

Do people wash their hands after using the bathroom?



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Publication date: November 2021

Foreword

This research project was funded by **safefood**, the all-island body responsible for the promotion of food safety. The project involved an investigation of hand hygiene facilities, policies, and practices in restroom settings on the island of Ireland.

Adequate hand hygiene practice and compliance – knowing *how and when* to do it and routinely *doing* it – is known to be very important for the prevention of many communicable diseases. However, most of the research investigating hand hygiene behaviour has focused on healthcare settings.

This research has relevance to food safety and hygiene, public health and the understanding of the spread of hygiene-related communicable diseases and foodborne illnesses. It provides new and up-to-date information on the hand hygiene – hand washing and hand drying – behaviours of children and adults in non-healthcare settings including restrooms in childcare service premises, and public and food business settings.

Improving hand hygiene behaviour is essential in preventing the spread of communicable diseases and key to improving the general health and wellbeing of the entire population.

Acknowledgements

safefood would like to thank the people and organisations who assisted with and participated in this research project:

- Researchers: Dr Marie Vaganay-Miller, Dr Aaron Lawson and Mr Robert Cameron from Ulster University
- Early Childhood Ireland (Republic of Ireland)
- Early Years (Northern Ireland)
- The preschool childcare service providers and staff
- The managers and the members of the public who participated in the investigation of hand hygiene facilities, policies and practices in the public and food business settings
- Ulster University Belfast Campus, Belfast City (observational studies).

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Executive summary

This research project is an investigation of hand hygiene facilities, policies and practices in restrooms in childcare, public and food business settings on the island of Ireland between 2018 and 2020.

Good hand hygiene practice and compliance – knowing *how and when* to do it and routinely *doing it* – is recognised as being the most effective method in preventing the spread of a range of communicable diseases and foodborne illnesses. Most of the research on hand hygiene behaviour has focused on healthcare settings, and documents that most hand hygiene practice and compliance is poor. Little research has focused on community settings including childcare, public or food business locations, and even less is known about hand hygiene practices across the population of the island of Ireland in general.

This research project consists of 7 studies that examined hand hygiene practices in restrooms in childcare service premises and in public and, to a lesser extent, food business settings in the Republic of Ireland and Northern Ireland. The studies included

- A review of published data on strategies to improve hand hygiene behaviours and compliance
- Visiting different locations to take microbiological samples from restrooms in public and food business settings and to interview staff and evaluate the hand hygiene facilities, policies and signage in restrooms in childcare, public and food business settings
- Interviewing childcare staff to examine hand hygiene practices in preschool childcare settings. Using thermal imaging cameras to observe and measure compliance with adequate hand hygiene practices among the general population in restrooms in public and food business settings
- Designing and developing a range of strategies and interventions and making key recommendations for improving hand hygiene behaviour, particularly in restrooms in public settings

The findings of this research highlight that most preschool children initially lack knowledge and awareness of the importance of adequate hand hygiene in communicable disease prevention. Most children are taught the proper method of hand washing and drying by childcare assistants and managers but this behaviour requires constant reinforcement. To this end, role models such as teachers, parents and guardians can play a significant part in influencing the hand hygiene behaviour of young children.

The findings of this research also helped establish the current level of hand hygiene practice and compliance in public settings. It should be noted that the observational studies were conducted at the beginning of the Covid-19 pandemic when there was considerable emphasis on public health measures such as hand hygiene. The pandemic also limited the observation studies and interventions could not be tested as premises with public toilets were closed.

A total of 498 adults were observed during the study. Observations from public restrooms showed a poor level of compliance: although 93 per cent of people did perform some hand hygiene, only 17 per cent washed and dried their hands adequately. This is most likely because of gaps in knowledge and a lack of awareness of the importance of practicing the adequate method of hand hygiene. The length of time spent washing and drying hands, and the number of steps followed to clean hands and nails properly, require improvement.

For the purposes of the study adequate hand hygiene is defined as washing hands for 20 seconds using soap and water and drying for 15 seconds using a hand dryer. Basic hand hygiene is defined as washing hands using soap and water, followed by drying, but not for the required length of time. Any other hand hygiene not fitting the adequate or basic definitions was defined as poor.

The hand hygiene facilities in all the settings were suitable, appropriate, well maintained and clean. However, there was no hand hygiene signage, information or poster visible in the restrooms in public and food business settings.

Different types of interventions can prompt different impacts on behaviour. In childcare settings, a unified approach to the design and delivery of novel interventions would help reinforce good hand hygiene behaviour and recruit parents as key role models.

In public restrooms and food business settings there appears to be a general lack of hand hygiene interventions that are displayed prominently. This may contribute to the poor levels of compliance observed among the general population.

The knowledge and importance of good hand hygiene practice need improving across the island of Ireland.

It is recommended that novel intervention strategies should be developed and used to help deliver a widespread, cultural change in behaviour and attitudes towards this key public health tool.

Key recommendations

1. Develop a unified approach to the education of preschool children on the importance of good hand hygiene practice and compliance across the island of Ireland.

Currently, different methods and tools are being used to teach children in the 2- to 4-year-old age group about the importance of hand hygiene, how to do it correctly and for how long. The use of different methods can create confusion or even act as barriers to good practice and compliance.

2. Design and publicise a specific hand hygiene policy.

A hand hygiene policy that is designed and promoted by government and national public health organisations would help clearly define what constitutes good practice and compliance, as well as highlight the significance of such behaviour in preventing communicable disease transmission.

3. Research and design innovative hand hygiene interventions that target specific barriers, settings and audiences.

It is clear from the findings of this research project that there is a general lack of hand hygiene interventions in both public and food business settings. Interventions could include stickers or signage promoting hand hygiene, with the aim of improving handwashing practice. More are available in childcare settings; however, most take the form of static posters and signage. Future research should focus on the development of new, innovative hand hygiene interventions that target specific barriers to good practice and compliance, or that are aimed at a specific setting or audience.

4. Increase communications and improve public awareness campaigns from relevant organisations on the importance of good hand hygiene behaviour.

The findings of this research indicated that, overall, there is a poor rate of compliance with proper hand hygiene procedures amongst the public. More research is required into the reasons for this, and how current communication campaigns and strategies influence public perception of hand hygiene and communicable disease transmission in various settings.

1 Introduction and background

Good hand hygiene is known to reduce the prevalence and spread of communicable diseases. Hygiene-related foodborne illnesses such as norovirus (sometimes called the “winter vomiting bug”), *Salmonella typhi* (which causes a typhoid-like fever), *Shigella* spp. and shiga toxin-producing *Escherichia coli* (STEC) cause sickness and death worldwide. These diseases can be transmitted by people (for example young children, the general public and food handlers) when proper hand hygiene practices are not complied with.

The provision of adequate hand hygiene facilities play a key role in influencing individual hand hygiene behaviours and compliance, but these facilities can also be a source of disease transmission because of poor hygiene practices. Many of these diseases can be contracted or spread after using the toilet. Transmission can be either person to person (through touch, or by coming into contact with contaminated blood or other bodily fluids, saliva or air), or through an external source (by contacting contaminated surfaces, utensils, bedding, clothing and so on).

Between 2014 and 2019 over 600,000 cases of infectious disease were reported in Ireland. Some of the most commonly reported communicable diseases during this period included 35,532 cases of influenza (flu), 12,491 cases of rotavirus infection (a common cause of diarrhoeal disease) and 5,189 cases of STEC (Health Protection Surveillance Centre, 2020).

Similarly, in Northern Ireland (NI) during the same period the reported sickness and absence rate was around 2.3 per cent of the total population – higher than the United Kingdom (UK) average of 1.9 per cent – or 42,587 individuals (Northern Ireland Statistics and Research Agency [NISRA] online, 2017a). The groups who experienced the highest rates of sickness absence were women, older workers, those with long-term health conditions, smokers, public health sector workers and those working in the largest organisations (those with 500 or more employees) (NISRA online, 2017b). The number of deaths as a result of communicable diseases between 2014 and 2019 was 1,109 people (NISRA online, 2020).

Accordingly, the high level of communicable disease transmission across the island of Ireland (IOI) during this period highlights the need for research into preventative measures. Research is needed to develop innovative ways to educate children, childcare service providers, the general public and food businesses to ensure they understand the importance of good hand hygiene practice and compliance.

safe food sought to investigate hand hygiene practices across the IOI. This involved examining hand hygiene behaviour and compliance in restrooms in community settings such as childcare service premises, in public places and in food businesses in both Ireland and NI.

Before this research project was undertaken, little was known about hand hygiene practices across the IOI, particularly in community settings. Understanding the current level of hand hygiene practice and compliance within community settings is key in preventing communicable disease.

2 Aim and objectives

Aim

The aim of this research project was to assess hand hygiene behaviours and compliance in a variety of settings including restrooms in childcare service premises and in public and food business settings) across the IOI.

Objectives

The objectives identified for this research project were

1. To review the literature (published data) on strategies to improve hand hygiene compliance and development of novel strategies for childcare service providers, public places and food businesses.
2. (a) To determine the microbiological status (cleanliness) of hand driers and door handles at the beginning and end of each day in restrooms in public and food business settings only.
(b) To evaluate hand hygiene policies and signage in restrooms in childcare, public and food business settings.
(c) To evaluate the facilities available for hand washing and drying.
3. (a) To examine hand hygiene practices in preschool childcare settings (2- to 4-year-olds)
(b) To measure compliance with adequate hand hygiene practices in restrooms in public and food business settings only.
4. To design, develop and evaluate a range of strategies for improving hand hygiene behaviour over time, and to develop innovative tools, interventions and recommendations for improving hand hygiene, particularly in restrooms in public settings.

3 Methods and material

A mixed research methods approach to data collection was used to fulfil the research aim and objectives. Seven studies were undertaken, shown in Figure 1.

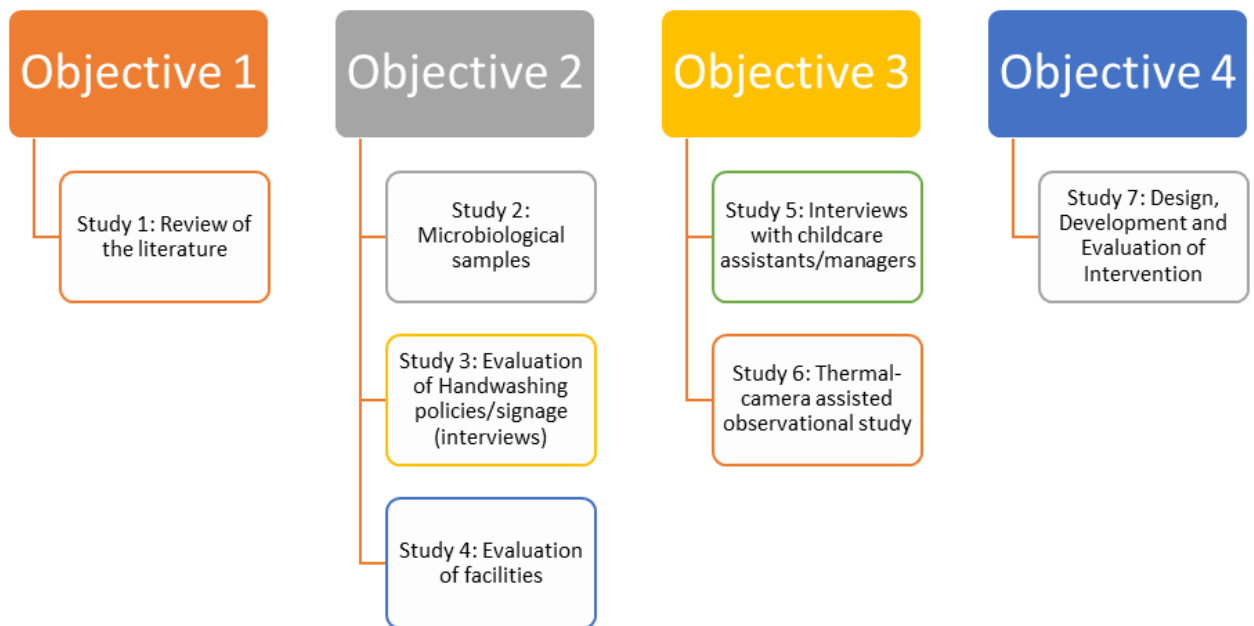


Figure 1: Flowchart showing how the 4 research objectives were fulfilled by the 7 studies undertaken.

