

Nudging Hand Hygiene in Long Term Facilities: a Pilot Study Among Health Workers in Northern Italy

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Abstract

Background.

The aim was to design and pilot an intervention to improve hand hygiene compliance in long-term facilities in the context of the COVID-19 pandemic in Northern Italy. Infection prevention has received so far poor attention in Long Term Facilities (LTFs) which were disproportionately affected by COVID-19 deaths.

Methods.

We used structured and unstructured observation and facilitated group discussions to investigate the barriers and facilitators of hand hygiene. The formative phase run across two long-term facilities in the Piedmont and Lombardy regions, Italy. The intervention took place between June and July 2021 in one long term facility in the Turin province, Piedmont, Italy. It involved two wards, placed on separate floors and with separate staff. The intervention included three behaviour change techniques: to improve knowledge, we used a briefing and posters; to increase salience, we used sign-posting the patient zone using tape; to increase ease of access to handrub, we providing portable baskets. We run a cross-over design to evaluate the effectiveness of the intervention.

Results.

We found that hand hygiene compliance was extremely low (~ 1%) during the baseline measurements. In the ward which received the intervention first, compliance was 28% during the intervention and then fell to 8% when the intervention was removed. Health workers had five times the odds of washing hands during the intervention compared to when the intervention was removed (OR = 4.9; CI:2.43–9.04). In the ward where control precedes the intervention, compliance went from 10–15% but the change was not significant.

Conclusions.

Hand hygiene compliance was alarmingly low. The intervention, and more specifically improving access and salience, was able to leverage substantial hand hygiene improvement. Altogether, the results suggest that the intervention is feasible at a very low cost and potentially effective and that there is need to test it with a large-scale study.

1. Background

The transmission of infections in long-term care facilities (LTFs) is a fundamental aspect of health-care. The single most effective tool to prevent infections' transmission is appropriate hand-hygiene of health

workers, but while a wealth of studies focuses on hand hygiene compliance in acute care facilities,¹ research on long-term facilities has been given less attention²⁻⁵.

In the context of SARS-CoV-2 pandemic, the limitations of LTFs in managing healthcare associated infection has emerged strongly. The mortality burden attributable to COVID-19 estimated in these contexts^{6,7} has attracted a lot of attention also on the poor quality of care around infection prevention.⁸ LTFs' limitations have been particularly evident in Northern Italy, where COVID-19 has critically impacted LTFs highlighting their weaknesses.^{9,10} The enabling environment for performing infection prevention behaviours was extremely weak in this context.

Specifically, there are key features of LTFs that hinder compliance with hand hygiene practices²³. Since in most LTF patients are resident in such premises, health workers have to strike a balance between a clinical and a home environment. In addition, they are simultaneously taking care of acute and vulnerable patients, with markedly different needs. Overall, the level of training dedicated to the health workers personnel in LTFs tends to be lower compared to other healthcare settings, with gaps in knowledge,²⁰ and there is a widespread lack of leadership on infection prevention and control.²¹ In Italy, anecdotally, LTF managers complain about the absenteeism of health workers of LTFs exacerbates this situation together with reported low budget for infection prevention.

Although there is indirect evidence of poor hand hygiene compliance in LTFs, detailed data are scant across Europe and Italy is no exception. The lack of reliable data is problematic for at least two reasons. First, it is difficult to identify the barriers to good hand-hygiene practices. Second and relatedly, it is hard to design effective behavioural interventions to improve hand-hygiene. The latter is particularly important because there is much evidence that hand hygiene interventions require contextualization to work and hence they should consider the characteristics of long-term facilities aforementioned.¹³

The objectives of this paper are: to provide a quantitative assessment of hand-hygiene compliance in LTFs (objective 1) and to design (objective 2) and test (objective 3) a low-cost behavioural intervention aimed at improving compliance in this context. In 2019, we established a partnership between the University of Turin, LSHTM, and a large cooperative running over forty LTFs in Northern Italy. The present study is based on observational and quantitative data collected in two of the cooperative's LTFs.

2. Methods

This prospective study comprises of three separate but interdependent stages.

