

Deficient handwashing amenities in public toilets in the time of the COVID-19 pandemic: a multi-regional survey

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ABSTRACT

AIMS: To identify the extent of the provision of handwashing amenities in public toilets at the time of the COVID-19 pandemic, and also to make comparisons with a related pre-pandemic survey.

METHODS: We collected data from 400 toilet facilities that were open to the public: all those in three contiguous city council territories (228) and a further convenience sample of 172 around other parts of New Zealand. Comparisons were made with the data on the same facilities included in a 2012/2013 survey.

RESULTS: Of the toilets in this survey, 2.5% had no water for handwashing and 14.8% had no soap. There was COVID-19-related health messaging signage in 19.5% of toilets, with posters of the COVID-19 QR code used for contact tracing in 12.3%, and generic handwashing signage in 1.8%. The handwashing water had 'no-touch' activation at 28.0% of toilets, and 18.5% of toilets had no-touch bowl flushing. Toilet bowl lids were not present at 32.8%, and 2.3% of toilets had damage that would impair their functionality (eg, broken toilet seats). This new survey found significantly increased provision of soap (risk ratio = 1.47; 95%CI: 1.25 to 1.72), but no increased provision of water, at the 128 sites that had also been examined in the previous survey.

CONCLUSIONS: Although handwashing is probably a much less critical COVID-19 control intervention than reducing aerosol transmission, it should still be strongly supported. Yet this survey found multiple deficiencies with handwashing amenities at public toilets and only modest improvements since a previous survey.

The COVID-19 pandemic has focused international attention on non-pharmaceutical interventions to reduce pandemic spread prior to vaccination roll-out. These interventions include hygiene practices such as appropriate handwashing, which is an evidence-based measure for preventing respiratory virus transmission.¹ More specifically, the World Health Organization (WHO) has issued guidance on COVID-19 and hygiene/sanitation,² which covers the need for handwashing amenities with water and soap.

The COVID-19 pandemic virus (SARS-CoV-2) appears to survive much longer on human skin than influenza A virus.³ Expert commentary has recommended hand-

washing for COVID-19 control, even though the current evidence indicates that the role of contaminated surfaces in transmission is likely to be small⁴ when compared to the inhalation route of transmission. In public toilets, which are often unheated and where the surfaces are generally impermeable, cooler temperatures and surfaces more retentive to coronavirus may increase the role of contaminated surfaces in transmission compared to other living and working situations.^{5,6}

Improved hygiene is also beneficial for reducing the spread of other respiratory viruses such as seasonal influenza and norovirus infection. For example, one review identified six studies that implicated

bathroom surfaces as primary sources of human norovirus infection.⁷

WHO also recommends having separate toilets “for people with suspected or confirmed SARS-CoV-2 infection” and that “the toilet should be flushed with the lid down to prevent droplet splatter and aerosol clouds.”⁸ The latter recommendation is supported by data from a COVID-19 quarantine room study, which found that “the inner walls of toilet bowl and sewer inlet were the most contaminated sites with the highest viral loads.”⁸ Another such study reported that “there was extensive environmental contamination by 1 SARS-CoV-2 patient,” with toilet bowl and sink samples being positive for viral RNA.⁹ A study using genomic sequencing also implicated exposure to sewage as a risk factor for SARS-CoV-2 infection.¹⁰ There has also been one study indicating circumstantial evidence of faecal aerosol transmission of COVID-19 via an apartment drainage system,¹¹ similar to an outbreak from faecal aerosols of SARS-CoV-1 in 2003.¹²

In New Zealand, there was community spread of the pandemic virus (SARS-CoV-2) on a number of occasions during the 2020 year, but elimination was successfully achieved and re-achieved after a series of border control failures.^{13,14} These successes arose largely from a combination of tight border controls (quarantine and isolation), a strict lockdown and widespread testing/contact tracing. Actions related to hygiene included:

- mass media messages relating to handwashing, cough etiquette, staying home when sick and mask use.
- actions by organisations to install hand sanitisers and posters with hygiene messaging in workplaces and various public places
- public toilets were all closed at the highest lockdown level
- actions by some local government agencies to increase soap availability in the public toilets they maintain (eg, Napier City Council¹⁵) and to include posters with hygiene messaging in these facilities.

