Public Services Delivery
Scotland

NHS SCOTLAND

NHS Scotland Assure Research Q&A

The role of toilet plume in dispersal of bacteria in healthcare and mitigation of risk with toilet lids/ covers in a simulated NHS en-suite.

ASR604-001
Version 1 - June 2026

Contents

1. NHS Scotland Assure Research Service

1.1. NHS Scotland Assure is adding to the knowledge base available to built environment projects. Building on this existing knowledge will reduce risks, increase quality and promote sharing research with key stakeholders.

1.2. Through working with external stakeholders and other NHS Scotland Assure services the research service will ensure information is based not only on best practice but best evidence and will benefit those who need it. The service will seek to ensure that the most up to date and robust research is translated into practice as new and emerging evidence become available.

1.3. NHS Scotland Assure Research service have commissioned a number of research projects which address gaps in current evidence. These research topics relate to previous issues and lessons learned within previous NHS Scotland projects and are in line with the key themes identified by NHS Scotland Assure stakeholders

Research Q&As

1.4. Our research Q&As are designed to talk about these research projects – why the research is needed, what it set out to achieve, what impact it will have on existing guidance and more.

1.5. Full research reports are also available by contacting NSS.NHSScotlandAssure@nhs.scot

2. Research Q&A with Dr Gordon Mackay

What is the research that was carried out?

2.1. The research has investigated the role of toilet flushing in the spread of bacteria in healthcare settings.

Why is this research needed?

2.2. The water distribution networks in healthcare settings link many areas to each other and there is a risk that this may be used by potential pathogens to spread. We have been aware of this risk for a long time, but the focus has been on sinks rather than on toilets. Toilets when flushed may create droplets and aerosols that could contaminate the bathroom area, but we do not know to what extent. Toilets in healthcare settings in Scotland do not have toilet lids as these are difficult to clean and disinfect. We needed to find out (1) to what extend is the healthcare environment contaminated by the toilet flush? (2) What is the effect of a standard toilet lid and sealed toilet lid on the spread of contamination caused by the toilet flush?

Who were the team behind the research?

2.3. The Chief Investigator was Professor W Gordon Mackay, Professor of Microbiology (University of the West of Scotland).

2.4. Co- investigators were: Kenny Richardson, Research Assistant (University of the West of Scotland), Simon Pybus and Teresa Inkster (Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Scotland).

What did the research set out to achieve?

2.5. The research sought to: describe characteristics of toilet flush droplets and aerosols and interventions to control them.

How was the research carried out?

2.6. The University of the West of Scotland (UWS) test isolation room within a laboratory setting accurately emulates an NHS standard isolation room, with the ventilation parameters based on Scottish Health Technical Memorandum (SHTM) 03-01. The work took place within a laboratory set up NHS-style patient en-suite bathroom. Experiments were undertaken to

assess three test conditions, which were no toilet lid, standard toilet lid and sealed toilet lid. In each case the toilet bowl was experimentally contaminated with the bacteria Pseudomonas putida and then the toilet flushed. Bacterial contamination of surfaces was assessed using settle plates (agar plates). Droplet and aerosol were assessed using a particle counter and air cyclone, which captured bacteria from the air at a flow rate of 60 Litres per minute.

What challenges did you encounter?

2.7. We did not experience any specific challenges during this research.

What were your main findings?

2.8. Our main findings were:

- flushing the toilet in healthcare settings contaminates the immediate environment with bacteria
- the potential for surface contamination resulting from the flushing of a toilet in a healthcare setting is dependent on the distance from the toilet
- toilet seats are effective at reducing contamination of the healthcare environment caused by flushing toilets. However, toilet seats may be difficult to fit to current infrastructure

How will the research be used?

2.9. A draft manuscript is in preparation for submission to the Journal of Hospital Infection. Additional laboratory work has been undertaken as part of a Masters level research project and this would not have been possible without the initial funding from NHS Scotland Assure. This research will also be used as pilot study evidence when submitting future funding applications.

What are the next steps for study in this field?

2.10. Further research towards cost-effective solutions to reduce droplet and aerosol spread from toilets for existing and new healthcare estate infrastructure. Assessment of areas where additional interventions would be most beneficial.

Will this research have an impact on current guidance?

2.11. Yes, specifically the SHTM 04-1 series that focuses on water safety for healthcare.