The *formative phase* was aimed at assessing the gaps in hand hygiene and designing an intervention (objective 1 and 2). It was conducted between January and May 2021 in three different LTFs, two of them in the Turin province (Piedmont, Italy) and one in Milan (Lombardy, Italy). The hand hygiene measurements (objective 3) took place between June and July 2021 in two long-term facilities located in Piedmont, each of which had two wards. In the same timeframe, the intervention pilot was carried out in

one of the two LTFs (objective 3). The wards had 39 and 45 patients each. The wards are placed on separate floors and have distinct staff members. The other LTF used as external control had around 60 patients. We followed the ORION for infection control statement to ensure our reporting was clear and complete.¹¹

2.1 Formative phase

The formative phase comprised 3 meetings with key management stakeholders (including the project manager), one focus group discussions with 10 health workers, unstructured observation in two long term facilities for a total of 10 days of observation, and early feasibility testing of some of the intervention elements. These steps supported an iterative intervention design process which we ultimately formally tested in the cross-over pilot described below.

2.2 Compliance measurement

To assess levels of hand hygiene compliance we used the WHO observation audit tool, the most common and validated method for direct data collection of hand hygiene.¹² Specifically, we used the four moments recommended for long term facilities.¹³

We defined an aggregate measure for hand hygiene which includes any attempt at hand hygiene (hand rubbing with gel with bare or gloved hands or hand washing with soap and water). Even though we acknowledge that hand rubbing over gloved hands does not strictly follow the hand hygiene guidelines, it still represents, behaviourally, an attempt to perform the action and this is why we included it in the overall measurement.

We focused on the morning cleaning routine of patients, which we identified as one of the most critical phases for healthcare-associated infection transmission in LTFs. Specifically, in this context key hand hygiene moments include: hand hygiene before and after touching the patient, between patients, before aseptic procedures such as washing the patient's face, toothbrushing, managing bed sores, and after body fluid exposure, such as changing the nappy. We contextualised the patient zone – the patient bed and items temporarily dedicated to that patient¹³ - in this study defined as the patient bed, the bedside locker, patient chair, and the trolley used for keeping health workers equipment (e.g. clients' towels, sleepers, cream). In addition, if the health worker was to touch patient' clothes (those on the patient or new clothes) that would still be considered within the patient zone.

One independent observer stationed in the facility where the intervention took place over 20 days and observed continuously between 6AM and 10AM every morning. Observers did not disclose they were observing hand hygiene specifically, but rather were instructed to say they were assessing the general routine of care and challenges faced by healthcare workers in performing their tasks. The observer attempted to capture an equal amount of observation hours per ward (both intervention and control wards). In addition, we also collected observational data using the same strategy of observation during 9 days in the same period from an external control LTF with similar characteristics. Data from the latter

observation is key to determine if behaviour change happened in the period of observation independently from our intervention and to assess the pure effect of having an external person observing the morning routine (potential Hawthorn effect).

2.3 Cross-over pilot to assess intervention feasibility

The cross-over experiment designed to evaluate the effectiveness of the intervention was set up in one long-term facility (objective 3). There was no previous contact with the research team. The baseline measurement involved all wards equally (5 days, baseline, objective 1). Then, one ward (Ward1) received the intervention first (8 days). Next, the intervention's materials were removed from the ward and simultaneously the other ward (Ward2) received the intervention (7 days). Figure 1 illustrates the design. At the time when each of the wards was not receiving the intervention, it was considered as an internal control.

2.4 Data analyses

We carried out a logistic regression model to assess the effect of the intervention on total hand hygiene compliance. We considered two separate models for each ward, to account for the order effect of the intervention period. We also accounted for ward units as fixed effects. Workload and staffing levels were stable during the study period and hence we do not account for this in the models.

3. Results

3.1 Formative phase results and intervention design

The formative phase used focus group discussion, stakeholder engagement and unstructured observation.

The key gaps in hand hygiene behaviour during the morning cleaning routine we identified were:

- Low compliance before aseptic or clean procedures (later confirmed in our structured observation—see Appendix 1);
- Chain of actions with no hand hygiene in between which can lead to substantial infectious transmission, for example, health workers did not typically wash hands between patient's change of nappy and tooth brushing
- Incomplete or absent hand hygiene between patients in the same room and between different rooms.