Study 1: Review of the published literature on strategies to improve hand hygiene behaviours (Objective 1)

A systematic literature review was conducted on published strategies to measure and improve hand hygiene practice and compliance amongst young children, the general public and food handlers.

Source of material

Material was gathered by searching

- Library databases (PubMed®, Scopus®, ScienceDirect® and MEDLINE®)
- Journal databases (manual scoping for studies cited by other articles, or “grey literature”)
- Governmental and other organisations’ publications (manual scoping for relevant publications in the UK, Ireland, the United States of America (US) and elsewhere.

Search terms

A combination of search terms and their synonyms was used in library database and internet search engines (Table 1).

Table 1: Literature review search terms

Search terms	Hand washing	Strategy	Improvement
			Education
	Hand hygiene	Policy	Improve, improvement, improving
	AND	Guidelines	Novel
	Behaviour	Procedure	Promotion
	Compliance	Practice	Training
		Intervention	

Inclusion criteria

These criteria were used to assess whether the material gathered should be included in the review.

- Articles or material must be directly relevant to the review.
- Material must be in English language.
- Journal articles must be peer-reviewed.
- Qualitative and quantitative studies were included. (Qualitative data are not directly measurable, for example opinions or attitudes. Quantitative data are measurable in numbers.)
- Material relating to healthcare settings was included if it was relevant to hand hygiene in childcare, public or food business settings.
- Material published by governmental agencies was included only if it was relevant to the UK, Ireland and the US.
- Material must be relevant to hand hygiene in childcare, public or food business settings or include young children, the general public and food handlers.
- Material published before 2008 was not included.

Ethics

The information reviewed was ethical (morally acceptable). All information was obtained lawfully, and all information was reported accurately.

Study 2: Microbiological samples taken from restrooms in public and food business settings to determine cleanliness (Objective 2)

Parameters for sampling

This study involved the microbiological sampling of different surfaces in restrooms in public and food business settings, which were tested for parameters recommended by **safe food**. The parameters tested for included

- *E. coli*
- Enterobacteriaceae (a large family of bacteria that can cause a wide range of diseases)
- *Staphylococcus aureus* (*S. aureus*) (a bacteria that can cause a range of illnesses)
- Total viable count (TVC) (an estimate of the number of microorganisms in a sample)

Sampling locations

Swabbing (collection of microbiological samples) took place in restrooms in public and food business settings. This included restrooms in 6 (number, or “n” = 6) public settings including a cinema, a service station and a shopping centre (1 of each in Ireland and in NI) and 2 food business settings (1 in Ireland and 1 in NI). A total of 57 samples from 6 locations were gathered.

Sterile swabs were used to test the level of microbial contamination on door handles and hand dryers (including liquid wells if present, where water from drying hands had collected at the bottom of a drier) at the beginning and end of each day in each location.

Swabbing method

The sample swabbing method was

- Wear gloves.
- Select a sampling area of about 10 centimetres by 10 centimetres.
- Break the seal around the tube containing the swab.
- Remove the swab from the tube, then rub and roll it firmly several times across the sampling area. If the sampled area is dry a wet or pre-moistened swab will be used.
- Return the swab to the tube.
- Label the sample and store it at refrigeration temperatures.
- Send the sample to the laboratory for analysis within 24 hours after collection.

Swab analysis

The swabs were analysed at Biosearch NI, an ISO-accredited private laboratory, and the microbiological colony-forming unit counts were provided to the research team afterwards for interpretation.

Study 3: Evaluation of hand hygiene policies and signage in restrooms in childcare, public and food businesses settings (including interviews with childcare assistants and managers and public and food business settings managers) (Objective 2)

Childcare settings

The researcher contacted and visited 18 participating preschools (6 in Ireland and 12 in NI) and accessed the existing hand hygiene policies and signage in place. The researcher interviewed the childcare assistants or manager about the policies and signage in their premises. (In addition the researcher enquired about hand hygiene practices in more detail to provide information for Study 5, which focuses on hand hygiene practices in childcare settings only.)

Public settings

The researcher visited restrooms in 6 public settings including a cinema, a service station and a shopping centre (1 of each in Ireland and in NI), accessed the existing hand hygiene policies and signage in place and interviewed the facilities managers about these.

Food business settings

The researcher contacted and visited 2 food business settings (1 in Ireland and 1 in NI), accessed the existing hand washing policies and signage in place and interviewed the business managers about these.

Study 4: Evaluation of hand hygiene facilities in restrooms in childcare, public and food business settings (Objective 2)

The researcher contacted and visited 26 participating locations to evaluate the facilities available for hand washing and drying. The locations included 6 preschools in Ireland and 12 in NI; 6 public settings including a cinema, a shopping centre and a service station (1 of each in Ireland and in NI); and 2 food business settings (1 in Ireland and 1 in NI).

The criteria used for evaluation of the facilities are shown in Table 2.

Table 2: Criteria for evaluation of hand hygiene facilities in restrooms in childcare, public and food business settings

Criteria	Public restroom design and facilities	Sink	Water and cleaning agent	Hand drying
				Method of drying
	State of cleanliness		Cleaning agent offered	Cleanliness of hand dryers
	State of repair	State of repair	Cleaning agent method of distribution	State of repair
	Lighting			
	Graffiti			
	Odours			
	Waste bin			

Study 5: Examination of hand hygiene practices in restrooms in childcare settings (interviews with childcare assistants and managers) (Objective 3)

The researcher contacted and visited 18 participating preschools (6 in Ireland and 12 in NI) and accessed the existing hand hygiene policies, practices and signage in place.

In order to collect complex, rich, qualitative data on hand hygiene practices in preschool childcare settings, the researcher conducted semi-structured interviews with childcare assistants and managers. At least 1 childcare assistant in each location was interviewed and the questions focused on the hand hygiene behaviour and practices of 2- to 4-year-olds.

The interview with childcare managers of each location also gathered information about training, methods used to encourage effective hand hygiene, and hand hygiene policies and signage used in the facility.

Study 6: Measurement of compliance with adequate hand hygiene practices in restrooms in public and food business settings (thermal imaging camera observations) (Objective 3)

This study involved the direct observation of individuals' hand hygiene behaviours, to measure compliance and usage of hand hygiene facilities, using thermal imaging cameras in restrooms in public and food business settings. It was expected that restrooms in 6 public settings including a cinema, a service station and a shopping centre (1 of each in Ireland and in NI) and 2 food business settings (1 in Ireland and 1 in NI) would be recruited to participate in this study.

It was expected that at least 600 research subjects would be observed across all locations (300 in Ireland and 300 in NI). In total, 52 locations were contacted to participate in this study and due to the Covid-19 pandemic, recording was possible in only 1 location (public restrooms in Ulster University Belfast Campus, Belfast City Centre).

Method for measurement of compliance with adequate hand hygiene practices in restrooms in public and food business settings

Thermal imaging cameras were installed in male and female restrooms using an Ulster University-approved contractor. Observation of the sink and hand dryer areas in each restroom was conducted over a 10-day period between the 10th and 20th of March 2020.

An example of the images captured during the thermal imaging camera observations in both the male and female public restrooms is shown in Figures 2 and 3.

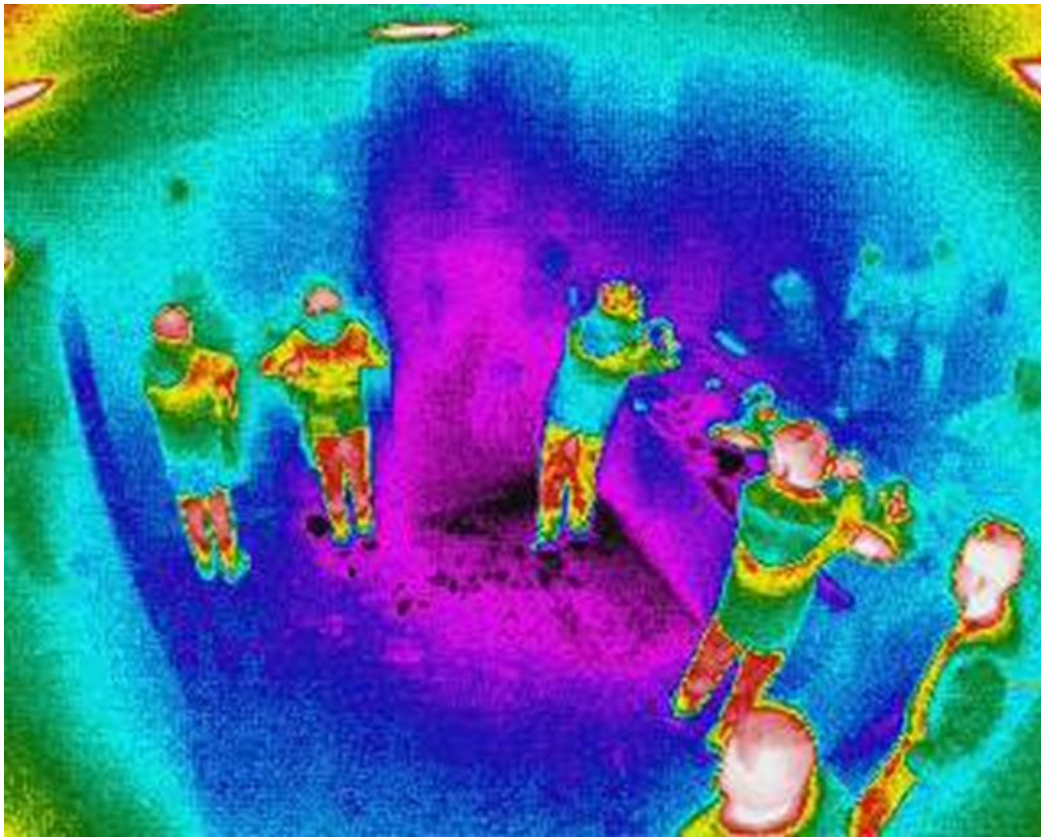


Figure 2. Thermal image of male restroom in a public setting under observation in Study 6, measuring compliance with adequate hand hygiene.