Given the latter point on public toilets, the aim of this study was to identify the provision of water and soap for handwashing (along with related health

messaging) in New Zealand public toilets at the time of the COVID-19 pandemic. We also aimed to report on other toilet features relevant to hygiene and COVID-19 transmission, and to make comparisons with a pre-pandemic survey¹⁶ that included a sample of the same facilities.

By way of context, New Zealand has previously reported shortages of public toilets, especially in areas with high numbers of international tourists.^{17,18} Previous research has also shown deficiencies with public toilets in the country, in terms of lacking handwashing water (4%) and soap (39%).^{16,19} Another study of toilets in one New Zealand city (mainly at cafés and public facilities) found that some had no handwashing facilities (2%) and no soap (13%).²⁰ Within this sample, the lack of soap was highest in the public toilets, at 38%. Another study of primary school toilets also reported that only 28% had facilities meeting the relevant code of practice (eg, there was a lack of hot water, lack of drying facilities and lack of soap).²¹ Inadequate hand hygiene has also been recorded, with public toilet users in New Zealand sometimes not washing hands (13%) or using soap (28%).²²

In New Zealand there are a range of public toilet types. These include both unisex and/or single-sex facilities (male and/or female). Unisex facilities contain a toilet bowl and usually handwashing amenities, and less frequently a urinal. Single-sex toilet facilities can contain separate cubicles (with toilet bowls, and sometimes with their own handwashing amenities) and, typically, common handwashing amenities. Male toilet facilities usually include urinals.

Methods

Definitions

A ‘toilet facility’ was the sampling unit in this study. We defined this as where there was an opening door from the outside world to a discrete toilet area (ie, a ‘male toilet’, a ‘female toilet’, a ‘unisex toilet’ or a ‘urinal-only toilet’). In some situations there could be multiple toilet facilities that make up a ‘toilet complex’. A ‘toilet complex’ was defined as where there was at least one toilet facility or multiple facilities, either in the same connected structure or within five metres of each other (eg, a male toilet and a female toilet, or two or more unisex toilets).

A 'toilet cubicle' was defined as the enclosed area with a toilet bowl and a lockable door.

Survey sampling

We attempted to include all the public toilet facilities in three contiguous cities (the 'three council area survey') with a combined population of 389,000 (Wellington City, Hutt City and Porirua City). We conducted additional convenience sampling in cities and rural areas, based on author travel plans for other reasons around New Zealand from 18 July 2020 to 2 January 2021. This sampling was for only toilets that could be accessed within those plans and was not of all toilets in any convenience sample local authority area. We expanded the sample to a total of 400 toilets, which we estimated would be at least 10% of the facilities nationwide. But we also aimed to replicate a previous survey of amenities in public toilets in the lower North Island in 2012/2013.¹⁶ The public toilets were located by:

- using online city council maps of public toilets, for the three council area survey²³⁻²⁵
- using Google Maps to locate a city/town/district, and then searching for 'public toilets' in the map
- using the smartphone app version of CamperMate²⁶
- watching for roadside public toilet signs when travelling by car.

The sample excluded temporary toilets, portable toilets and public toilets that were not directly open to the outside (ie, which were inside of other buildings, such as shopping complexes, council-owned buildings (eg, libraries) and railway or ferry buildings, some of which were signed as for 'patrons only'). Where toilet facilities were closed or were being cleaned, we attempted repeat visits where this was convenient.

Data collection

At each toilet complex, we surveyed all the male and unisex toilet facilities. Data were collected on the availability of water and soap for handwashing either in the toilet cubicles or toilet facility. 'Soap' included liquid, foam and cake forms, and we aimed to separately identify alternatives (eg, alcohol gel). Toilets with only empty soap containers were counted as without soap. We also photographed all health-related signage (eg, relating to COVID-19 and handwashing).