We also identified the following barriers preventing appropriate hand hygiene compliance during the morning cleaning routine:

1. Knowledge and beliefs gaps: health workers indicated distrusting the effectiveness of handrub; health workers over-relied on the capacity of gloves to stop germ transmission. More generally, health workers displayed a poor understanding of the concept of the patient zone including lack of

hand hygiene between patients, and a poor understanding of when hand hygiene is most crucial e.g. before aseptic procedures.

2. Structural/environmental barriers: to access to the materials to practice the hygiene: the handrub was placed on a trolley which cannot be taken into patients' rooms; moreover, given the cognitive deficits of many patients, it was not possible to have handrub dispenser installed in the rooms; hand washing was often only feasible in the patients' toilet. The considerable time constraints faced by health workers during their workload exacerbated the cost of practicing hand hygiene.
3. Lack of reminders: no reminders were present.

Given the aforementioned barriers, the intervention included three components aimed at increasing knowledge (barrier 1), facilitating access to hand hygiene materials (barrier 2), and raising salience (barrier 3). Specifically:

1. an informative briefing and the diffusion of summary infographics, focusing in particular on the morning cleaning routine and the moments in which hand hygiene is pivotal.
2. the introduction of a portable basket to facilitate the transportation of the handrub next to the patient zone;
3. visual cues to delimit the patient zone and prompt hand hygiene between patients.

Figure 2 presents the materials we used: the iconographies, the portable basket to easily move the alcohol-based gel, and the red tape used to highlight the patient zone. The components were designed to be possible to replicate at very low cost.

Since the objective was to address the three barriers identified during the formative phase, we decided to employ the three measures together. The simultaneous implementation of the interventions is motivated by the desire to develop an effective strategy to promote hand hygiene allows us to maximize the behavioural response. Multi-modal strategies and grounding in the local context have been shown to be effective in fostering healthcare hand hygiene behaviour.^{1,14,22}

3.2 Data in absence of intervention

As a first result, we found that hand hygiene compliance was extremely low (~1%) during the baseline measurements (see Table 1) in the intervention LTF. In the external control LTF, overall compliance was of 3.8% across all the 9 days of observation.

Table 1- Hand hygiene compliance by intervention period in the intervention LTF

	<i>Baseline</i>	<i>Control</i>	<i>Intervention</i>
<i>Hand rubbing with gel</i>	0.4	0.2	6.4
	[-0.4 1.1]	[-0.2 0.7]	[3.8 9.0]
<i>Washing with soap</i>	0	3.2	2.3
	0	[1.6 4.9]	[0.7 3.9]
<i>Hand rubbing (with gel) over gloves</i>	0.7	5.5	11.4
	[-0.3 1.8]	[3.4 7.7]	[8.0 14.7]
<i>TOTAL HAND HYGENE</i>	1.1	9.0	20.1
	[-0.1 2.4]	[6.3 11.7]	[15.9 24.4]
<i>N</i>	269	434	343

Notes: Table 1 reports compliance with the definitions of hand hygiene in percentage points and relative confidence intervals in the tree phases of the experiment and in the external control.

3.3 Intervention effect

During the respective control periods in the two intervention LTF wards (i.e. when one ward was not treated while the other was) compliance was between 8% and 10%. This is higher than baseline highlighting a possible reaction to having an active intervention dedicated to this topic. A spillover effect is also conceivable possible between the intervention and the control ward in period 1 (see Figure 1).

Table 2 summarizes the percentage of compliance in the different periods of the trial (before the intervention, when acting as control and when treated) for each LTF and ward. In the ward which received the intervention first, compliance was 28% during the intervention and then fell to 8% when the intervention was removed (control period). Whilst, in the ward where control period preceded the intervention, compliance went from 10% to 15%. The compliance level in the external control was substantially lower than any intervention period in the intervention LTF (5.6% during the baseline, 0% after intervention starts in the first ward).

Table 2. Descriptive statistic for Total Hand Hygiene by LTF and Ward

<i>TOTAL HAND HYGENE</i>	<i>N</i>	<i>Baseline</i> % (CIs)	<i>Control</i> % (CIs)	<i>Intervention</i> % (CIs)
<i>Intervention LTF - Ward 1</i>	492	1.81 [-0.24 3.85]	7.65 [3.76 11.54]	27.97 [20.52 35.42]
<i>Intervention LTF- Ward 2</i>	554	0 -	9.96 [6.23 13.69]	14.50 [9.58 19.42]
<i>External LTF</i>	319	5.6 [2.5 8.71]	0 -	N/A
<i>N</i>	1046	269	434	343

Notes: Mean compliance and 95% Confidence Interval in square brackets.