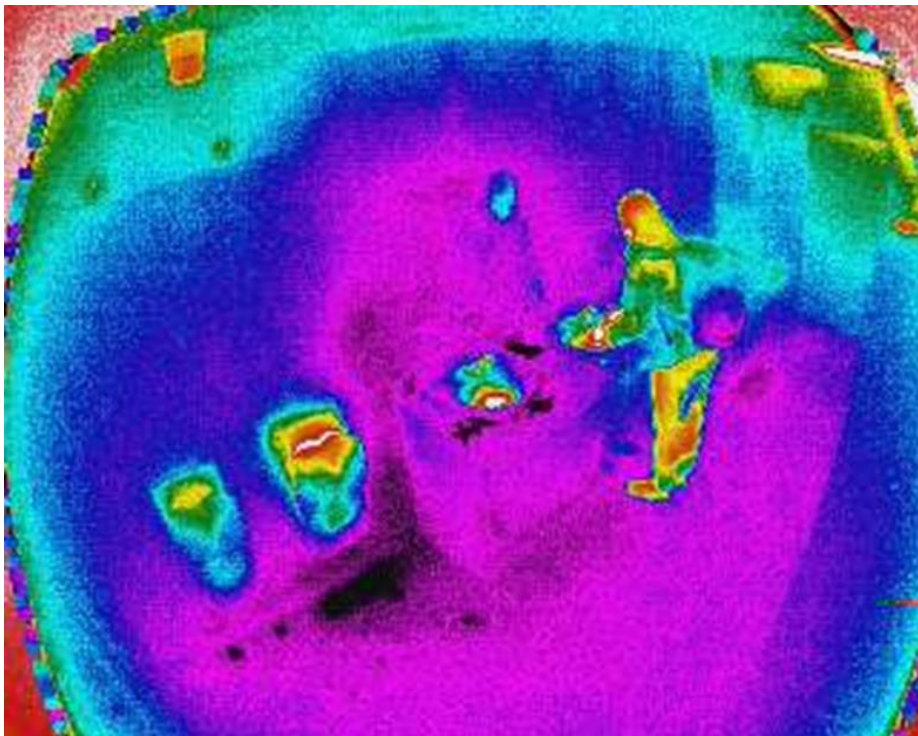


Figure 3. Thermal image of female restroom in a public setting under observation in Study 6, measuring compliance with adequate hand hygiene.

Privacy and security

The identity of the research subjects who used the hand hygiene facilities within each setting was unknown to the observer because only a thermal image (heat image) was produced and therefore no individual can be identified. No personal details such as names, addresses or medical history were recorded, and signage was placed in each location to make individuals aware of the presence of cameras for research purposes.

Using thermal imaging cameras minimised the “Hawthorne Effect” (the alteration of behaviour by the subjects of a study due to their awareness of being observed), which is essential when attempting to capture reliable data. To this end, each camera was fitted before recording began, to allow restroom users to become accustomed to their presence.

Only the lead researcher had access to any footage recorded, and everything observed was kept strictly confidential and secure in accordance with data protection regulations.

The hand hygiene compliance of the general population was defined into 4 distinct categories, based upon previous studies and relevant literature. The 4 categories and their definitions are described in Table 3. The term “inadequate” refers to the combination of non-hand hygiene, poor hand hygiene and basic hand hygiene.

Table 3: Hand hygiene categories used for measuring compliance with adequate hand washing and drying

Hand hygiene category	Description of hand hygiene behaviour
Adequate	Washing hands for 20 seconds using soap and water and drying for 15 seconds using a hand dryer
Basic	Washing hands using soap and water and drying using a hand dryer but not for the adequate length of time
Poor	Any other combination of hand hygiene not fitting the description of “adequate” or “basic”
None	Did not wash or dry hands at all

Study 7: Design, development and evaluation of interventions to improve hand hygiene behaviours (Objective 4)

Several interventions were designed and developed, which were informed by the findings from the review of the literature and the thermal imaging camera observations. These took the form of posters and signage. In total, 9 were designed and submitted for feedback and approval by *safe food*.

It was intended that these interventions would be evaluated after an initial period of thermal imaging camera observation to establish hand hygiene practices and compliance. However, due to the COVID-19 pandemic and associated restrictions, this study could not be completed.

Data analysis

- All the data and findings from Studies 1 to 7 were analysed by the research team.
- All qualitative data, including the interview feedback from Study 5, were transcribed and then analysed using NVivo® data analysis software.
- Written and photographic evidence of hand hygiene facilities, policies, posters and signage (Studies 3 and 4) was analysed by the lead researcher and verified by the principal investigator.
- Microbiological samples collected in Study 2 were analysed by Biosearch NI and the findings interpreted by the research team against predetermined microbiological contamination guidelines.
- Thermal imaging camera footage from Study 6 was analysed using IBM® Statistical Package for Social Sciences® software (SPSS® v.25).

A range of data analysis techniques have been considered for use in the results interpretation. Both descriptive and inferential statistics were calculated. (Descriptive statistics describe data to make them meaningful, for example a graph. Inferential statistics make predictions or generalised assumptions based on the data.)

To investigate correlation between variables (individual characteristics, or items of data), the Pearson chi-squared (χ^2) correlation coefficient was computed. This test is used to determine whether an association (or relationship) between 2 categorical variables in a sample is likely to reflect a real association between these variables in the population.

4 Results

Study 1: Review of the published literature on strategies to improve hand hygiene behaviours (Objective 1)

This systematic literature review focused on hand hygiene interventions. Most authors agree that the most effective interventions are those that are multimodal in nature (that is, they use several methods and approaches) and consist of a combination of different interventions that are cost-effective and realistically can be implemented (Sax, Allegranzi and colleagues, 2007; Pincock and colleagues, 2012).

Currently, most hand hygiene intervention programmes across the world are based on the “best practice” approach rather than an evidence-based approach (Contzen and colleagues, 2015), which some authors argue is not the most effective method (Scott and colleagues, 2007; Biran and colleagues, 2009).

In childcare settings, for example, interventions aimed at young children have historically focused on the teachers or childcare assistants (Watson and colleagues, 2018). Their message is normally about health risks, based on the danger from germs and how they are spread (Biran and colleagues, 2009; Vujcic and colleagues, 2015). However, other studies suggest that the threat of health risk is often not an effective motivator of behaviour change (Biran and colleagues, 2009).

In addition, other authors (McCambridge and colleagues, 2014; Vujcic and colleagues, 2015) argue that most child-focused intervention programmes are largely school-based, and that they do not reach older children or those who are out of school. If a hand hygiene intervention programme does not run for an appropriate length of time, then it is unlikely that it will be successful or have a lasting impact (Finch and colleagues, 2004; Bloomfield and colleagues, 2006).

Outside of childcare settings, most research on hand hygiene interventions has focused on healthcare settings or on those living in developing countries (Widmer and colleagues, 2007; Rodríguez-Baño and colleagues, 2009; Cairncross and colleagues, 2010), and found only slight improvement in hand hygiene compliance during those studies. Levels of hand hygiene compliance did not improve to the required standard, and little research has investigated the long-term impact of hand hygiene interventions in community settings.

It is generally agreed that intervention programmes informed by the evidence of the factors for noncompliance, that are sensitive to diverse cultural and social needs (Little and colleagues, 2015), and

contain elements of social marketing are the most effective type (Sax, Allegranzi and colleagues, 2007; Dancer, 2009; Gould and colleagues, 2017).

Equally, hand hygiene interventions are more likely to be effective if their aim is to change behaviour, rather than provide information (Finch and colleagues, 2004). Any potential hand hygiene intervention programme should be clear and consistent in its message, targeted and tailored depending on the audience and setting (Finch and colleagues, 2004; Waterman and colleagues, 2006).

Proper hand hygiene education is essential when instigating behavioural change (Zingg and colleagues, 2009). Previous research has highlighted the positive impact of hand hygiene education on behaviour and compliance (Cairncross and colleagues, 2005; Zomer and colleagues, 2013). In Cairncross and colleagues' 2005 study, for example, there was a positive association between improved hand hygiene practice and compliance and adult health education classes combined with home visits. In Zomer and colleagues' 2013 study, the researchers employed the use of a multimodal intervention consisting of 4 components. These included: availability of hand hygiene amenities (dispensers and refills for paper towels, soap, alcohol-based hand sanitiser, and hand cream); training to educate about national hand hygiene guidelines; team training sessions aimed at goal setting and formulating specific hand hygiene improvement activities; and reminders and cues for action (posters and stickers).

It is equally important that an effective hand hygiene intervention should focus on improving hand hygiene technique (when and how to do it effectively). Practicing adequate hand hygiene at key times such as before handling or preparing food, or after using the toilet, is essential in preventing the transmission of communicable diseases (Medeiros and colleagues, 2001; Nieto-Montenegro and colleagues, 2008; Luby and colleagues, 2011).

Teaching people to practice the correct number of hand hygiene steps is also key (Pittet and colleagues, 2006; Bloomfield and colleagues, 2007). This is demonstrated in Lee and colleagues' 2015 study, which used a simplified 5-step hand washing technique modified from the World Health Organization's 7-step hand washing technique. In addition, spending the correct amount of time washing and drying hands is essential in effective hand hygiene (Bloomfield and colleagues, 2007; Friedrich and colleagues, 2017). The minimum recommended time that should be spent washing and drying hands in community settings is 20 seconds for each process (United States Centers for Disease Control and Prevention, 2015; Mick, 2016).

Many different types of hand hygiene intervention exist and should be used in combination to maximise their effectiveness at changing behaviour. Generally, these include adequate hand hygiene education programmes that are delivered across all age groups at different life stages. This is usually in combination with written material such as hand hygiene policies and guidelines that are led by organisations and government bodies (Zingg and colleagues, 2009).

Visual reminders such as posters and signage are the most common type of intervention used in community settings. They can be effective tools in motivating behavioural change by reminding people to wash their hands (Feather and colleagues, 2000; Lo and colleagues, 2005; Nichols, 2014). For example, in Feather and colleagues' 2000 study hand hygiene compliance increased by 98 per cent after the use of hand washing signs. Similarly, in Hugonnet and colleagues' 2000 study usage of handwashing posters and signage led to an increase of 16.1 per cent in the hand hygiene compliance rate of participants. However, the success of such visual cues depends on their strategic placement (Chapman and colleagues, 2010), their design and the intervention being kept in place continually, to facilitate good, sustained behaviour (Willison-Parry and colleagues, 2013).

Other common interventions include the active monitoring of compliance and continued feedback of performance (Nichols, 2014). This is usually driven by key role models such as parents, teachers, colleagues and peers, who assist in reinforcing a good behavioural culture and encourage positive practice and compliance (Bellissimo-Rodrigues and colleagues, 2016).

Technological interventions have also had some limited success in the past, with examples such as automated sinks, touch-sensitive faucets and disposable toilet seat covers having been shown to increase the quality of hand washing practice and compliance (Larson and colleagues, 1997; Naikoba and Hayward, 2001; Drankiewicz and Dundes, 2003; Larson and colleagues, 2005). These types of technology and fixtures are examples of how hygiene and infection control have influenced and modernised restroom design (Dodge and Kitchin, 2016), by reducing contact between the individual and contaminated surfaces within the restroom and so minimising the risk of disease spread (Drankiewicz and Dundes, 2003; Dodge and Kitchin, 2016). Many of these types of interventions are cost-effective in terms of installation and save energy also (Anthony and Dufresne, 2007; Chen and colleagues, 2015; Jaglarz and Charytonowicz, 2015).

In conclusion, a successful hand hygiene intervention programme involves a combination of different interventions that are cost-effective and realistically can be implemented. Generally, these include:

- Proper hand hygiene education across all age groups, with adherence to written material and hand hygiene policies that are led by organisations and government bodies.
- Visual reminders such as posters and signs, along with active monitoring of compliance and continued feedback of performance.
- Role models such as parents, teachers, work colleagues and peers helping to create a good behavioural culture and encourage positive practice and compliance.
- Proper environmental cleaning practices that are adhered to.

Using these methods together maximises the reduction of communicable pathogens (disease-causing organisms) on hands and reduces cross-contamination from person to person and from the environment.

To effect and sustain a cultural shift in hand hygiene practice and compliance, interventions must target specific groups of the general population. To achieve this, interventions must use all effective forms of communication, including education and increased presence both in traditional and social media.

Adequate sources of public health funding must also be set aside to deliver effective intervention strategies and ensure the provision of well-designed and properly maintained public restroom facilities and hand hygiene amenities.