Requirements for touching (or not touching) taps/buttons/levers that activated tap water and flushed the toilet were noted. The presence of lids for toilet bowls was documented, given concerns around potential virus dispersion when flushing when the lid is not down (see the introduction).

Analysis

We compared the results of the three council area survey with the supplementary convenience sample. Comparisons were also made with the exact same facilities involved in the previous survey conducted in 2012/2013 (albeit excluding the 14.7% (22/150) that were not readily accessible or that had subsequently been closed down). Statistical analysis used OpenEpi (v 3.01) and Mid-P exact values were calculated (2-tailed).

National denominator estimation

To provide context for our survey, we estimated the total number of public toilet complexes in New Zealand using the following steps:

- For city-based local authorities, we used as a basis the facilities we surveyed in the three council area survey (n=131 or 3.4 per 10,000 population).
- For the other local authorities (LAs), we used data from Google Maps in three LAs in the Wairarapa region (n=13 facilities) and scaled from our estimate of the sensitivity of such data on Google Maps from the three council area survey (at 61.8% or 81/131, giving a scaling factor of 1.62). This gave 21 complexes, or 4.3 per 10,000 population.
- We then extrapolated the three council area survey results to the 12 other city LAs in New Zealand, and we extrapolated the Wairarapa results to the other 51 LAs that were council districts.

Results

Survey results for 2020/21

Data could not be collected at seven toilet complexes in the three council area survey that we intended to be complete, due to closure for repairs and/or being padlocked shut—the latter finding suggestive that these locked toilet complexes were only opened for specific sporting events.

Our total survey comprised 400 toilet facilities at 242 toilet complexes. The distribution of these 400 facilities spanned major urban areas (49% of the sample), other urban areas (40%) and small town and rural areas (11%) (Table 1). Most of the city councils in the country were included in the sampling (62%), but only 26% of the district councils were included. We estimated that the total number of such toilet complexes nationwide was around 1,104 in city councils and 760 in district councils (ie, around 1,864 in the whole country, or 3.7 per 10,000 population). So, our sample was estimated at 13.0% of the estimated total (242/1,864), which was greater than our target of a 10% sample. Our estimate of the total number is slightly higher than an OpenStreetMap estimate of 1,740 in 2016.²⁷

Most of the sample of 400 toilet facilities were from the survey of three contiguous city councils (n=228), relative to the additional convenience sample (n=172). The former group consisted of toilet facilities that were all in the lower North Island, more likely to be in major urban areas and more likely to be unisex (vs male toilets) (Table 1).

The proportion of all the 400 toilet facilities without water for handwashing was 2.5%, with this being higher in the convenience sample than the three council area survey sample (5.2% vs 0.4%; risk ratio (RR)=11.9; 95%CI=1.53 to 93.3; p=0.0030). None of the toilets without running water had any other methods of hand sanitation (eg, alcohol gel) that could replace use of soap with water. Absence of soap was 14.8% overall, and this absence was also higher in the convenience sample vs the three council area survey sample (21.5% vs 9.6%; RR=2.23; 95%CI=1.37 to 3.64; p=0.0011). Most soap was dispensed as a liquid or foam (Supplementary File 1, Figure S1-3), but at 6.0% of toilets it was available in a cake/bar form. A number of toilets had containers for liquid soap that were empty (Table 1).

'No-touch' activation was available for handwashing water at 28.0% of facilities, for toilet bowl flushing at 18.5% and for urinal flushing at 80.5%. Toilet bowl lids were not present for 32.8% (many were designed or built this way) (Supplementary File 3, Figure S3-1), and 2.3% of toilets had damage that would impair their functionality (eg, Supplementary File 3: broken

toilet seats, Figure S3-1; broken toilet rolls, Figure S3-2; destroyed liquid soap dispensers, Figure S3-3).