Table 3 reports the results from a logistic regression of compliance with hand hygiene. The adjusted models suggest that the intervention was effective in Ward1, where health workers had five times the odds of washing hands during the intervention compared to when the intervention was removed (OR=4.9; CI:2.43-9.04). No significant effect was found for Ward2.

Table 3. Logistic regression of total hand hygiene

Outcome: Total Hand Hygiene (any hand hygiene: use of soap and water, gel on bear hands or gloves)				
	Ward 2		Ward 1	
	Crude OR [CI]	Adjusted OR [CI]	Crude OR [CI]	Adjusted OR [CI]
Intervention	1.53 [.86 2.71]	1.50 [.84 2.67]	4.68*** [2.43 9.04]	4.66*** [2.47 8.78]
Number of observations	451	451	326	326
Pseudo r-squared	0.007	0.024	0.083	0.083

Notes: Odds ratios reported, confidence intervals in square brackets. *** $p < .01$, ** $p < .05$, * $p < .1$

Figure 3 summarizes the hygiene behaviour of the two Wards in the intervention LTF.

We observe how the intervention had a strong and punctual effect for the ward that received the treatment first and from which it was removed (Ward 1) while it is smaller and smoother for the other which received the treatment in a second time and was not removed (Ward 2).

We also compared the compliance, before and after the intervention start date in the external control LTF to verify whether any external circumstance would have somehow affected the compliance independently of intervention and we could not see any indication of hand hygiene compliance improving after the baseline in the external control LTF. According to a Two-sample Wilcoxon Mann-Whitney test, compliance was higher before than after the intervention (5.6% vs 0, p -value 0.01). Note that performing logistic regression was not possible due to the distribution of the data. This reduction is due to the fact that there has been a strong Hawthorne effect concentrated on the first day (21% in the first day).

4. Discussion And Conclusions

In the absence of an intervention, our study found alarmingly low level of hand hygiene compliance (1-3.8%) during routine morning cleaning of LTF residents/patients; this is low compared to hand hygiene studies in other healthcare^{15,16} structures and also slightly lower than other LTF studies⁵ in high income countries. Although structured observation of hand hygiene compliance was measured only in two facilities, we also performed unstructured observation in a third facility with similar behavioural patterns. Further studies should confirm whether our findings of low compliance are generalisable in LTFs across Italy. Currently, independent hand hygiene audits are not standard practice in LTFs in Italy. These should be integrated to ensure compliance monitor and feedback is sustained in quality improvement cycles.¹⁷ Our findings also support other existing evidence that health workers are often not adequately trained on the concept of patient zone, and on how to contextualise the patient zone contextualising to their specific clinical context and types of procedures performed.¹⁸ Specifically, this is key in LTFs where the boundaries between clinical and home environments care are blurry.

During this pilot study, we tested an intervention based on improving knowledge, access to hand-rub and improved salience which aimed to address the barriers to hand hygiene compliance we found during the formative phase. The intervention was multi-modal and highly contextualised as per evidence from other studies aimed at improving hand hygiene and following international WHO guidelines on the topic.^{1,16,19} We tested this intervention using a cross-over pilot approach which allowed us to compare the intervention effect in one ward to one internal ward and one external facility. The intervention increased compliance almost by five folds (CI: 2.47–8.78) in the ward where the intervention (Ward 1) was first introduced and then removed. This provides some evidence that «structural access» and «salience» can achieve temporary behaviour change by themselves, and independently of knowledge and information. Compliance during this period was much lower for the internal control ward and the external control facility. The intervention did not yield significant change in Ward 2 - which received the intervention in period 2. Most likely this is down to the fact that, in this ward, the ward manager did not believe in the need for the intervention. This suggests that the intervention is likely to yield better results if management engagement is prioritised in future versions of this intervention as suggested by the wider literature on infection prevention.¹⁷ Overall, our results suggest the intervention is feasible and potentially effective; given the extremely low cost of the intervention (overall: €200) it provides a potential strategy for other forty LTFs managed by the cooperative we collaborated with.