Study 2: Microbiological samples taken from restrooms in public and food business settings to determine cleanliness (Objective 2)

In total, 57 samples were taken from public settings including a cinema, a shopping centre and a service station (1 of each in Ireland and in NI) and food business settings (1 in Ireland and 1 in NI). The full results of the microbiological analysis for the presence of TVC, *E. coli*, Enterobacteriaceae and *S. aureus* in each location is shown in Appendix 1.

Table 4 presents a summary of the microbiological results from this study.

Table 4: Analysis of microbiological samples taken from restrooms in public and food business settings

Location of sampling	Sampled material	Type of microorganism (range of colony forming units per swab)				TVC
		<i>E. coli</i>	Enterobacteriaceae	<i>S. aureus</i>		
Public setting	Door handle	< 10		< 10		30 - >300,000
Public setting	Hand dryer	< 10	< 10 - > 150,000	< 10 - 20		550 - >300,000
Food business setting	Door handle	< 10	< 10 - > 150,000	< 10		10 - >300,000
Food business setting	Hand dryer	< 10	< 10 - > 150,000	< 10		30 - >300,000

Study 3: Evaluation of handwashing policies and signage in restrooms in childcare, public and food business settings (including interviews with childcare assistants and managers and public and food business settings managers) (Objective 2)

In total, 26 locations were visited for this study across childcare, public and food business settings. This included 18 preschools (6 in Ireland and 12 in NI); 6 restrooms in public settings including a

cinema, a service station and a shopping centre (1 of each in Ireland and in NI); and 2 food business settings (1 in Ireland and 1 in NI).

The findings from this study are given in full in Appendix 2 and summarised here.

Childcare settings

- Most preschools (83 per cent) had a written hand hygiene policy as part of their infection prevention and control, or health and hygiene policy.
- Around half (44 per cent) of the childcare assistants and managers interviewed thought it was important to have a written hand hygiene policy because they believed it was a legal requirement and important to have for staff and parents in establishing the correct procedures to be followed.
- The main reasons given for not having a written hand hygiene policy were because it was not a legal requirement (17 per cent) and some (11 per cent) did not think it was necessary as hand washing was a routine practice.
- Nearly all the childcare service premises (89 per cent) had hand hygiene posters and signage in the children’s restrooms. Few (22 per cent) had hand hygiene posters or signage in the main play area.
- Most premises used a variety of hand hygiene posters and signage created by various governmental and public health organisations, or created by themselves, as shown in Table 5.

Table 5: Creators of hand hygiene posters and signage used in restrooms in childcare settings

Poster or signage creator	Preschools in Republic of Ireland (n 6)	Preschools in Northern Ireland (n 12)	Total (n 18)
<i>safefood</i>			10
Health Protection Agency		0	1
Food Standards Agency	0	1	1
HSC Health & Social Care Board	0	5	5
Lincoln Lancaster Health Department	1	0	1
Sainsburys Active Kids	0	1	1
Childcare service provider	3	6	9

Public settings

- There was no specific hand hygiene policy present in the restrooms in public settings surveyed in either Ireland or in NI, although each public setting had a general health and safety policy that includes basic hygiene and cleanliness.
- Only 1 of the public settings surveyed (which was in NI) had small hand washing signs above the sinks in the public restrooms. The other locations had no hand hygiene posters, signage or any other type of health promotion material available in the restrooms.

Food business settings

- No hand hygiene signs were present at the time of examination, nor any other types of health promotion or hand hygiene material.

Study 4: Evaluation of hand hygiene facilities in restrooms in childcare, public and food business settings (Objective 2)

In total, 26 locations were recruited for this study across childcare, public and food business settings. The locations visited included restrooms in 18 preschools (6 in Ireland and 12 in NI); 6 public settings including a cinema, a service station and a shopping centre (1 of each in Ireland and in NI); and 2 food business settings (1 in Ireland and 1 in NI).

Photographic and written evidence was recorded for each of the criteria detailed in Table 2. The results of this study are summarised here and given in full in Appendix 3.

Childcare settings

- All premises had working toilets for the children. There was a mixture of adult-sized and child-sized toilets in the restrooms of some premises.
- All premises had working dedicated hand washing sinks and running hot and cold water.
- All premises had soap available.
- All premises provided paper towels for drying hands. Some also offered hand dryers (33 per cent) or cloth towels (11 per cent).

Public and food business settings

- All public restrooms within each setting had running water, foam soap available for washing hands and hand dryers for drying hands.
- A signed, regularly updated cleaning rota was present in each restroom in the public settings.
- The restroom condition in each location was excellent – they were clean, tidy, there was no graffiti or odours, the lighting was excellent, and a waste bin was available.
- The sink and hand dryers in each location were in good working order and good condition.

Study 5: Examination of hand hygiene practices in childcare settings (interviews with childcare assistants and managers) (Objective 3)

A total of 18 preschools participated in the research study (6 in Ireland and 12 in NI), located in both rural and urban settings.

A full summary of the results from the semi-structured interviews are given in Appendix 4. The results of this study are summarised briefly here.

Hand hygiene knowledge

- Children attending the facilities generally have poor understanding of the relevance of hand hygiene in relation to disease prevention, and poor knowledge of adequate hand washing and drying practices.
- Childcare service staff all had great understanding of the relevance of hand hygiene in relation to disease prevention, key times when hand washing is necessary, and very good knowledge of the adequate hand hygiene practice and understanding of each of the steps involved.

Hand hygiene attitudes

- All interviewees stated that at the beginning of the year none of the children could be trusted to know when or how to wash and dry their hands. However, when the hand hygiene routine is established, usually after a few weeks, most children would know to go and wash their hands at key times such as before handling or eating food, or after using the toilet, using an adequate hand hygiene procedure.
- However, there were always some children who still could not be trusted to wash and dry their hands at key times and needed repeated encouragement.
- Encouraging good hand hygiene practice and compliance at key times was a priority for childcare service staff, particularly at the start of each term year.

Hand hygiene practices and compliance

- In addition to using hand hygiene posters, signage and songs, some premises also use other methods to promote good hand hygiene practice and compliance, including
 - Conducting hand hygiene talks and demonstrations to educate the children (44 per cent)

- Using hand hygiene flash cards and stickers, particularly for children with learning difficulties and those with cultural barriers (for example, foreign language speakers) (22 per cent)
- Holding parent induction evenings and coffee mornings and science, technology, engineering and mathematics (STEM) play days to highlight the issue (11 per cent)
- Arranging for a public health visitor to speak with the children on the importance of good hand hygiene practice and compliance (6 per cent)
- Using social media groups (for example, parents' or schools' Facebook® groups), a regular newsletter and mobile apps to provide information to parents (6 per cent)
- Using library books to help teach the children about hand hygiene (11 per cent)
- Many reasons were reported for children not washing their hands. The most common reasons included
 - Lack of education (39 per cent)
 - Lack of reinforcement of hand hygiene at home (33 per cent)
 - Distractions such as “play” or “going to eat” (28 per cent)
 - Dermatological issues such sensitive skin, eczema and dermatitis (11 per cent)
 - Lack of time (children feeling rushed, or are busy) (28 per cent)
 - Lack of understanding because of young age (11 per cent)
 - The opinion that hand hygiene was a chore rather than a “fun” activity (6 per cent)
 - Cultural barriers such as language making it increasingly difficult to teach the hand hygiene routine – some children may not speak or understand Irish or English and so they need visual aids to learn the routine (17 per cent).
- Reported methods of improving children’s hand hygiene practice and compliance included
 - Placing greater emphasis on educating children and parents about how germs spread and the importance of good hand hygiene practice and compliance at home (50 per cent)
 - Increasing staff supervision of children when washing and drying their hands (22 per cent)
 - Having access to better education tools for childcare services, such as more child-friendly hand hygiene posters and songs, with more graphics especially for the younger age group or children of foreign backgrounds (33 per cent)

- Using different media to increase promotion of the benefits of good hand hygiene practice and compliance (for example, television adverts, social media campaigns and so on) and using the “praise factor” to make hand hygiene a “fun” activity for the children (22 per cent)

Study 6: Measurement of compliance with adequate hand hygiene practices in restrooms in public and food business settings (thermal imaging camera observations (Objective 3))

A total of 498 members of the public were observed over an 11-day period using thermal imaging cameras. This included 254 males and 244 females. Descriptive and inferential statistics were calculated where appropriate.

The hand hygiene compliance of the general population observed in this study is summarised in Tables 6, 7 and 8, and further information is provided in Appendix 5.

Hand washing practices and compliance

In the observation period, 463 (92.97 per cent) of the individuals (230 males and 233 females) were seen to have washed their hands after using the public restroom. As shown in Table 6, most (57.63 per cent) washed their hands with water and soap for less than 20 seconds (287 people: 142 males, 145 females). Many people (33.73 per cent) washed their hands with water and soap for more than 20 seconds (168 people: 84 males, 84 females), which is considered adequate. No statistically significant differences were found between genders regarding hand washing practice and compliance.

Table 6: Hand washing practices and compliance in restrooms in public and food business settings by gender

Hand washing method	Males n 254 (percentage of individuals)	Females n 244 (percentage of individuals)	Total individuals n 498 (percentage of individuals)
Water alone < 20 secs			7 (1.41)
Water + soap < 20 secs	142 (55.91)	145 (59.43)	287 (57.63)
Water alone > 20 secs	0 (0.00)	1 (0.41)	1 (0.20)
Water + soap > 20 secs	84 (33.07)	84 (34.43)	168 (33.73)
Total washed hands	230 (90.55)	233 (95.50)	463 (92.97)
Did not wash hands	24 (9.45)	11 (4.5)	35 (7.03)
Total individuals observed	254 (100.00)	244 (100.00)	498 (100.00)

Hand drying practices and compliance

In the observation period, 442 (88.75 per cent) of the individuals (220 males, 222 females) were seen to have dried their hands after using the restroom. As shown in Table 7, most (80.32 per cent) dried their hands adequately using a hand dryer (400 people: 198 males, 202 females). No statistically significant differences were found between genders regarding hand drying practices and compliance.

Table 7: Hand drying practices and compliance in restrooms in public and food business settings by gender

Drying method	Males n = 254 (percentage of individuals)	Females n = 244 (percentage of individuals)	Total individuals n 498 (percentage of individuals)
Hand dryer > 20 secs			90 (18.07)
Hand dryer < 20 secs	146 (57.48)	164 (67.21)	310 (62.25)
Toilet paper	16 (6.30)	15 (6.15)	31 (6.22)
On clothes	6 (2.36)	5 (2.05)	11 (2.22)
Total dried hands	220 (86.61)	222 (90.98)	442 (88.75)
Did not dry hands	34 (13.39)	22 (9.02)	56 (11.24)
Total individuals observed	254 (100.00)	244 (100.00)	498 (100.00)

Overall hand hygiene compliance

Table 8 shows the overall hand hygiene compliance categorisation by gender for the population that was observed. Only 17.07 per cent of the individuals washed and dried their hands adequately as defined in this study. A significant proportion (62.65 per cent) showed intent to wash their hands, with females being significantly more likely to do so compared to males (statistical difference, or “p” = 0.02). However, this is still considered inadequate hand hygiene practice. Significantly, 7.23 per cent of the general population do not wash or dry their hands at all, with males being more likely to practice inadequate hand hygiene (p = 0.02).

Table 8: Overall hand hygiene practice and compliance categorisation by gender

Overall hand hygiene compliance	Males n = 254 (percentage of individuals)	Females n = 244 (percentage of individuals)	Total individuals n 498 (percentage of individuals)
Adequate hand hygiene			85 (17.07)
Basic hand hygiene	146 (57.48)	166 (68.04)	312 (62.65)
Poor hand hygiene	33 (12.99)	32 (13.11)	65 (13.05)
No hand hygiene	25 (9.84)	11 (4.51)	36 (7.23)
Total individuals observed	254 (100.00)	244 (100.00)	498 (100.00)

Study 7: Design, development and evaluation of interventions to improve hand hygiene behaviours (Objective 4)

The design and development phases for the hand hygiene interventions were completed. However, due to the COVID-19 pandemic it was not possible to complete the evaluation of the hand hygiene interventions that were designed. Premises containing public restrooms were closed for several months.

