeism from school/work or respiratory symptoms. Assessing absenteeism is not appropriate for an older population, and looking at respiratory symptoms can be problematic as coughs or shortness of breath are symptoms that can be associated with other conditions prevalent in older people, she says. This leaves laboratory-confirmed respiratory illness as the outcome to measure, but studies using this as a metric are complex and expensive.

Conventional hygiene interventions targeted at children and caregivers highlight the key times when handwashing should be performed, with an emphasis on the approach relevant for faecal-oral diseases—after using the toilet, before making food, before serving food, before eating food and after changing nappies. However, respiratory infections need a different approach.

“Covid-19 has made us think about some of these messages, because the risky times are quite different for transmitting a respiratory infection,” Dr Leder says. “It’s really after coughing or sneezing, or when entering a new environment or after touching surfaces. There are different trigger points that are going to have to be thought through in terms of the times that you need to wash your hands.”

# Disrupting transmission of respiratory infection: other hygiene measures

Covid-19 has also demonstrated the importance of hygiene practices other than handwashing for preventing transmission of ARIs, such as coughing into elbows and not covering our mouth with our hand, and the importance of regular cleaning of frequent touch points such as door handles.

While in LMICs shared handwashing stations have been a cost-effective way of providing these facilities in low-resource settings where water is scare, they could also paradoxically carry some risk themselves. “In the context of covid-19, where you’re telling people to also socially distance, crowding around and touching the taps or soap bottle increases the potential for transfer of pathogens,” Dr Leder says.

“It adds another layer of complexity that shows us that we can’t completely just transfer the kinds of interventions and implementations that focused on gastrointestinal infections to something like covid-19.”

Public health messages for covid-19 have emphasised the importance of wiping down surfaces, particularly frequent touch points, and not just hand washing. “When covid-19 emerged, one of the first interview questions I was asked was how long does covid-19 last on different surfaces, and we just didn’t know,” says Dr Leder.

How long a pathogen on hands or on surfaces varies according to numerous factors, such as the type of surface, air humidity, air temperature and the viability of the pathogen itself. “There’s a whole lot of experimental work needed to understand this question better, as well as data on the public health benefits of different interventions or various combinations of interventions,” Dr Leder says.

People wearing face masks in public has been a common sight in some South-east Asian countries since the SARS outbreaks in the early 2000s, but until 2020 it was rarely seen elsewhere. At the start of the covid-19 pandemic, evidence of the benefits of use of masks by the general public was unclear, and there was a shortage of personal protective equipment (PPE) for use in healthcare settings, so widespread use of masks by the general public was not immediately advised.[213] There were also concerns that any benefit from mask wearing might be outweighed by the harms resulting from poor mask technique, such as touching the mask with the hands, wearing dirty masks and not laundering reusable masks correctly, or not disposing of single-use masks safely.[214]

Some research has suggested that community use of masks provides some protection against infection, and most countries eventually recommended their use in public places.[215,216] However, a recent Cochrane review concluded that there is uncertainty about the ability of medical/surgical masks to protect against seasonal influenza, concluding that use of masks did not show a clear reduction in respiratory viral infection and that their harms were unclear.[217]
The reviewers added that a large randomised controlled trial is needed to assess their effectiveness in multiple settings and populations, especially in those most at risk of ARIs.[218]

Conversely, other experts have pointed out that the previous trials had been designed to look at whether wearing a mask prevents infection in the person wearing it, and not whether it prevents them spreading disease to others.[219]

The latest advice from the WHO is clear that mask wearing does not provide sufficient protection by itself: “Masks should be used as part of a comprehensive strategy of measures to suppress transmission and save lives; the use of a mask alone is not sufficient to provide an adequate level of protection against covid-19.”[220] The guidance highlights the range of hygiene behaviours that together can help to reduce transmission: “If covid-19 is spreading in your community, stay safe by taking some simple precautions, such as physical distancing, wearing a mask, keeping rooms well ventilated, avoiding crowds, cleaning your hands and coughing into a bent elbow or tissue.”

