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Point-of-care testing and environmental sustainability: Balancing patient care and planetary health

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Point-of-care testing (POCT) is testing performed at the site of patient care in a variety of settings, by clinical staff who are generally not laboratory personnel, to allow healthcare providers to make prompt clinical decisions. In low- and middle-income countries (LMICs), access to laboratory service can be challenging for various reasons.[1,2,3] To improve access to tests, the World Health Organization recommends implementation of the model list of essential *in vitro* diagnostics, where the majority of the tests recommended for community hospitals and health facilities without laboratories (designated as Tier I) are rapid diagnostic tests or utilise dipstick technology,[4] typically performed at the point of care.

The goal of the list of essential *in vitro* diagnostics is to guide countries in prioritising *in vitro* diagnostics that can be made available at various levels of their healthcare systems, strengthening laboratory capacity, while promoting rational use of tests.[4] It is also expected that the list of essential *in vitro* diagnostics will guide donor nations and manufacturers to focus on globally important health issues.[4] Implementation of the list of essential *in vitro* diagnostics is expected to improve access to laboratory testing, reduce reliance on empirical treatment and enhance earlier diagnosis and treatment. Most rapid diagnostic tests (RDT) designated for Tier 1 settings will be single-use devices and those for noncommunicable disorders will most likely be performed using small analysers with single-use cartridges and other disposable consumables. Consequently, it is expected that the use of POCT and consumables will increase. For example, 3.9 billion rapid diagnostic tests were delivered between 2010 and 2022 to support malaria diagnosis, and more than 82% of these tests were to sub-Saharan African countries.[5]

Despite the benefits and hope that POCT offers, it also has negative environmental consequences, owing to the need to maintain a good supply chain reliant on the use of fossil fuels. There is also the predicted need to dispose of single-use plastic devices with limited recyclability that will be processed as biohazardous waste.[6] For various reasons, waste produced in healthcare facilities continues to increase yearly by 2% – 3%.[7] While 75% – 90% of healthcare waste is non-hazardous, as much as 10% – 25% is considered hazardous.[6] In LMICs, waste segregation is often limited, and healthcare waste is frequently disposed of entirely as hazardous waste into open dumpsites, usually at suboptimal temperatures, prior to incineration.[6]

Point-of-care test devices typically have high plastic and metal components and contribute to landfills in LMICs. About 16 000 tonnes of plastic are produced globally for rapid testing every year,[8] and deterioration of plastic in landfills into micro- and nano plastics is known to contribute over 16 000 chemicals to the environment, of which more than 4200 are known to have adverse long-term effects on human health.[9] Burning rapid diagnostic tests at suboptimal temperatures contributes to environmental contamination owing to the production of hydrocarbons, dioxins and furans, known carcinogens, which can contaminate the soil.[6] Noxious gases, vapours, and particulate matter that are released into the atmosphere from burning cause outdoor air pollution – the second-highest risk factor for non-communicable diseases, estimated to have caused more than 4.2 million premature deaths worldwide in 2019, with 89% of those deaths occurring in LMICs.[10]

Batteries used in powering POCT devices, which contain heavy metals such as mercury and cadmium, are disposed of in open burn sites, which will lead to contamination of soil and groundwater by the residual ash. Heavy metal toxicity is associated with damage to the immune system, neurological system, lungs and kidneys.[6,11] Chaotropic agents made from cyanide derivatives, such as guanidinium thiocyanate, are common components for nucleic extraction in POCT devices used for infectious disease testing. They can contaminate water sources and poison aquatic life.[12] It is therefore clear that the use of POCT in LMICs, without adequate planning about

how the generated waste will be managed, will most likely worsen the health status of the communities where these devices are used.

Steps to mitigate the environmental impact should start with the selection of the POCT devices to be used. When possible, devices with sustainability certification should be selected because these will probably have less environmental impact. At a global level, regulations and guidelines should be formulated and implemented to ensure that POCT devices meet minimum sustainability standards. Local manufacturing of devices will become important to reduce the environmental impact of supply chain and, in LMICs, will require support through the implementation of favourable government policies.

Low- and middle-income countries must develop and implement waste management strategies that will reduce environmental contamination. The World Health Organization document on waste management[6] proposes minimum guidelines on segregation, collection, storage, transportation and disposal of healthcare waste, which could be followed where national policies do not exist. Development of policies suitable for the local context should be encouraged. At a global level, the target product profiles provided by the World Health Organization and other bodies should include language on waste management requirements for POCT devices. Training healthcare staff in the proper handling of healthcare waste will also be an important component of the process to enhance the level of understanding about how healthcare waste should be handled, as well as its effect on health when not managed properly.[6,11] Avoiding unnecessary testing will reduce the environmental impact of POCT by reducing waste production.