When designing the interventions in this study, the researchers took into consideration the findings of study 1 and study 6.

Increasing awareness of effective hand hygiene procedure

The purpose was to promote good hand hygiene procedure and raise the awareness of the importance of adequate hand hygiene in disease prevention.

This could be achieved by a combination of

- Hand hygiene policy document

A hand hygiene policy document would clearly state simple guidance on hand hygiene and could be adopted by organisations to promote good hand hygiene in a variety of settings.

- National hand hygiene campaign

This would simply explain the necessity of effective hand hygiene and clearly state what an effective hand hygiene procedure is. The campaign could be delivered using mixed media methods (television campaigns, billboards, radio advertisements, posters and so on) and refer to the national hand hygiene policy.

Increasing hand washing compliance

The purpose is to increase compliance or encourage people to wash their hands at critical times (after using the toilet, for example). Methods to achieve this could include;

- **Hand hygiene posters**

These would be targeted towards the general population for use in restrooms in public settings. They could be situated behind the door of the cubicle or on the door exiting the toilet facility. The message would have to be tailored, effective, and motivating for noncompliant restroom users to encourage them to wash their hands. This could be by using behavioural elements in the marketing design to promote peer pressure to increase hand washing compliance or the human “disgust factor” to change behaviour.

- **Hand hygiene signage and stickers**

The stickers and signage would take the form of colourful arrows or handprints placed in the restrooms to direct people to the sinks after using a toilet cubicle or urinal and directing people to the hand driers after hand washing.

Improving the effectiveness of hand hygiene practices

Many people do practice some hand hygiene. However, Study 6 clearly documented that only a few practiced it adequately. To change this, there are some novel interventions and methods that could be used.

- **New, effective hand washing technique**

The aim is to devise and promote a simple but effective hand washing technique. The suggestion is to use a “double soapy wash”. This would increase the timing of the hand washing and effectiveness of the wash but would not focus on sometimes complex actions involved. This would be followed by simple advice of drying hands using the method available until dry, or for 20 seconds.

- **Hand hygiene posters to publicise the new hand washing technique**

These are targeted towards the general population for use in restrooms in public and food business settings. The message would address using the new, effective hand washing technique. They also could be more focused on specific behaviour: timing of effective hand washing, technique of effective hand washing, timing of effective hand drying and technique of effective hand drying.

- **Trivia messages and quotes of the day to increase timing of hand hygiene practices**

Trivia messages and quotes could be placed at eye level in front of the sinks and in front of the hand dryers in a laminated advert display (designed so facilities managers could change these regularly). The text of these quotes should be designed to increase the length of time members of the general population spend washing and drying their hands.

- Hand hygiene signage and stickers to promote effective hand drying after washing

The stickers and signage would take the form of colourful arrows or handprints placed in restrooms to direct people to the sinks after using a toilet cubicle or urinal and directing people to the hand driers after hand washing. The emphasis is on effective hand drying after washing, preventing people from skipping the hand drying step or re-entering the cubicles to use toilet paper to dry their hands on.

Examples of the interventions designed for evaluation in this study are included in Figures 4 and 5 below.



Figure 4. Hand washing trivia quote: “Thought of the day” is intended to increase the length of time people spend washing and drying their hands.



Figure 5. Hand washing signage and stickers: Arrows directing people to wash their hands after using the toilet.

5 Key findings and discussion

This research project consisted of 7 studies intended to fulfil 4 objectives. Table 9 summarises the findings from the results of the studies against the objectives.

Table 9: Summary of study findings for the 4 objectives

Objectives	Findings
<p>Objective 1: Review the published literature on strategies to improve hand hygiene behaviours</p>	<p>The review of the literature did not provide a “one size fits all” intervention to improve hand hygiene. Rather, it highlights the need for comprehensive strategies using a multimodal approach to communicate the importance of hand hygiene to the general population and to reinforce the key message of practicing effective hand hygiene at critical points (for example, when using restrooms in public settings).</p> <p>These strategies and interventions may include visual cues such as hand hygiene posters, stickers and signs, and use of various education tools, demonstrations, written material and advertising campaigns. For people to complete effective hand hygiene behaviours the provision of clean and adequate facilities is also essential.</p> <p>To effect and sustain a cultural shift in hand hygiene behaviours these comprehensive strategies must utilise all effective forms of communication including education and increased presence in both traditional and social media.</p> <p>Commitment of public funding, followed by written policies and guidelines, is paramount to the success of changing hand hygiene behaviours in the long term.</p>
<p>Objective 2: Evaluation of the hand hygiene facilities, policies and signage in restrooms</p>	<p>The surfaces that were tested in the restrooms in public and food business settings were mostly clean.</p> <p>The hand hygiene facilities in the restrooms in all the settings were suitable, appropriate, well-maintained and clean.</p>

	<p>The existence of hand hygiene policies was limited: only a few of the childcare settings had one.</p> <p>Hand hygiene posters were provided in the restrooms in childcare settings but not in the public or food businesses settings.</p>
<p>Objective 3: Examination of hand hygiene practices and compliance</p>	<p>It was generally agreed that, in theory, children know how to wash their hands. However, other barriers to compliance such as distraction or forgetfulness can influence the practice. Drying hands after washing in particular requires improvement.</p> <p>It was agreed that very few children would know how to wash their hands properly when starting school for the first time. The exceptions are among children who previously attended childcare premises (pre-nursery school) or whose parents were particularly proactive in promoting good hand washing practice and compliance.</p> <p>Observations from the restrooms in public settings showed a poor level of compliance: although most people observed did perform some hand hygiene (93 per cent) only 17 per cent did so adequately.</p>
<p>Objective 4: Design, development and evaluation of a range of strategies and interventions for improving hand hygiene behaviour</p>	<p>The findings for objectives 1, 2 and 3 helped the researchers to design a range of interventions that aimed to increase awareness of effective hand hygiene procedure, increase compliance and improve effectiveness of hand hygiene practices among the general population.</p> <p>Due to the COVID-19 pandemic none of the interventions were implemented and evaluated.</p>

Key findings

The research project aimed to investigate hand hygiene facilities, policies and practices across the IOI in restrooms in childcare, public and food business settings.

A summary of the key findings is given here.

Childcare settings

- All childcare service providers try to teach preschool children good hand hygiene practices through educational methods and constant reinforcement by the childcare staff.

- All childcare service providers used a varied mix of materials and methods, from posters and visual demonstrations to songs and other educational activities.
- All childcare service providers recognised the critical role played by parents as role models in reinforcing good hand hygiene practices.
- There was no consistency in both Ireland and NI regarding the provision of hand hygiene information, posters, signage and policies in the childcare settings.

Public and food business settings

- There was a general level of poor hand hygiene compliance amongst the population observed.
- Although a large proportion of the population performed hand washing, only a few completed this adequately.
- Hand hygiene facilities were suitable, appropriate, well maintained and clean.
- Microbiological sampling of door handles and hand dryers in restrooms in public and food business settings showed no significant contamination.
- There was a general lack of information about hand hygiene, or visual reminder for practicing hand hygiene, in all but 1 of the restrooms in public and food business settings.
- Poor compliance with hand hygiene practices as observed in study 6 could be the result of
 - Lack of understanding of what effective hand hygiene procedure is and lack of awareness of the importance of good hand hygiene in disease prevention
 - Misjudging the ability to perform the hand hygiene procedure adequately
 - Lack of reinforcement messages for practicing good hand hygiene and how to perform this effectively.
- The lack of a national hand hygiene policy framework in both Ireland and NI may lead to poor compliance, confusion as to what constitutes adequate hand hygiene practice among the general population and an overall poor culture of hand hygiene behaviour.

Discussion

Childcare settings

It was clear that most preschool children across the IOI had good intentions to wash their hands at key times such as after using the toilet, after playing outside or before handling or eating food. This behaviour was likely the result of constant reinforcement by the childcare assistants and managers on the importance of hand washing at key times. Most reported that the children's knowledge and awareness of germs, communicable diseases and the importance of hand hygiene in the first instance

was lacking but that as time progressed this improved, through taught lessons and reinforcement by the staff. Previous research has highlighted the necessity and benefit of behavioural reinforcement regarding hand hygiene, as hand washing is considered an inherent behaviour that is ingrained in humans from a young age (Whitby and colleagues, 2007). If good hand hygiene practice and compliance are not established at an early age it is more likely that poor hand hygiene behaviour will result in later life, unless people are re-educated (Kennedy and Burnett, 2011).

Also, the findings of this research project highlighted that there is a need for consistency in the learning approach to hand hygiene practice and compliance in childcare settings. Different preschools use different teaching and learning methods to educate children about germs and the importance of hand washing at key times. For instance, some use physical demonstrations, some use songs and others use visual material such as posters and signage to teach and reinforce the behaviour. While multimodal teaching and learning approaches can be beneficial, more clarity is needed on which methods are the most effective in facilitating good learned behaviour. Good hand hygiene practice and compliance are important behaviours to learn from an early age. However, using different methods may in some cases create barriers or gaps in the knowledge and understanding of the importance of hand hygiene in some children. Previous research has emphasised the need for a unified approach to hand hygiene education, especially within childcare settings (Erasmus and colleagues, 2009; Lee and colleagues, 2015).

Another important aspect to consider is the importance of key role models like parents and guardians in reinforcing good hand hygiene behaviour and compliance in preschool children. Based upon the findings of this research, the position of most childcare assistants and managers is that they have a greater influence on the children's hand hygiene behaviour in practice than parents or guardians do (although it is difficult to verify this opinion). Other research has highlighted the significance of role models such as parents, guardians and teachers in influencing children's hand hygiene behaviour (Erasmus and colleagues, 2009; Parveen and colleagues, 2018). It is recommended that future intervention strategies should focus on supporting and educating parents and guardians as to how they can reinforce such behaviour in the home environment.

More emphasis should be placed on the role of hand hygiene interventions that are aimed towards preschool children by governmental and public health organisations. For example, the "Rufus the Monster" hand hygiene intervention pack by **safefood** (safefood, 2020) could help facilitate better hand hygiene education amongst preschool children, as it focuses on why, when and how hands should be washed.

Public and food business settings

This research highlighted that there is a general level of poor hand hygiene practice and compliance amongst the general population. There are numerous reasons for this.

For example, there may be a poor understanding of what good hand hygiene practice is, when to perform it and why it is so important especially in relation to communicable disease control.

Another reason may be the facilities available. Built environment features likely influence differences in practice and compliance, with the provision and availability of hand hygiene amenities and facilities known to have an effect (Eseoghene and Ujiro, 2013; Zomer and colleagues, 2013). However, the findings of this research clearly show that the facilities were adequate, and the microbiological sampling study did not provide evidence that regularly touched environmental surfaces in restrooms pose a significant risk of communicable disease transmission to humans.

This research shows that most people did attempt to wash their hands (93 per cent), just not well enough. The reasons for poor practice are complex. Mostly, people do not spend the adequate length of time washing and drying their hands, a minimum of 20 seconds for each process. Previous research has demonstrated that if hands are not washed for an appropriate length of time, then communicable germs may remain on the surface of the hands and potentially pass to other people directly or indirectly (Strunz and colleagues, 2014). Equally, the findings of this research showed that there are clear differences between hand washing and hand drying behaviours: most people generally spending longer washing than drying their hands or have specific preferences over which drying methods they use (for example, hand dryer or paper towel or on their clothes). This variation in practices results in poor overall hand hygiene behaviour, and this likely stems from the lack of clear messaging in hygiene education and the lack of reinforcement of such messaging. This opinion was reinforced by the lack of hand information or direction (posters or other signage) in the restrooms observed.