While regular use of masks by the general population in public places or at home may not become adopted worldwide in the long term, a greater understanding of the protective capabilities of masks and their risks would better inform recommendations and practice in any future pandemics. It would also enable advice on any benefits to protect against transmission when there is a confirmed index case of a respiratory infection such as influenza in settings such as care homes or even private dwellings.

## Looking after older people: How Hong Kong's care homes weathered the covid-19 pandemic

Hong Kong was expected to be hit hard by the covid-19 pandemic because of its population density, proximity to mainland China (where the disease emerged), and status as an international transport hub. Instead, Hong Kong's containment measures, based on its experience of fighting the severe acute respiratory syndrome (SARS) epidemic in 2003, have been lauded as highly effective, particularly during the early stages of the pandemic.[221,222]

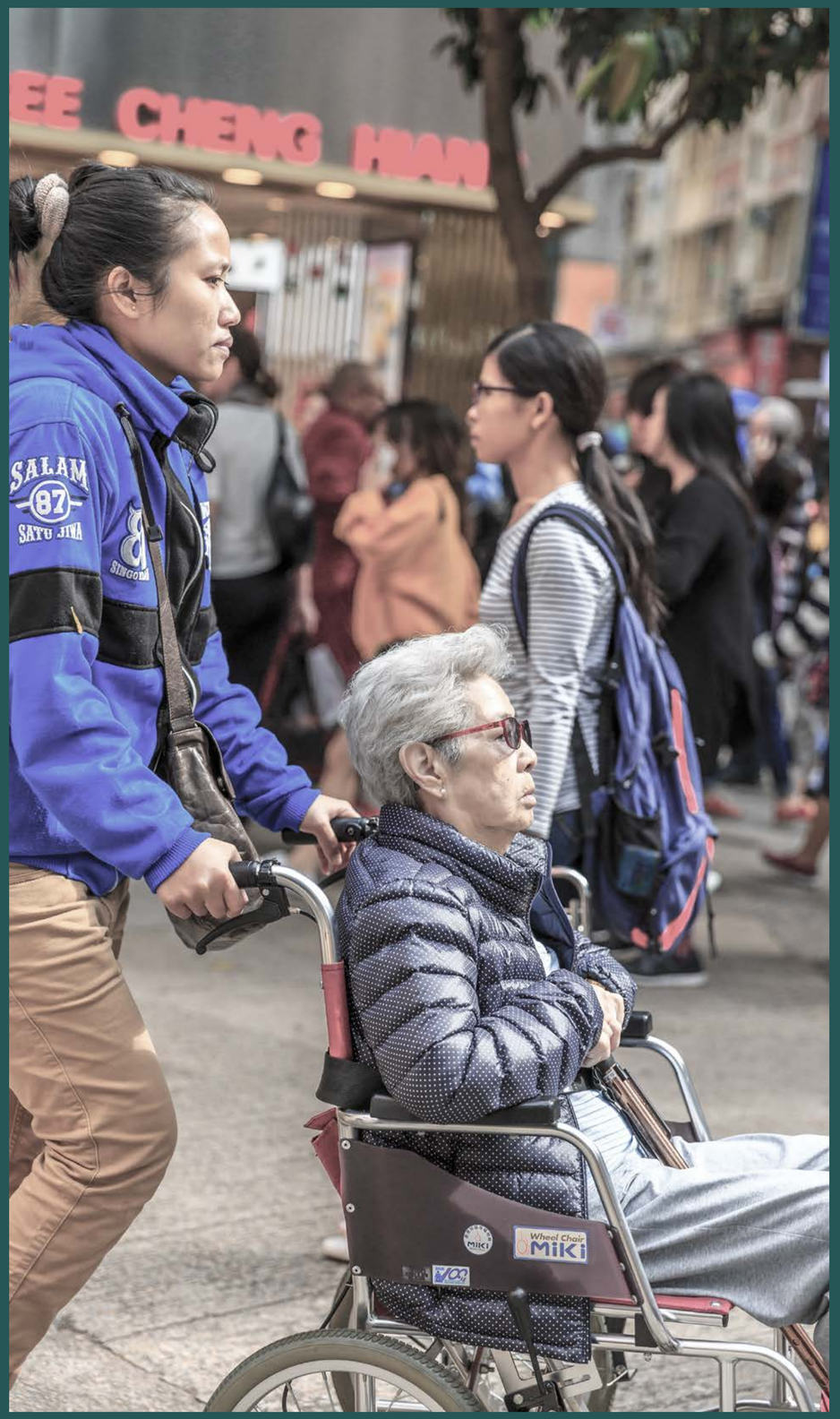
While large parts of Europe saw high covid-19 death rates in the early stages of the pandemic, particularly among care home residents, more than three months into the pandemic, Hong Kong had recorded only 1,053 infections and four deaths, with no infections reported in residential care homes or other long-term care facilities.

