We need to talk about crapping

Access to toilets and basic sanitation systems revolutionized living environments and reduced the burden from diarrhoeal diseases in the developed world. With more than half of the global population still living without access to a household toilet, the need to tackle this feculent problem requires greater prominence.

Of the many international observances each year, World Toilet Day (19 November; <https://go.nature.com/2plxWVd>) doesn't perhaps garner the attention that such an important public health area deserves. In part, this may draw from the curious taboo that sees even the non-squeamish among us avoid toilet-related topics in casual conversation, yet allows huge variety in excrement-based expletives to add colour to our collective lexicon. When greeting a colleague one morning, if they cheerily explained how they had recently passed a stool of notable size and consistency, you would probably be somewhat surprised, if not outright shocked. Yet ascertaining where someone's faeces sit on the Bristol stool scale can inform on the health of their gastrointestinal tract; the colleague was simply letting you know that they were well. Similarly, when suffering from an enteric infection, to avoid a sense of embarrassment and spare others what we might consider to be unedifying details, we are more likely to use euphemisms such as 'tummy bug' or 'stomach bug' than to announce that we are experiencing explosive bouts of diarrhoea and have mushy or liquid stools. The manner in which we handle faeces can inform us not just about an individual's gut health (or squeamishness) but also about a nation's public health systems, and by being averse to discussing defecation we may also be inadvertently turning a blind eye to the poor or absent sanitation in large parts of the world.

The degree of provision of toilets and sanitation to safely separate people from their poop is a marker for how developed a country is. Unfortunately, the statistics make it clear that ensuring everyone on the planet has access to the level of sanitation that is taken for granted in the developed world, remains a huge job. Approximately 4.5 billion people live without a household toilet, while 2.3 billion lack access to basic services that enable human waste to be safely processed and around 892 million (~12% of the global population) practice open defecation. The associated human and economic costs are immense, with diarrhoeal disease — owing to infection by pathogens such as rotavirus or certain

pathotypes of *Escherichia coli* — leading to the death of around 800,000 children under 5 years of age each year, while costing developing countries around US\$260 billion. Furthermore, the lack of a household toilet or pit and use of open defecation sites has been linked with an increased likelihood of non-partner sexual violence against women (A. Jadhav et al. *BMC Public Health* **16**, 1139; 2016).

The problems associated with poor or absent sanitation systems and unavailability of freshwater and hygiene measures are recognized in UN Sustainable Development Goal (SDG) 6 (ensure availability and sustainable management of water and sanitation for all), and in particular SDG target 6.2, which aims to "achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations". Yet, as noted in a recent report by the UN, progress on SDG 6 is not on track for the (admittedly ambitious) goal to be reached by the 2030 deadline (<https://go.nature.com/2pKcIGe>). Factors identified as limiting progress include weak or fragmented governance, lack of appropriate levels of financing and capacity in water and sanitation sectors, as well as a lack of data acquisition and monitoring.

While meeting many other SDG targets will require new technologies to be established (for instance, in the development of diagnostics, vaccines or antibiotics for SDG 3.3), this is not the case for SDG 6.2, as the basic apparatus needed were developed long ago. The mechanics underpinning the flushing toilet have not dramatically changed since the first iteration was invented by Sir John Harrington in 1596, while sewer systems for removing human waste from private household toilets were used in the Indus Valley as early as 2350 BC. Even in the developed world, it wasn't until the 1900s that access to clean running water, a toilet and proper sewer systems for a household became the norm. Yet wherever they have been introduced, together with the necessary infrastructure to maintain separation of waste and effluent from contaminating fresh water sources until it can be treated

and made safe, sanitation and fresh running water have had an indisputable positive impact on public health and led to a decrease in morbidity and mortality associated with infectious disease. Indeed, according to readers of the *British Medical Journal* in a 2007 survey, the introduction of clean water and sewage disposal was the most important medical milestone since 1840, beating the development of antibiotics and anaesthesia (A. Ferriman *BMJ* **334**, 111; 2007).

So what can be done to narrow the gap to achieving universal access to toilets and sanitation? We can begin by helping to tackle the taboo. For this most microbiologically relevant of topics, we should not shy away from talking shit in public, and with global policy makers and financiers in particular. We can point out that microorganisms not only contribute to the creation of faeces but are also a major constituent of it, and that this can be a problem if the poop in question contains microbial pathogens that gain access to a water source and spread in a community. We can demonstrate that the introduction of toilets, sanitation and sewage treatment facilities to communities that lack them has not only saved lives by interrupting transmission chains, but can also deliver a substantial return on investment in terms of reduced economic burden and increased productivity. We can note how provision of household toilets is a basic dignity, but also how it creates a safer place for women and girls that may otherwise be subjected to violence if forced to defecate in the open by lack of facilities.

That even the basic toilet and sanitation technologies first in use hundreds (sometimes thousands) of years ago are not globally available today, should be of far greater embarrassment to us than discussing the waste matter that they were created to dispose of. But how much better we can do if the creative minds of microbiologists and engineers can be combined to bring toilet technology into the twenty-first century. We should all be inspired to start giving more of a crap. □

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