The study had a limited scope to three facilities for a short period and hence our findings are hardly generalisable. Yet, poor quality of care in LTFs, especially in the context of the COVID-19 pandemic, has been denounced before and is consistent with our findings.^{5,8,9} Another limitation is to do with the Hawthorne effect we witnessed in our data, the presence of data collectors observing health workers hand hygiene compliance raised the profile of the issue and in itself instigated some change. However, the comparison with internal and external controls suggests that this effect was small.

The SARS-CoV-2 pandemic exacerbated the need for infection prevention in long-term care facilities (LTFs) and therefore the need of performing rigorous studies on how to improve infection control in LTFs, which presents unique characteristics and challenges compared to acute clinical settings. Our study suggests that an intervention based on salience and structural access is feasible and potentially effective at a very low cost. Our intervention has the advantage to have flexible elements are not expensive to adapt and adopt. Future research should use rigorous large-scale randomised studies to assess its effectiveness of sustained behaviour change.

Declarations

Trial registration: N/A (pilot study).

Ethics approval and consent to participate. The study obtained the approval by the Ethical Committee of the University of Turin in date 24/02/202, reference number 183393.

Availability of data and materials. The datasets used during the current study are available from the corresponding author on reasonable request.

Competing interests. The authors declare that they have no competing interests

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Authors' contributions: BB design of the work, analysis and interpretation of data, draft and revision; GG design of the work, interpretation of data, draft and revision; TM design of the work, analysis and acquisition of data, revision; MM acquisition of data, revision; DP design of the work, draft and revision. All authors read and approved the final manuscript.

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Figures

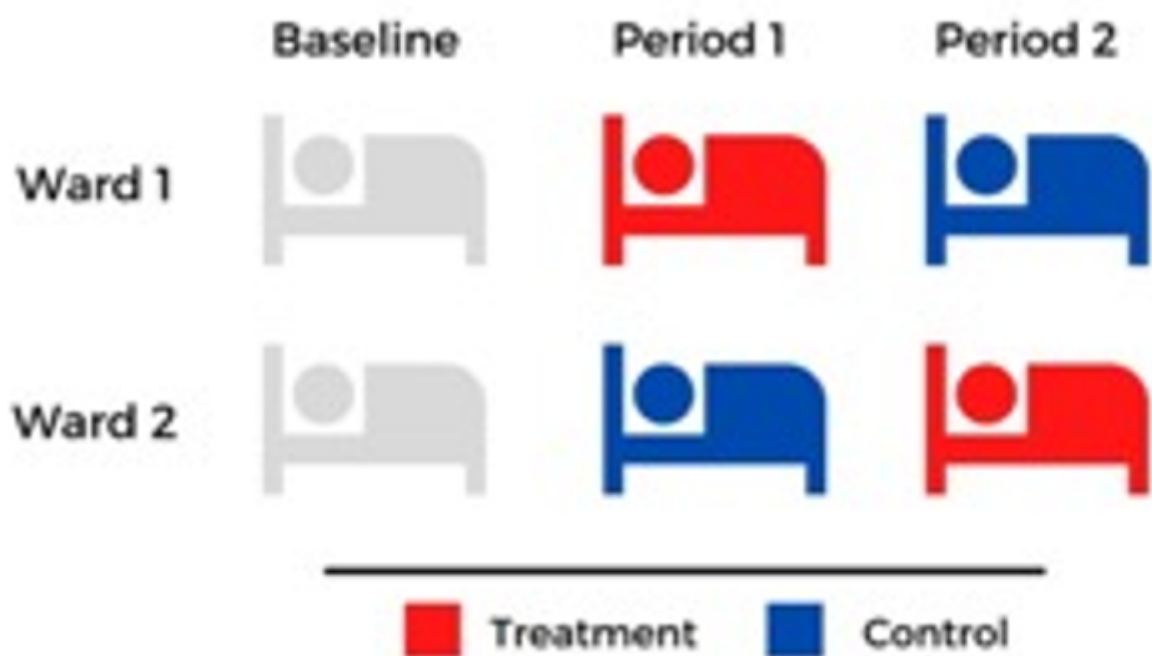


Figure 1

Illustration of the cross-over design

Notes: Figure 1 illustrates graphically the cross-over design



Figure 2

Intervention materials

Notes: Components of the multimodal strategy. From the left to the right: iconographies, the portable basket, patient zone highlighted with red tape.