Subsequently, widespread, continual poor hand hygiene behaviour amongst the general population can facilitate communicable disease transmission within childcare, public and food business settings. To improve hand hygiene practice and compliance, it is important that future intervention strategies should focus on improving the method of adequate hand hygiene, particularly the timing, and the need for hand drying also.

Future hand hygiene interventions should be innovative in their design and implementation and focus on addressing the specific barriers to compliance identified or in targeting specific groups.

Governmental and public health organisations across the IOI should focus more of their resources on improving hand hygiene behaviour through a comprehensive and unified approach, and through increasing awareness of its significance in communicable disease prevention.

To effect and sustain a positive change in the overall culture of hand hygiene behaviour, the creation of an overarching hand hygiene framework that defines adequate practice and compliance is required. The framework should be tailored to the setting (healthcare and nonhealthcare), so that there is no confusion regarding the proper method of hand hygiene, particularly the number of steps that should be followed and, more importantly, the length of time that should be spent. Until the issue of timing is addressed, then total adequate hand hygiene compliance cannot be achieved. Any intervention

strategy should also be tailored to the audience, in this case the general population, so that overall hand hygiene practice and compliance may improve.

6 Conclusions and recommendations

This research project aimed to investigate hand hygiene facilities, policies and practices across the IOI. The project consisted of 7 studies carried out over a 27-month period in restrooms in childcare premises and in public and food business settings. The main contribution of this research to food safety, public health and hygiene knowledge was in helping identify and evaluate the current hand hygiene practices and compliance of the general population in various settings on the IOI.

Our conclusions and recommendations are based upon the key findings outlined in this report.

Childcare settings

Conclusions

- All childcare settings provided good opportunities to educate children and involve parents and encouraged good hand hygiene practice on the premises, with adequate facilities.
- Findings from this study highlight the need for consistency across all childcare settings, both in Ireland and NI, regarding the provision of hand hygiene information, posters, signage and policies.

Recommendations

- All childcare service locations should be provided with a hand hygiene information pack that contains information on hand washing and drying and the spread of germs, as well as posters, signs and written policies.
- The information pack should highlight the need for a mixed-methods approach when teaching children about hand hygiene and the spread of germs. Potential beneficial approaches include live hand washing and drying demonstrations with the children especially at the start of each term and after holiday periods, so that the routine is reinforced. Displaying the hand hygiene signs and posters in the children's restrooms and in the play areas near the entrances and exits would also be useful. Learning and singing hand hygiene songs should be encouraged, as well as peer support.
- The pack should also help childcare service providers to try to involve other key role models for preschool children. More emphasis should be placed on educating parents and guardians on the importance of practicing good hand hygiene at key times and the prevention of the spread of germs. This could be achieved through parent information days, parent interviews, online social media groups or chat forums, and by email and post. Childcare service managers

should also be provided with hand hygiene songs and leaflets for parents about the importance of adequate hand hygiene and the spread of germs, to further reinforce the routine practice of adequate hand hygiene.

Public and food business settings

Conclusions

- Facilities in restrooms in public and food business settings were adequate.
- No signage or information was consistently present to remind people to practice hand washing and drying nor how to perform these effectively.
- Most people did perform some hand hygiene behaviour but only a few did so adequately.

Recommendations

- Increased media coverage to raise awareness of the importance of good hand hygiene for infection prevention and control, particularly in the current context of the COVID-19 pandemic, should be prioritised by government and relevant public health organisations in both Ireland and NI.
- A major focus of any future public health campaigns on hand hygiene should be on improving the length of time spent washing and drying hands for at least 20 seconds, as timing is the key factor in performing the adequate method of hand hygiene.
- Public settings should be provided with more guidance and material in the form of a written national hand hygiene policy so that the message of good hand hygiene practice and compliance – how to do it adequately, when and why – can reach the general population and to further serve as reinforcing reminders to practice good hand hygiene.

Further work needed

- More research is needed into the design, development and evaluation of different types of hand hygiene interventions aimed at specific groups within community settings.
- Further research on hand hygiene practice in food businesses.
- Investigating the impact of technology-based interventions could help address some of the key barriers to good hand hygiene practice and compliance identified in this research.
- More research is also required on how current public communication campaigns and strategies influence public perception and the culture of hand hygiene and communicable disease transmission in different settings.

7 Added value and anticipated benefits of research

This research project and its key findings have relevance in public health, food safety and hygiene and in highlighting the importance of adequate hand hygiene in communicable disease prevention. It is the most comprehensive research project of its kind carried out on the IOI. It has provided invaluable, up-to-date information and new knowledge on the hand hygiene behaviours and compliance of young children, the general public and food handlers across different community settings (including childcare services and public and food business settings) before which there was little information available. Improving hand hygiene behaviour and compliance is key to improving the general health and wellbeing of the entire population, especially amongst the more vulnerable groups in the population such as children and the elderly.

The findings of this research can be used to inform the government and public health policy makers in Ireland, NI and beyond, highlighting the importance of good hand hygiene as a simple method in reducing the spread of hygiene-related and foodborne diseases. It can inform how government policy could achieve better hand hygiene standards through changes in the built environment (the design and layout of hand hygiene facilities), the introduction of novel interventions designed to improve behaviour and compliance, and through influencing a cultural shift in knowledge and attitudes among children and the general public. The findings relating to childcare settings and public toilets are of greater significance than those in food businesses as the numbers of food businesses studied are insufficient to draw robust conclusions.

The findings can also influence industries such as business, food, manufacturing and retail by improving the general health of the population, reducing economic downturn and loss of productivity. Improving hand hygiene behaviours will lead to less days lost at work due to illness, reducing skill-loss and in turn saving both the individual and employer financial costs in the short and long term.

This innovative research project provided **safe food** and Ulster University with the opportunity of leading and promoting world-class research on the IOI, by being involved in, and caring for, public health and wellbeing. It also strengthened links between Ireland and NI in terms of current and future research collaboration.

8 References

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9 Appendices

Appendix 1: Full results of analysis of microbiological samples taken from restrooms in public and food business settings to determine cleanliness (Study 2)

Sterile swabs were used to test the level of microbial contamination on environmental surfaces including the door handles of restrooms and hand dryers (including liquid-wells formed when water from drying hands collected at the base of adryer, where present). The locations for swabbing included restrooms in 2 food business settings (1 in Ireland and 1 in NI), and restrooms in 6 public settings including a cinema, a shopping centre and a petrol station (1 of each in Ireland and in NI). All swab samples were taken by the project Research Associate at the beginning and end of each day in each location. All swab samples were analysed, and the results provided by an accredited laboratory (Biosearch NI).

In total, 57 swab samples were taken. The results of the microbiological analysis for the presence of TVC, *E. coli*, Enterobacteriaceae, and *S. aureus* in each location is shown in tables 10 to 15.

Table 10: Analysis of microbiological samples taken from restrooms in a shopping centre in the Republic of Ireland

Date of sampling	Location of sampling	Source of sample	Time of sampling	Type of microorganism and number of colony forming units per swab)			
							TVC
09/05/2019	Male restroom	Hand dryer	a.m.	Less than 10		Less than 10	more than 300,000
		Hand dryer	p.m.	Less than 10	more than 150,000	Less than 10	more than 300,000
	Female restroom	Hand dryer	a.m.	Less than 10	more than 150,000	Less than 10	more than 300,000
		Hand dryer	p.m.	Less than 10	9,000	Less than 10	more than 300,000

Table 11: Analysis of microbiological samples taken from restrooms in a shopping centre in Northern Ireland

Date of sampling	Location of sampling	Source of sample	Time of sampling	Type of microorganism and number of colony forming units per swab			
							TVC
29/03/2019	Pilot	Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	3000
01/04/2019	Male restroom	Hand dryer	p.m.	Less than 10	40	Less than 10	9000
	Female restroom	Hand dryer	p.m.	Less than 10	Less than 10	Less than 10	8000
09/04/2019	Male restroom	Hand dryer	a.m.	Less than 10	60	Less than 10	1790
		Door handle	a.m.	Less than 10	Less than 10	Less than 10	3000
		Hand dryer	p.m.	Less than 10	Less than 10	Less than 10	550
		Door handle	p.m.	Less than 10	Less than 10	Less than 10	4000
	Female restroom	Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	1290
		Door handle	a.m.	Less than 10	Less than 10	Less than 10	420
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	1240
		Door handle	a.m.	Less than 10	Less than 10	Less than 10	110

Table 12: Analysis of microbiological samples taken from restrooms in a food business in the Republic of Ireland

Date of sampling	Location of sampling	Source of sampled material	Time of sampling	Type of microorganism and number of colony forming units per swab			
							TVC
14/08/2019	Male restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	280
			p.m.	Less than 10	Less than 10	Less than 10	10

			p.m.	Less than 10	More than 150,000	Less than 10	More than 300,000
	Female restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	220
			p.m.	Less than 10	Less than 10	Less than 10	30
		Hand dryer	a.m.	Less than 10	More than 150,000	Less than 10	More than 300,000
			p.m.	Less than 10	More than 150,000	Less than 10	More than 300,000

Table 13: Analysis of microbiological samples taken from restrooms in a food business in Northern Ireland

Date of sampling	Location of sampling	Source of sampled material	Time of sampling	Type of microorganism and number of colony forming units per swab			
							TVC
29/03/2019	Pilot	Door handle	a.m.	Less than 10	Less than 10	Less than 10	1360
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	3000
01/04/2019	Male restroom	Door handle	a.m.	Less than 10	Less than 10	60	840
			p.m.	Less than 10	Less than 10	Less than 10	4000
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	280
01/04/2019	Female restroom		p.m.	Less than 10	Less than 10	Less than 10	180
		Door handle	a.m.	Less than 10	Less than 10	Less than 10	1890
			p.m.	Less than 10	Less than 10	Less than 10	4000
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	90

			p.m.	Less than 10	Less than 10	Less than 10	30
09/04/2019	Male restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	990
			p.m.	Less than 10	Less than 10	Less than 10	980
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	17000
			p.m.	Less than 10	Less than 10	Less than 10	7000
	Female restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	190
			p.m.	Less than 10	Less than 10	Less than 10	720
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	1590
			p.m.	Less than 10	Less than 10	Less than 10	47

Table 14: Analysis of microbiological samples taken from restrooms in a cinema in the Republic of Ireland

Date of sampling	Location of sampling	Source of sampled material	Time of sampling	Type of microorganism and number of colony forming units per swab			
							TVC
29/04/2019	Male restroom	Door handle	a.m.	Less than 10		Less than 10	120
			p.m.	Less than 10	Less than 10	Less than 10	3000
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	More than 300000

	Female restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	5000
			p.m.	Less than 10	Less than 10	Less than 10	40
		Hand dryer	a.m.	Less than 10	More than 150000	20	More than 300000
			p.m.	Less than 10	More than 150000	Less than 10	More than 300000

Table 15: Analysis of microbiological samples taken from restrooms in a cinema in Northern Ireland

Date of sampling	Location of sampling	Source of sampled material	Time of sampling	Type of microorganism and number of colony forming units per swab			
							TVC
12/04/2019	Male restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	50
			p.m.	Less than 10	Less than 10	Less than 10	120
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	More than 300000
			p.m.	Less than 10	Less than 10	Less than 10	2000
	Female restroom	Door handle	a.m.	Less than 10	Less than 10	Less than 10	30

			p.m.	Less than 10	Less than 10	Less than 10	2000
		Hand dryer	a.m.	Less than 10	Less than 10	Less than 10	More than 300000
			p.m.	Less than 10	Less than 10	Less than 10	More than 30000000

Appendix 2: Full findings of the evaluation of handwashing policies and signage in restrooms in childcare, public and food business settings (Study 3)

The full findings of Study 3 and examples of the photographic evidence of posters and signage taken from the participating settings are presented here.

