Swab Mob! Using Adenosine Triphosphate screening to improve environmental cleaning practice in residential care settings during COVID-19.

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Overview

Our Swab Mob project aimed to increase awareness of environmental cleaning among colleagues, improve cleaning practice and ultimately reduce the chance of infection transmission.

We used Adenosine Triphosphate (ATP) screening to raise awareness of surface contamination within our services at Sandown Road and Northern Supported Living. All are environments that contain potential reservoirs of contaminants that cause infection.

ATP screening originates from food manufacturing and has since been innovatively applied in healthcare to improve infection prevention (Dawson & Reakes, 2014). Here, we used the same method in two social care settings to improve cleaning practice, particularly during the COVID-19 pandemic.

2.0 Background

2.1 What is Adenosine Triphosphate (ATP)?

ATP is the primary energy source in all living organisms. Its role is to transport chemical energy within cells to allow them to grow. Present in both human and microbial organic matter, detection of ATP on a solid surface indicates the presence of bacteria or human cells. This can help inform where a surface is not clean or where cleaning has been ineffective.

When applied in health and social care ATP screening can assess environmental cleanliness and engage colleagues in improving standards of cleaning through greater awareness of contaminants.

2.2 Why is this approach important?

Much research points towards the importance of environmental cleaning. It is an essential step in preventing the spread of infection (Loveday et al, 2014) but sometimes can be seen as an additional workload rather than integral to care (Stein, Makarawo and Ahmad, 2003).

Since the COVID-19 pandemic, our colleagues are more aware than ever of the dangers of environmental contamination (and transmission) to the people we support and themselves.

We knew that as we moved forward to the autumn and winter there would be a growing need to ensure cleaning processes were robust; not only against the possibility of a second peak of COVID-19 but also seasonal increases in infections such as influenza and norovirus.

Swab Mob offered a way to assure that our cleaning is effective in removing possible contaminations and preventing transmission. This is wrapped in an engaging process using an innovative approach in social care.

ATP testing has been successful in improving environmental cleaning within food manufacturing and hospital environments (Lillis, 2014) thus it was surmised that applying this approach to care homes may be effective. It must be considered that cleaning in care services comes with its difficulties. Unlike hospitals and factories, there is no primary team responsible for upholding cleanliness, it relies on the care staff to maintain. Therefore, ATP testing was assumed to be an informative method of evaluating staff's methods and highlighting whether more attention needs to be given to environmental cleaning.

3.0 Methodology

Swab Mob had three simple steps: swab, RAG, act (Figure 1). Following this, an anonymous survey was distributed to colleagues that had taken part in the project to investigate acceptance through the validated Technology Acceptance Model (TAM, Technology Acceptance Model, Davis, 1989). The method is described below.

- **Swab:** Colleagues swabbed the environment in two of our services: Sandown Road (a residential care home with 8 residents) and Northern Supported Living (an assisted care facility with one resident requiring full-time support) and using the ATP machine, measured the potential hazard of surface contamination. Swabbing was carried out weekly at Sandown Road on 10 nominated surfaces (see Appendix 1), and twice a week at Northern Supported Living on 7 nominated surfaces (see Appendix 3). Sampling sites were chosen based on possible disease transmission routes and current literature of high-touch surfaces informed from the World Health Organisation's research on surface transmission (WHO, 2020).

- **RAG:** Once the swab had been taken it was then processed in the handheld ATP screening machine. A score was given in relative light units (RLU) and these correlated to a Red, Amber, Green (RAG) rating. Red meant significant contamination (fail) and green meant an acceptable level of cleanliness (pass) – we were aiming to make our services Swab Mob! This information was logged so we

could keep track of the scores over time and achieve an upward trend in green passes.

- ***Act***: The results of the RAG rating showed colleagues where to target cleaning by making surface contamination visible (through the RAG system). Cleaning processes could then be reviewed to identify why surfaces might be missed or cleaned ineffectively. This was all about learning to create a safer environment by making all the sample sites "green".