Hong Kong, especially in the early stages of the pandemic, showed that it had learned lessons from the past. In 2003 Hong Kong bore the heaviest disease burden of the SARS epidemic, with 1,775 people infected (22% of the total infected worldwide) and 299 deaths (39% of total deaths worldwide).[223] Of the total number of people affected, 324 (18%) were aged 65 years or over and 72 were care home residents, of which 57 died.[224,225]

This prompted a series of measures to protect care home residents, including the publication in 2004 of a comprehensive hygiene manual for care homes, and the requirement for all care home operators to designate an infection-control officer to implement infection-control measures.[226] The manual, now in its third edition, runs to 92 pages, and details day-to-day hygiene practices and additional measures to take in the event of an outbreak of various infectious diseases.[227]

Experience of the SARS epidemic also meant that Hong Kong's residents responded swiftly by wearing masks in public areas, following strict hand-hygiene practices and maintaining social distance. The government also implemented a range of public health measures to contain a potential community outbreak and prevent any transmission of the virus from hospitals to nursing homes.

In January 2020 Hong Kong's Social Welfare Department closed off care homes as much as possible, including banning all face-to-face visits. The temperature of all staff was checked before work, and anyone with a fever or other signs of respiratory infection was not allowed to work. All staff had to wear a mask while working, as did residents in all indoor public areas. Residents were asked to eat in their rooms and to stay in their rooms most of the time.[228] Strict hand-hygiene practices were observed and the Social Welfare Department provided financial support to allow NGO service providers (which provided almost all home care and 40% of residential care) to procure sanitary and PPE, and to hire additional temporary staff for extra cleaning and hygiene practice.[229,230]



# Learning lessons from pandemics and other disease outbreaks

Experience shows that more attention is paid to hygiene practices during pandemics and other disease outbreaks and that this has a positive impact on the incidence of other respiratory infections and diseases spread by the faecal-oral route. Following the H1N1 influenza (swine flu) pandemic in Mexico in 2009, there was a fall in the incidence of diarrhoea in young children, with those areas that had seen the highest incidence of H1N1 experiencing the largest reductions in diarrhoea cases.[231] These reductions were still in evidence three years after the pandemic.

It was suggested that the pandemic motivated people to acquire information about better hygiene practices and to wash their hands or use hand sanitisers.[232] This is backed up by data showing increased Google searches for hygiene behaviour, specifically hand sanitiser, and Mexican manufacturing data that, between 2008 and 2009, there was a 6.4-percentage-point increase in production of soaps, cleaners and cosmetics, compared with a 2.3-percentage-point increase from 2003 to 2007.[233]

In the UK during the H1N1 pandemic, the government issued public health advice, including using tissues when sneezing, washing hands regularly with soap and water, and setting up a network of "flu friends" to provide mutual assistance should someone become ill.[234] A telephone survey of 997 adults found that 37.8% of participants had been performing at least one of the recommended behavioural changes over the past four days because of swine flu, 28.1% were washing their hands more than usual, and 17.3% were cleaning and disinfecting touch points such as door knobs and hard surfaces more frequently. [235]

Knowledge and understanding of the mechanisms of transmission plays a part in that behaviour change. A telephone survey of 705 Hong Kong and 1,201 Singapore adults conducted during the 2002-04 SARS epidemic revealed that 86.7% of people in Hong Kong and 71.4% of people in Singapore knew that SARS could be transmitted by respiratory droplets, while only 75.8% and 62.1% respectively knew that fomites were a possible transmission source.[236] Residents with higher levels of anxiety, better knowledge about SARS and greater risk perceptions were more likely to take comprehensive precautionary measures against the infection.[237]