Childcare settings

- Over half (83 per cent) of all preschools had a written hand hygiene policy as part of their infection prevention and control or health and hygiene policy.
- Many interviewees thought it was important to have a written hand hygiene policy because they believed it was a legal requirement (50 per cent) and important to have for staff and parents in establishing the correct procedures to be followed (44 per cent).
- In Ireland, all premises followed the Early Years Inspectorate “Quality and Regulatory Framework” in relation to hand hygiene practice and compliance (Section 2: Health, Welfare and Development of the Child: Personal Care, page 31, and Appendix 4: Policy on Infection Control, pages 96 and 97). The requirements for the provision and maintenance of adequate hand hygiene amenities and facilities are also outlined (Section 2: Health, Welfare and Development of the Child: Premises, pages 86 and 87).
- In Northern Ireland, premises that had a written hand hygiene policy followed the HSC Public Health Agency’s “Infection prevention and control. Best practice advice for nurseries and childcare settings” guidelines (Hand hygiene, pages 11 to 13).
- The main reasons given for not having a written hand hygiene policy was because it was not a legal requirement (17 per cent) and some did not think it was necessary as hand washing was a routine practice (11 per cent).
- Of the schools that did not have a written hand hygiene policy, all reported they would consider the introduction of one if required.
- Nearly all the childcare service premises had hand hygiene posters and signage in the children’s restrooms (89 per cent).
- All the posters and signage in each premises were located either above the sink at eye level, or next to the sink at eye level for the children.
- Few had hand hygiene posters or signage in the main play area (22 per cent).
- Most premises used a variety of hand hygiene posters and signage created by various governmental and public health organisations or created by themselves, as shown in Table 16.

Table 16: Creators of hand hygiene posters and signage displayed in preschools on the island of Ireland

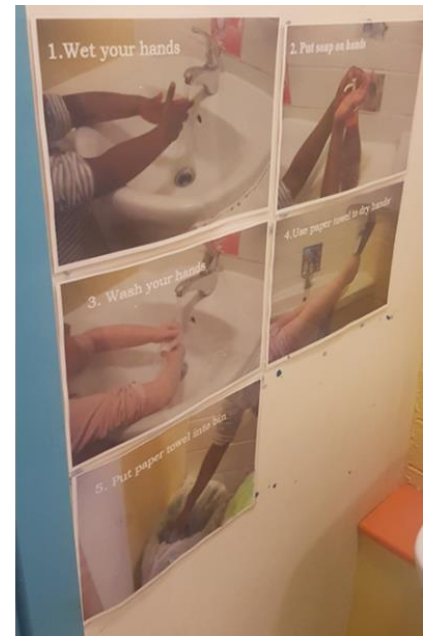
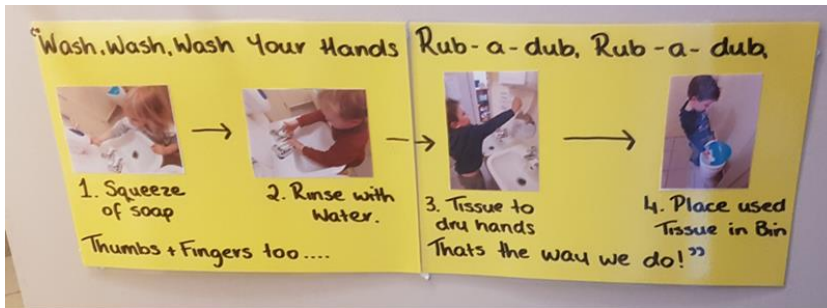
Poster or signage creator	Preschools in the Republic of Ireland (n 6)	Preschools in Northern Ireland (n 12)	Total (n 18)
<i>safefood</i>			10
Health Protection Agency		0	1
Food Standards Agency	0	1	1
HSC Health & Social Care Board	0	5	5
Lincoln Lancaster Health Department	1	0	1
Sainsburys Active Kids	0	1	1
Childcare service provider	3	6	9



Figure 6. Examples of *safefood* hygiene posters in different preschools.



Figure 7. Examples of *safefood* hand hygiene posters in different preschools.



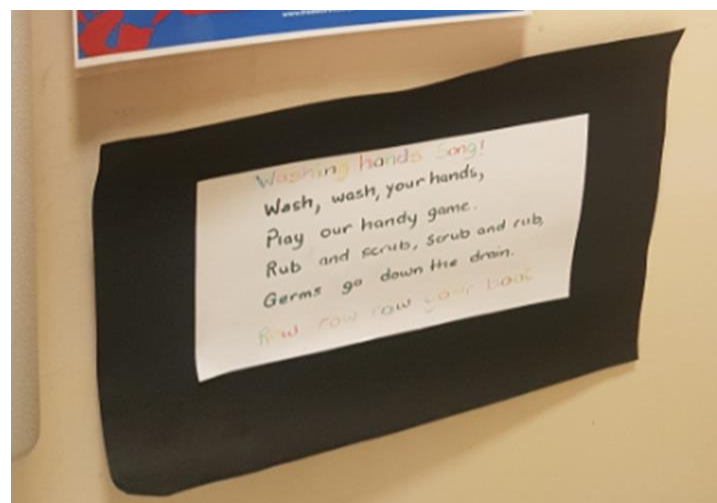
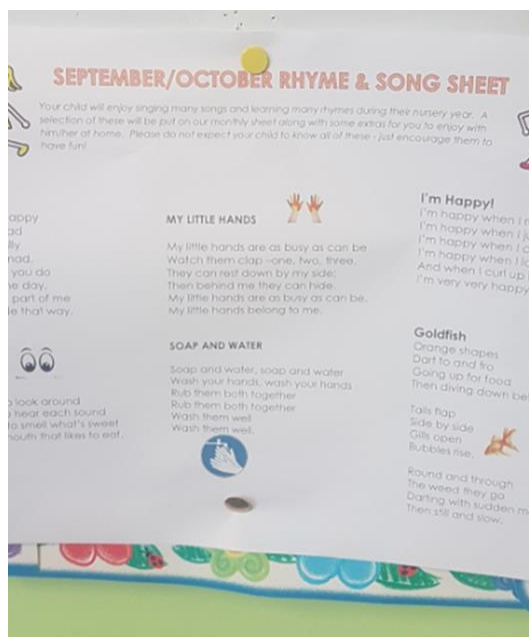


Figure 8. Examples of childcare service providers' own hand hygiene songs in different preschools.

Public settings

- No specific hand hygiene policy was present in the restrooms in public settings surveyed in either Ireland or NI, although each public setting had a general health and safety policy within which basic hygiene and cleanliness is incorporated.
- Only 1 of the public settings surveyed had small hand washing signs above the sinks in the restrooms. Other locations did not have any hand hygiene posters, signage or any other type of health promotion material or information available in the restrooms. Facilities managers were positive and open to the idea of receiving more hand hygiene posters and signage from the government and relevant public health organisations in both Ireland and in NI respectively.
- Generally, managers' knowledge and understanding of the spread of germs and the importance of hand hygiene in infection prevention and control was excellent. In terms of building management and public restrooms, each manager interviewed stated that they would conduct a visual check of each public restroom within their premises each morning and throughout the day to ensure they were clean and well-maintained. An hourly, signed cleaning rota was present as evidence of this. The perceived reasons most reported for poor hand hygiene or noncompliance amongst the general public included time pressure, laziness and lack of knowledge or awareness of the importance of good hand hygiene behaviour in infection prevention and control.



Figure 9. An example of hand hygiene signage in a restroom in a public setting: “Thought for the Week”.

Food business settings

- In NI, although there was no specific hand hygiene policy present, there is a food safety and hygiene and health and safety policy into which basic hygiene and cleanliness is incorporated. As all the food business staff have Level 2 Food Hygiene training, they are aware of the importance of good hand hygiene. In addition to their own hand washing sink, the food business hand sanitisers for use by staff.
- There were no hand hygiene signs present during the time of examination, nor any other types of health promotion or hand hygiene information or material available for the general public. However, the manager was keen on receiving appropriate hand hygiene posters and materials that would help remind the people of the importance of practicing good hand hygiene.



Figure 10. An example of signage in a restroom in a food business setting (the cleaning rota).

Appendix 3 Full findings of the evaluation of hand hygiene facilities in restrooms in childcare, public and food business settings (Study 4)

The full findings of Study 4 and examples of the photographic evidence of the hand hygiene facilities in childcare, public and food business settings are presented here.

Childcare settings

- All the participating childcare service premises in Ireland and NI had working toilets for the children. There was a mixture of adult-sized and child-sized toilets in the restrooms of some premises.
- All premises had working dedicated hand washing sinks and running hot and cold water.
- Nearly all premises used liquid-based antibacterial soap (83 per cent), or a mixture including non-antibacterial or foam soap (17 per cent).
- All premises had working soap dispensers. These included a mixture of wall-mounted and pump-action soap dispensers and bottled pump-action soap.
- All premises provided paper towels for drying hands, or a mixture of paper towels and hand-dryers (33 per cent), or paper towels and cloth towels (11 per cent).



Figure 11. Examples of wall-mounted, pump-action soap dispensers and bottled soap dispensers in different preschools.



Figure 12. Examples of wall-mounted paper towel dispensers and hand dryers in different preschools.

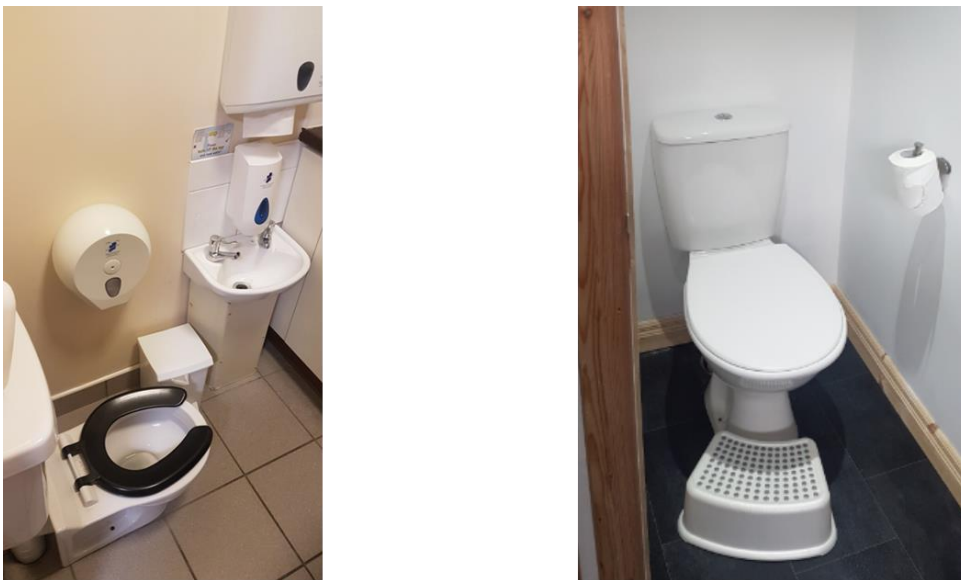


Figure 13. Examples of child-sized and adult-sized toilets in different preschools.

Public settings

- All the restrooms within the public settings had running water, foam soap available for washing hands and hand dryers for drying hands.
- A signed, regularly updated cleaning rota was present in each restroom.
- The restroom condition in each location was excellent – they were clean, tidy, there was no graffiti or odours, the lighting was excellent and a waste bin was available.
- The sink and hand dryers in each location were in good working order and good condition.