The majority of toilets had no health-related signage (72.8%). Out of those with signage, some form of COVID-19-related health messaging was the most common type (19.5%), followed by the NZ COVID Tracer App QR code used to facilitate contact tracing (12.3%), generic handwashing signage (1.8%) and then non-smoking signage (1.3%) (see Supplementary File 2 for examples of these posters). Signs with COVID-19 health messaging were more common in the convenience sample than in the three council area survey sample (RR=1.81; 95%CI=1.21 to 2.71; p=0.0040). There was no signage that promoted toilet lid lowering prior to flushing.

From a qualitative perspective, we noted that several COVID-19 signs in tourist areas were in Chinese language (Supplementary File 2, Figure S2-1), and a few handwashing signs included te reo Māori (Supplementary File 2, Figure S2-3). We also noted that some automatic water and soap dispensers took some time to activate and then dispensed too little soap or too little water for a satisfactory handwash (ie, repeat activation was required).

Comparing survey results for 2020/21 with 2012/13

The comparison of the exact same toilet facilities involved in the previous survey in 2012/13 is shown in Table 2. There was no improvement in the availability of water for handwashing, but soap availability improved significantly from 59% to 86% (RR=1.47; 95%CI: 1.25 to 1.72; p<0.0000001).

Discussion

Main findings

This survey found a deficient provision of both soap (14.8% of toilet facilities with none) and, to a lesser extent, water (2.5% with none). These findings suggest that although there has been a statistically significant improvement in soap provision (but not water provision) in the eight-year period since the previous survey, the attempts by some local government agencies to increase soap provision at the time of the COVID-19 pandemic¹⁵ need to be further augmented.

Table 1: Full results for the 2020/2021 survey of public toilet facilities in New Zealand (n=400 surveyed), showing column percentages.

Characteristic	Attempted complete sample of three city LAs (n=228 unless indicated otherwise)		Additional convenience sample (n=172 unless indicated otherwise)		Total (n=400)		Comments
	N	%	N	%	N	%	
Type, location							
Toilet complexes (ie, some with multiple toilet facilities)	131	-	111	-	242	-	That is the average toilet complex had 1.7 separate toilet facilities (400/242) (median=1 facility; range: 1 to 6 facilities). All but one complex had no user charges; and one complex had an office with a supervisor.
Male toilet facility	44	19.3%	65	37.8%	109	27.3%	Four of these were urinals only.
Unisex toilet facility	184	80.7%	107	62.2%	291	72.8%	
Toilet facilities in the North Island	228	100.0%	126	73.3%	354	88.5%	The range was from Auckland to Wellington.
In the South Island	0	0.0%	46	26.7%	46	11.5%	The range was from Picton to Christchurch.
In a city council territory	228	100.0%	40	23.3%	268	67.0%	8 out of the 13 city councils in NZ were included (62%).
In a district council territory	0	0.0%	132	76.7%	132	33.0%	14 out of the 53 district councils in New Zealand were included (26%).
In a major urban areas (100,000+ population)*	185	81.1%	9	5.2%	194	48.5%	These were: Auckland City (n=5), Hutt City (n=50), Wellington City (n=135), Christchurch City (n=4).
In a small, medium or large urban areas (1,000 to 99,999 population)*	38	16.7%	123	71.5%	161	40.3%	
In a small town or rural area (<1,000 population)*	5	2.2%	40	23.3%	45	11.3%	
Water for handwashing							
Water not available	1	0.4%	9	5.2%	10	2.5%	
Automatic, no-touch water delivery	104	45.6%	8	4.7%	112	28.0%	
Lever mechanism for tap	5	2.2%	11	6.4%	16	4.0%	This is a subset of the above row.

Table 1: Full results for the 2020/2021 survey of public toilet facilities in New Zealand (n=400 surveyed), showing column percentages (continued).