Hygiene and social distancing measures to protect against covid-19 have also had an impact on other diseases. The 2020 winter seasonal influenza has been particularly mild in southern hemisphere countries and regions, a factor that has been attributed to hygiene and social distancing measures implemented as a result of the covid-19 pandemic.[238] For example, seasonal influenza was virtually eliminated in Australia: 7,029 influenza notifications were recorded for the March to September 2020 period, compared with an annual average 149,832 for the same period in 2015-19.[239] Behavioural mitigation strategies for the covid-19 pandemic also exerted a strong impact on the circulation of other respiratory viruses.[240]

But in the same way that infrastructure alone will have only a limited impact on hygiene and disease prevention practices, clear messaging is also not sufficient by itself. During the Ebola epidemic of 2014-16 in Sierra Leone, measures to contain the spread, such as handwashing and safe burials, were promoted successfully through a variety of mechanisms, including radio and the engagement of community and religious leaders, and evidence suggests that this had an impact.[241,242] However, maintaining these measures has proved difficult in a low-resource settings with inadequate WASH infrastructure (see chapter 3).

“With emerging diseases we get a certain enthusiasm, especially as we gain control or the case numbers drop,” says Dr Luby. “[But] there is no ongoing attention to the political and economic barriers that lead to poor WASH infrastructure and the lack of products and PPE supplies in healthcare facilities that can reduce the risk of spread of infection.”

Dr Luby, who worked with Liberian hospitals on handwashing during the Ebola epidemic, says: “There was a lot of attention given to hand hygiene around Ebola, but many of the supplies were coming from foreign aid and NGOs, so when Ebola receded, soap, alcohol gel and chlorine supplies disappeared.”

On the one hand, the Ebola experience means that healthcare staff in Liberia facing covid-19 can draw on “some behavioural memories, as healthcare facilities were primed during Ebola” and wider communities are more receptive to hygiene messaging, says Dr Luby. “But it’s pretty disheartening when we look at healthcare facilities across low-income countries, not just Liberia but also Bangladesh, and see them not having routine hand-hygiene facilities.”

While there has clearly been more attention to hygiene behaviours throughout the world because of covid-19, Dr Luby believes that it is a mistake to think of the primary barriers to good hygiene practices such as handwashing as being behavioural, especially in the low-income countries where the burden of disease is highest. “My perspective is this is primarily around [poor] infrastructure. People in Bangladesh know that handwashing is a good idea, but it’s just very difficult to implement.”

Ms Ruwodo says that human behaviour is influenced by a number of environmental, societal and cultural factors. “With covid-19, there has been much improved change in behaviour around hygiene practices, but it is an inconvenience for many people if the water is not available, never mind the soap.” In the long term, the rural poor and urban slum dwellers are not going “to invest in soap over food”,  she emphasises.

“At the moment, they may change behaviour somewhat because they are seeing the high number of deaths, but it’s not sustainable change, it’s temporary. Without continued access to the resources that are necessary to perform the new behaviour, people will quickly switch back to normal.”

Improved hygiene practices have been observed in people in response to ‘health shock’ events such pandemics. These are maintained for a period, but ultimately are likely to wane, even in high-income countries where infrastructure is not an issue. These events provide an opportunity to draw attention to and address the lack of hygiene-promoting infrastructure in LMICs. They also provide a unique opportunity globally to harness the public’s interest and attention to hygiene issues, so that that momentum can be built towards preserving and further driving good hygiene behaviour.

# Conclusion and policy takeaways

2020 has pushed hygiene into the spotlight by showing that a novel disease can rapidly emerge that cannot be tackled with our usual therapeutic arsenal of treatments. Instead, we have had to go back to basics to prevent transmission through hygiene interventions, such as handwashing with soap, and social distancing.

However, despite the evidence of the impact of hygiene practices such as handwashing, there is huge room for improvement in this simple intervention. People must undertake better hygiene behaviours—our research shows that simple interventions can instil change and bring wider benefits to communities.