Figure 14. Examples of hand washing sinks and hand dryers in different shopping centres.

Food business settings

- All the restrooms within the food business settings had running water, foam soap available for washing hands and hand dryers for drying hands.
- A cleaning rota that was signed every hour and a cleaner was present in each restroom examined.
- The restroom conditions were excellent. They were clean, tidy, and there was no graffiti or odours, the lighting was excellent and a waste bin was available.
- The sink and hand dryers were in good working order and good condition.



Figure 15. Examples of hand washing sinks and hand dryers in restrooms in different food business settings.

Appendix 4 Full summary of semi-structured interviews conducted for the examination of hand hygiene practices in childcare settings (Study 5)

Semi-structured interviews were conducted with assistants and managers in childcare service premises in Ireland and NI. Forty-one questions were asked regarding hand hygiene practices.

A full summary of the key findings is presented here.

Hand hygiene knowledge

- Children are made aware at the beginning of the year that germs can make them sick and that proper hand hygiene practice and compliance gets rid of germs on the hands.
- However, it is generally unclear how much understanding the children have of what germs are and what they can do, as germs are invisible. It is only after messy activities such as painting, using sand or playdough that they know to wash their hands because their hands are visibly dirty.
- Childcare staff show the children how to clean their hands properly at the start of the term year: applying soap and water, and rubbing the hands back and front, and in between the fingers, then rinsing and drying.
- Childcare staff also use hand hygiene steps posters when teaching the children how to wash and dry their hands properly, and draw the children's attention to the poster particularly when they are starting preschool and are learning the hand hygiene routine for the first time.
- It was completely agreed that hand washing with soap is essential, and that washing hands with water alone is not enough to remove germs from the hands.
- It was completely agreed that hand drying is equally important because it helps remove residual germs from the hands left over after washing, further preventing cross-infection and preventing irritation in children with sensitive skin or skin conditions such as eczema.
- It was completely agreed that practicing good hand hygiene at key times such as before handling or eating food, or after using the toilet, did help prevent the spread of diarrhoea, colds and flu particularly after the children have coughed and sneezed.
- It was completely agreed that good hand hygiene practice and compliance by children does help protect childcare service staff from contracting communicable diseases. As key role models, the childcare staff encourage good hand hygiene practice and compliance among the children as standard behaviour.

Hand hygiene attitudes

- All interviewees stated that at the beginning of the year, none of the children could be trusted to know when to wash their hands. However, when the hand hygiene routine is established, after a few weeks, most children would know when to go and wash their hands at key times such as before handling or eating food, or after using the toilet.
- However, there were always some children who still could not be trusted to wash their hands at key times and needed repeated encouragement.
- Encouraging good hand hygiene practice and compliance at key times was a priority for childcare staff, particularly at the start of each term year.

Hand hygiene practices and compliance

- It was generally agreed that, in theory, the children know how to wash their hands; however, other barriers to compliance such as distraction or forgetfulness can influence this.
- It was agreed that very few children would know how to wash their hands properly when starting preschool for the first time. The only exceptions are in children who previously attended (pre-nursery) or whose parents were particularly proactive in promoting good hand hygiene practice and compliance.
- Some preschools reported that primarily childcare staff would teach children how to wash their hands properly (50 per cent). Others reported that it would be a mixture of childcare staff and parents (50 per cent). Table 17 shows that only 33 per cent of preschools in Ireland and NI reported that children in their care spent the adequate time of 20 seconds or more washing their hands.
- The reported activities after which children would wash their hands included: before eating or handling food; after eating food; after outdoor play; after using the toilet; and after messy play or activities such as using sand, playdough or arts crafts.
- Some schools reported that the children did not need encouragement or prompting to dry their hands properly after washing as this was the next natural step in the hand hygiene routine (44%). Others reported that the children did need encouragement and prompting to dry their hands properly after washing, especially when lots of children are drying at the same time: they would not spend the correct amount of time drying their hands as there was a queue and they wanted to get back to an activity (56%). Table 18 shows that only 17 per cent of preschools in Ireland and 25 per cent in NI reported that children in their care spent the adequate time of 20 seconds or more drying their hands.

Table 17: Reported time children spend washing their hands in preschools on the island of Ireland

Children spend at least 20 seconds washing hands	Preschools in the Republic of Ireland (n = 6)	Preschools in Northern Ireland (n = 12)	Total preschools (n = 18)
Always			6
Sometimes	3	6	9
Never	1	2	3

Table 18: Reported time children spend drying their hands in preschools on the island of Ireland

Children spend at least 20 seconds drying hands	Preschools in the Republic of Ireland (n = 6)	Preschools in Northern Ireland (n = 12)	Total preschools (n = 18)
Always			4
Sometimes	4	7	11
Never	1	2	3

- In addition to using hand hygiene posters, signage and songs, some childcare service premises use various other methods to promote good hand hygiene practice and compliance including
 - Conducting hand hygiene talks and demonstrations to educate the children (44 per cent)
 - Using visual hand hygiene flash cards and stickers, particularly for children with learning difficulties and those with cultural barriers (for example, foreign languages) (22 per cent)
 - Holding parent induction evenings and coffee mornings and STEM play days to highlight the issue (11 per cent)
 - Arranging for a public health visitor to speak with the children on the importance of good hand hygiene practice and compliance (6 per cent)
 - Using social media groups (for example, parents' or schools' Facebook® groups), a regular newsletter and mobile apps to provide information to parents (6 per cent)
 - Using library books to help teach the children about hand hygiene (11per cent)
- Multiple reasons were reported for children not washing their hands. The most common reasons included

- A lack of education (39 per cent)
- A lack of reinforcement of handwashing at home (33 per cent)
- Distractions such as “play” or “going to eat” (28 per cent)
- Dermatological issues such sensitive skin, eczema and dermatitis (11 per cent)
- A lack of time – children feeling rushed or are busy (28 per cent)
- A lack of understanding because of young age (11 per cent)
- The opinion that hand washing was a chore rather than a “fun” activity (6 per cent)
- Cultural barriers such as language making it increasingly difficult to teach the hand hygiene routine as some children may not speak or understand Irish or English and so they need visual aids to learn the routine (17 per cent)
- Reported methods of improving children’s hand hygiene practice and compliance included
 - Placing greater emphasis on educating children and parents about how germs spread and the importance of good hand hygiene practice and compliance at home (50 per cent)
 - Increasing staff supervision of children when washing their hands (22 per cent)
 - Having access to better education tools for childcare services, such as more child-friendly hand hygiene posters and songs with more visuals especially for the younger age group or children of foreign backgrounds (33 per cent)
 - Increasing media presence to raise awareness of the benefits of good hand hygiene practice and compliance (for example, television adverts, social media campaigns and so on) and using the “praise factor” to make practicing good hand hygiene a “fun” activity for the children were also highlighted as potential methods of improving hand hygiene behaviours (22 per cent)

Appendix 5 Further information gathered from thermal imaging camera observations to measure compliance with adequate hand hygiene practices in restrooms in public and food business settings (Study 6)

Details of the general population’s hand hygiene practices and compliance are provided here.

Table 19 shows the hand drying method used by male and female members of the general population who were observed

Table 19: Hand drying method used by males and females in restrooms in public and food business settings

Hand drying method	Males (percentage of total)	Females (percentage of total)	Overall (percentage of total)
Hand dryer			400 (80.33)
Toilet paper	16 (6.30)	15 (6.15)	31 (6.22)
On clothes	6 (2.36)	5 (2.05)	11 (2.21)
Did not dry hands	34 (13.39)	22 (9.02)	56 (11.24)
Other	0 (0.00)	0 (0.00)	0 (0.00)
Total	254 (100.00)	244 (100.00)	498 (100.00)

Figures 16 and 17 show how long members of the general population spent washing and drying their hands.

The mean (average) length of time spent washing hands for all individuals was 18.66 seconds (amount of variation, or “standard deviation”: 13.91).

The mean length of time spent drying hands for all individuals was 13.46 seconds (standard deviation: 9.49).

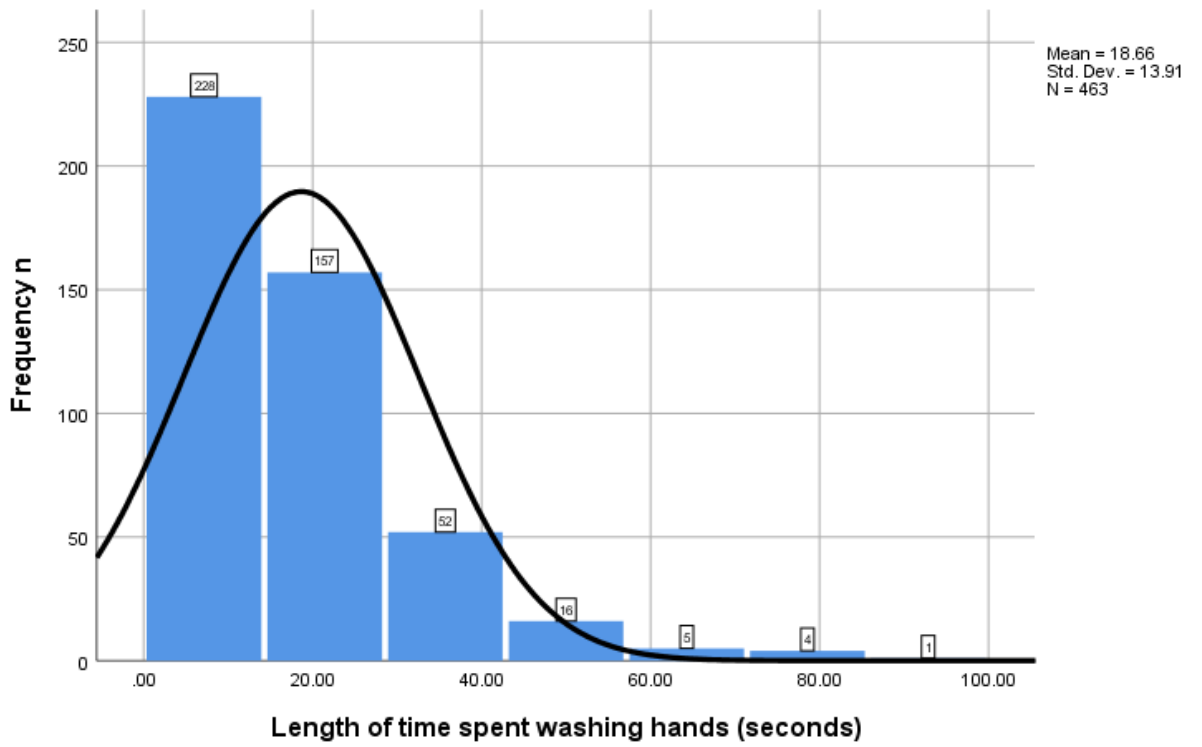


Figure 16. Mean length of time people spent washing their hands.



Figure 17. Mean length of time people spent drying their hands.

safefood

7 Eastgate Avenue, Eastgate, Little Island, Co.Cork, T45 RX01

7 Ascall an Gheata Thoir, An tOileán Beag, Co. Chorcaí, TT45 RX01

7 Aistyett Avenue, Aistyett, Wee Isle, Co. Cork, T45 RX01

Tel +353 (0)21 230 4100

Fax +353 (0)21 230 4111

Email: info@safefood.eu

 [@safefood_eu](https://www.facebook.com/safefood_eu)

 [@safefood_eu](https://twitter.com/safefood_eu)

 **Helpline**
ROI 1850 404 567 NI 0800 085 1683