Many POCT devices are made from plastic materials derived from non-renewable sources. Reducing the environmental impact of such devices will require vendors to consider and implement the use of more sustainable materials during the design phase, such as the pregnancy test designed by LIA Diagnostics, based on material derived from 100% cellulose structure, is flushable.[13] Regulations may become necessary to limit the plastic content of POCT devices.[8] The use of non-chaotropic agents, such as sodium dodecyl sulfate, for nucleic acid extraction, has been investigated and its use in the manufacture of POCT devices should be encouraged. Take-back schemes for broken equipment should be expanded to LMICs to reduce the production of greenhouse gases from the improper disposal of such items.

Conclusion

While expanding POCT will be important in providing much-needed laboratory testing coverage, health systems in LMICs must consider the environmental effects of these devices and implement policies that will minimise its impact. This will include selecting tests that meet sustainability standards, using local manufacturers where feasible, and localised waste management plans. These steps will be critical in ensuring that enhancing diagnostic capability does not cause adverse environmental effects that will further worsen the health of the communities that are served.

References

1. Nkengasong JN, Nsubuga P, Nwanyanwu O, et al. Laboratory systems and services are critical in global health: Time to end the neglect? Am J Clin Pathol. 2010;134(3):368–373. https://doi.org/10.1309/AJCPMPSINQ9BRMU6
2. Katoba J, Kuupiel D, Mashamba-Thompson TP. Toward improving accessibility of point-of-care diagnostic services for maternal and child health in low- and middle-income countries. Point Care. 2019;18(1):17–25. https://doi.org/10.1097/POC.0000000000000180
3. Wilson ML, Fleming KA, Kuti MA, Looi LM, Lago N, Ru K. Access to pathology and laboratory medicine services: A crucial gap. Lancet. 2018;391(10133):1927–1938. https://doi.org/10.1016/S0140-6736(18)30458-6
4. World Health Organization. The selection and use of essential in vitro diagnostics: Report of the fourth meeting of the WHO strategic advisory group of experts on in vitro diagnostics, 2022 (including the fourth WHO model list of essential in vitro diagnostics). Geneva: World Health Organization; 2023. Contract No. 1053.
5. World Health Organization. WHO Malaria policy advisory group (MPAG) report, 18–20 April 2023. Geneva: World Health Organization.
6. World Health Organization. Safe management of wastes from health-care activities [homepage on the Internet]. 2nd ed. Geneva: World Health Organization; 2014 [cited 2025 Sep 24], p. 329. Available from: https://www.who.int/publications/i/item/9789241548564
7. Kaposi A, Nagy A, Gomori G, Kocsis D. Analysis of healthcare waste and factors affecting the amount of hazardous healthcare waste in a university hospital. J Mater Cycles Waste Manag. 2024;26(2):1169–1180. https://doi.org/10.1007/s10163-024-01890-1
8. University of Edinburgh. Experts urge plastic limit for lateral flow tests [homepage on the Internet]. 2025 [cited 2025 Sep 10]. Available from: https://www.ed.ac.uk/news/experts-urge-plastic-limit-for-lateral-flow-tests-0#:~:text=The%20researchers%20urge%20setting%20plastic,range%20of%20illnesses%20and%20conditions
9. Wagner ML, Monclús L, Arp HPH, et al. State of the science on plastic chemicals – Identifying and addressing chemicals and polymers of concern [homepage on the Internet]. 2024 [cited 2025 Sep 10]. Available from: https://zenodo.org/records/10701706
10. World Health Organization. Ambient (outdoor) air pollution. WHO Fact Sheet [homepage on the Internet]. 2024 [updated 2024 Oct 24; cited 2025 Jun 30]. Available from: https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health
11. Janik-Karpinska E, Brancaleoni R, Niemcewicz M, et al. Healthcare waste—a serious problem for global health. Healthcare (Basel). 2023;11(2):242. https://doi.org/10.3390/healthcare11020242
12. Ongaro AE, Ndlovu Z, Sollier E, et al. Engineering a sustainable future for point-of-care diagnostics and single-use microfluidic devices. Lab Chip. 2022;22(17):3122–3137. https://doi.org/10.1039/D2LC00380E
13. Gross P. Lia diagnostics has launched its eco-friendly, flushable pregnancy test to consumers [homepage on the Internet]. Tech.ly; 2021 [cited 2021 Mar 15]. Available from: https://technical.ly/startups/lia-diagnostics-launched-flushable-pregnancy-test/