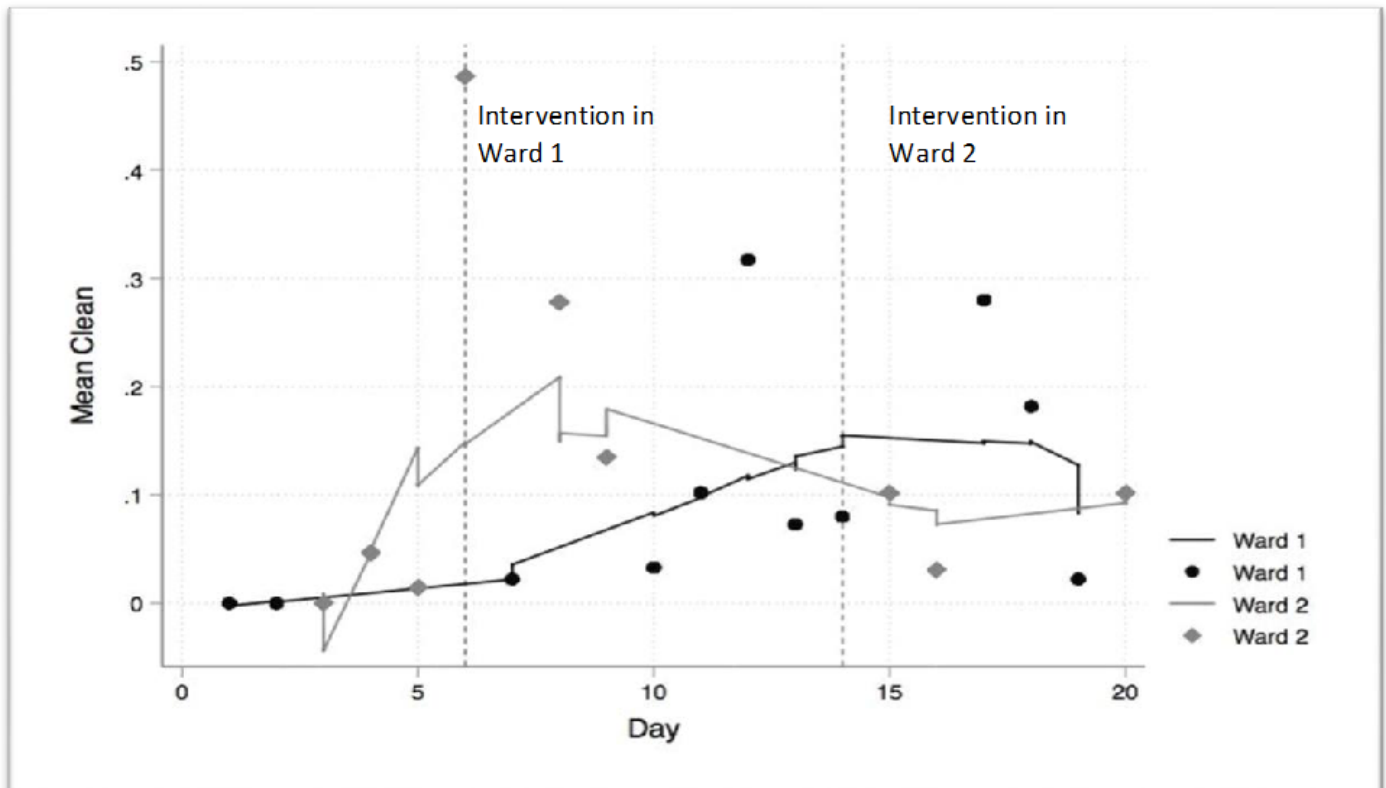


Figure 3

Time trend of hand hygiene compliance of different wards

Notes: Figure 3 illustrates point estimates and trends during the days of observation. The left dotted line symbolises the intervention being delivered in Ward 1; dotted line on the right symbolises the intervention was delivered in Ward 2 and removed from Ward 1.

Supplementary Files

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- [APPENDIXtoNUDGINGHANDHYGIENEINLONGTERMFACILITIES.docx](#)