Characteristic	Attempted complete sample of three city LAs (n=228 unless indicated otherwise)		Additional convenience sample (n=172 unless indicated otherwise)		Total (n=400)		Comments
	N	%	N	%	N	%	
Soap							
Not available	22	9.6%	37	21.5%	59	14.8%	
Dispenser not working / empty	12	5.3%	3	1.7%	15	3.8%	This is a subset of the above row.
Bar/cake soap only	0	0.0%	24	14.0%	24	6.0%	
Toilet bowls							
Automatic flushing (no need to use a button or lever)	58/226	25.7%	14/163	8.6%	72/389	18.5%	Denominator excluded urinal only toilet facilities
Lid missing	78/240	32.5%	68/205	33.2%	146/445	32.8%	Denominator includes all separate toilet bowls in toilet cubicles
Urinal flushing							
Automatic flushing	52/55	94.5%	43/63	68.3%	95/118	80.5%	Other urinals required a button/level/cord to be used
Notable facility damage							
Damage	6	2.6%	3	1.7%	9	2.3%	See footnote for details.**
Health-related signage							
Any COVID-19-related behavioural messaging	33	14.5%	45	26.2%	78	19.5%	Excluding QR codes—see below. There was an example of a hand-washing sign involving soap in a toilet with no soap available.
Any COVID-19 QR code signage	27	11.8%	22	12.8%	49	12.3%	Inside or on outside wall/door. We included one sign that had fallen onto the floor.
Any handwashing signage	7	3.1%	0	0.0%	7	1.8%	That is generic signage, not COVID-19 specific
Any non-smoking signage	2	0.9%	3	1.7%	5	1.3%	
No health-related signage	175	76.8%	116	67.4%	291	72.8%	None of the four categories above.

* Using the New Zealand Statistical Standard for Geographic Areas 2018.

** Damage included broken seats, a toilet bowl lid with a hole, soap dispenser container remnants, the light not working and a toilet roll holder on the ground.

The higher absence of water (5.2% vs 0.4%) and soap provision (21.5% vs 9.6%) in the convenience sample versus the three council area survey sample is likely to reflect the more modern amenities in the latter and/or a higher-quality maintenance schedule. As New Zealand is highly urbanised, we suspect that the true nationwide results would be closer to those of the three council area survey than the convenience sample ones. However, as provincial and rural areas have a proportionately greater number of domestic and international tourists in comparison to the resident population, which has a greater impact on public toilets, there appears to be a further and continued long-term need for central government investment in, and regulation of, rural and small-town toilets. The consistent need for a high or very high prioritisation of toilet infrastructure for tourists across rural regions and roads indicates a large backlog of investment.²⁷

The relatively low level of health-related signage, especially COVID-19-related health messaging (only 19.5%), NZ COVID Tracer App QR code signage (only 12.3%) and generic handwashing signage (only 1.8%), was a problematic finding for health promotion and disease control. These deficits are likely to represent both a long-term lack of public signage relating to handwashing and an inadequate response to the COVID-19 threat.

Also of note from a hygiene perspective was the limited extent of no-touch activation of devices (ie, for handwashing water at 28.0% and for toilet bowl flushing at 18.5%). These should ideally be expanded with the potential long-term goal being to have maximally no-touch amenities (including automated door opening and locking via hand waving in front of a sensor; no-touch

water and soap dispensing; and no-touch toilet flushing and hand-drier activation). Automation could extend to the toilet bowl lid being closed before flushing.

Ensuring that all toilet bowls have lids (missing for 32.8% in this survey, often by design) is also desirable, along with messaging to close the lids prior to flushing (see the introduction for the rationale for lid closing).

Study strengths and limitations

This is the largest such survey to date in New Zealand that we know of, and it was able to compare a sub-sample of the same toilet facilities after an eight-year period. It was also conducted at a time when there was heightened need for hygiene, due to the COVID-19 pandemic.

Nevertheless, the study was limited by only attempting to be complete in three contiguous council areas, with the rest being convenience sampling. This was owing to this being an unfunded study with no budget for travel. The convenience sampling is likely to have involved surveying facilities that were more accessible to the researchers by being on or near main roads. These may be relatively newer and have a better maintenance schedule than facilities in small rural towns. This may have resulted in some under-estimation from the convenience sample of the extent of the problems outside urban areas (eg, with water and soap availability).