A life-course approach for hygiene could play an important part in teaching positive behaviours and reducing the spread of infections. The effects would be seen in people from an early age, with reinforcement at key life stages maximising the public health benefits for individuals, societies and economies.

Some of the key policy takeaways to consider in order to develop and implement a life-course approach for hygiene could include:

# Boost children’s education around good hygiene behaviour at school

This should include handwashing technique and practical observed handwashing to embed good handwashing behaviour into children’s daily routines. Children can also be effective change agents for good hygiene behaviour in the home. The importance of handwashing and other hygiene behaviour, such as coughing into the elbow, and regular cleaning and disinfecting of touch points, should then be reinforced for older school children and during key points in adulthood as these are currently limited. Opportunities need to be created to reinforce hygiene behaviour during all stages of adulthood too.

# Consider a gendered approach to hygiene intervention

Women still do the lion's share of child and aged care, food preparation and cleaning, and, in LMICs, the collection of water. This means that ensuring good hygiene behaviour in women is not only important for them but also for protecting the wider family. Currently, interventions for adults are limited to pregnant women and new mothers through maternal and child health services, but new approaches need to be considered to target other adults. In particular, more research is needed on why handwashing behaviour is poorer in men and how this can be improved.

# Take a two-pronged approach for success: promote improved behaviour while ensuring the availability of appropriate infrastructure

The ability to practise hygiene measures is impacted by poor infrastructure. It is difficult to follow good handwashing practices without convenient access to clean and affordable water and soap. Effective sanitation and refuse systems also need to be in place to remove contaminants from the immediate environment that drive infectious diseases. In LMICs WASH infrastructure should be targeted where it can have the most benefit.

The priority should be health facilities, which can become amplifiers for good hygiene practices, and in schools to enable children to learn and practice good hygiene habits. Also an important focus are public places associated with activities where handwashing would be particularly advisable, such as food vendors and shared toilet facilities.

# Empower girls' life chances by focusing on menstrual hygiene

All across the world girls and women struggle to access sanitary products. In LMICs this is compounded by lack of access to WASH facilities and cultural expectations that may negatively impact their education, employment and ability to engage in society. More research is needed to look at the impact of poor menstrual hygiene. Most studies are qualitative and focus on short-term outcomes; there is a need for quantitative research that looks at the consequences of poor menstrual hygiene in terms of girls' life chances and the wider impact on economies and society. An important first step is to assess the level of absenteeism among girls at schools to determine how much is linked to menstruation, including issues related to access to sanitary products, period pain and cultural expectations.

# Sustainable inclusive solutions for regenerating slums

Growing numbers of people are moving from rural to urban areas in search of work and ending up living in crowded slums. Poor or non-existent infrastructure for clean water, sanitation and solid waste is a key barrier to improving hygiene in slum communities, and limits the efficacy of efforts to improve hygiene practices. Informal settlements often involve people squatting on land, so landowners and government have limited interest in improving infrastructure, and improvements can be costly and difficult owing to high population density low quality of housing. However, successful slum-improvement initiatives are being developed to allow residents to be involved in the co-creation and implementation of projects where there is a desire to improve public health; these are often co-financed by multiple sources.

# More diverse hygiene research is needed

Most research looking at hygiene initiatives has focused on improving hand hygiene behaviour in children or on initiatives where diarrhoea in the under-5s is the primary outcome. There is limited research looking at the health outcomes of hygiene practices in older people, hygiene practices other than handwashing, or in breaking the transmission of respiratory diseases. The covid-19 pandemic has highlighted the importance of focusing more on respiratory infections, specifically at the basic science level, such as through promoting a better understanding of droplet, aerosol and fomite transmission so that pathways can be disrupted. Also important is awareness of how long pathogens remain viable on hard surfaces and the impact of variable environmental factors, such as temperature and humidity. It is also important to improve our understanding of the effectiveness of different cleaning regimens and handwashing practices, as well as interventions that can be implemented in epidemic and pandemic situations, such as mask wearing by the general population and specific population segments, such as carers.

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