The study was also limited to male and unisex toilets. Internationally, there are indications that the quality of public toilet facilities for females may be poorer.²⁸ The limitation may have had implications for the surveyed quality of facilities, especially for small town and rural areas, which had a smaller proportion of unisex toilets.

Table 2: Comparison of the same public toilet facilities in the two surveys (not including those demolished or closed at the time of the second survey; all facilities were in the lower North Island).

Characteristic	Previous survey in 2012/13 ¹⁶		This survey in 2020/21		P-value
	N	%	N	%	
Water available for handwashing	123/128	96.1%	123/128	96.1%	1.0
Soap available**	75/128	58.6%	110/128	85.9%	<0.0000001

* If a toilet complex had changed in the number of toilet facilities (eg, expanded from two to three unisex facilities), we only compared the exact same number of facilities as in the original survey.

** In liquid, foam or bar/cake forms.

Potential research and policy implications

A fundamental research issue is to better quantify the risks of infectious disease transmission associated with use of public toilets (eg, from any aerosolisation of faeces and from touching contaminated surfaces). This is not only relevant to SARS-CoV-2 but also other infectious diseases (eg, norovirus infection and seasonal influenza).

Nevertheless, surveys such as this could be improved by being made fully random at the national level and collecting additional data on the facilities to compare them with local standards (eg, as per New Zealand ones,²⁹ albeit from 1999) or more state-of-the-art Japanese designs.³⁰ We suggest that regular (at least five yearly) nationwide surveys funded by the central government are needed to better establish the health and other risks, and as a way to audit compliance with current and future regulations. Research on ways to minimise the vandalism of public toilets is also needed, as in the past this has been reported as a barrier to using soap dispensers in New Zealand.¹⁵ Artwork inside toilets and on exterior walls is used in some New Zealand toilets (Supplementary File 1, Figure S1-1) and might be worth expanding if it is found to be effective against vandalism.

Some toilets are still without basic elements of hygiene. Policy goals for local government could be to ensure all facilities have water and soap, and to move towards designs that are maximally no-touch. Built-in redundancy (eg, two separate soap dispensers) may be desirable to minimise the risk of running out of soap, and cakes of soap should probably be avoided as these are more vulnerable to theft. If fully automated taps are not installed, then tap levers or floor pedals for activating water flow could be an alternative. Levers allow users to use the back of their hands and can also be more suited than conventional taps for people with disabilities such as arthritis.

Central government could set and better enforce minimum standards for council-owned public toilet facilities and the extent of their provision. Currently, local government authorities largely regulate the quality of their own toilet facilities, although theoretically District Health Boards

could use their powers under the Health Act 1956 to ensure that unhealthy facilities are improved. A possible way to ensure mandated national standards are established, monitored and maintained is through the central government's current Three Waters Reform Programme.³¹ The underlying principles for standards of public toilet quality and provision have been discussed in a United Nations report,³² and the World Bank has reported on design, operation, management and regulatory guidelines.³³

Part of the required role for local authorities in communicable disease control could be regulations on the presence of standard health messages and signage in relevant public facilities, to help address the major deficit that we found. New Zealand's national-level legislation requiring smokefree signs (eg, on school grounds) is an example that could be followed.³⁴

Central government could also boost funding support for the provision and quality of toilets, at least partly from border charges collected from international tourists (a funding system already in place in New Zealand). The extent of the funding needed should be seen in the context of the huge costs of COVID-19 and future pandemics, and from other respiratory viruses such as seasonal influenza and from norovirus infection.

Conclusions

To conclude, despite the serious threat and great costs of the COVID-19 pandemic, and although there has been some improvement in soap provision in the eight-year period since the previous survey, attempts by some local government agencies to increase such provisions need to be further augmented. There are also other design and maintenance deficiencies that would improve hygiene in public toilets. There is a major scope for improving health messaging at these sites, and this might be a quick, low-cost intervention to assist pandemic control in any future outbreaks.

Supplementary files

- [View Supplementary File 1.](#)
- [View Supplementary File 2.](#)
- [View Supplementary File 3.](#)

Competing interests:

Nil.

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