Figure 1. Swab Mob: Swab, RAG, act
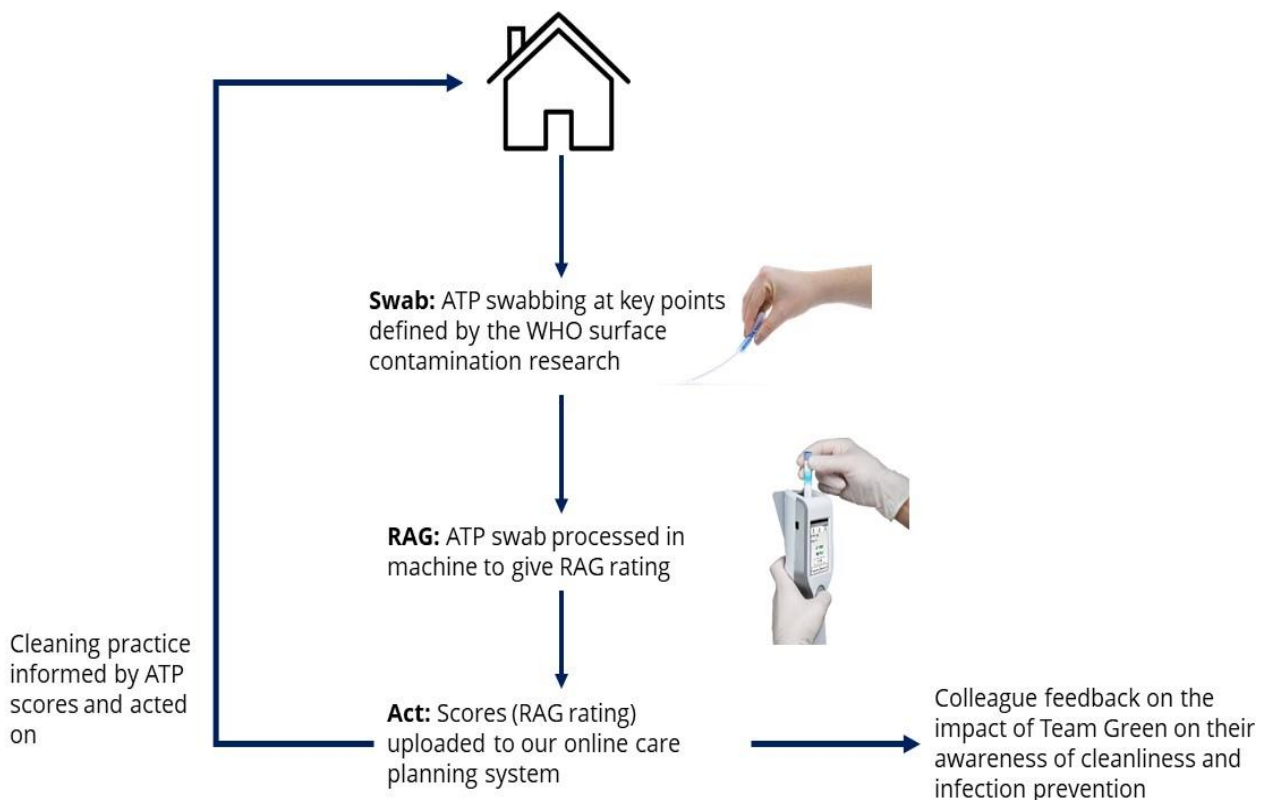
3.1 Collecting ATP Scores

Data gathered from swabbing sessions at both services (Sandown Road and Northern Supported Living) identified areas of effective and ineffective environmental cleaning. The RAG threshold ratings used the boundaries of Red >300+; Amber 151-299; Green <150 RLU (3M, 2019). Although 3M produces the ATP screening devices for the food manufacturing industry, adopting these thresholds provided a rationale for our RAG rating approach. The overall aim was to see a downward trend in contaminants through better cleaning along with exploring the engagement of colleagues to the approach.

3.2 Perceptions on Use of ATP Screening

The technology acceptance model (TAM) (Davis, 1989) is a framework relying on end-user perception, predicting the acceptance of and intention to use (I) new technologies. The intent to use is informed by perceived usefulness (PU) and perceived ease of use (PEU). The PU considers the extent to which the user believes using the technology will enhance their performance. The PEU considers the effort the user believes using the technology will take. These perceptions are derived from a questionnaire. The TAM questionnaire was constructed to accurately capture the end-user perception of using the ATP machine (see Table 1), considering the impact of the technology on hygiene practices in a care service setting.

Table 1. TAM Survey.

Survey Statement (Rated 1 = Strongly Disagree, 7 = Strongly Agree)
If I had access to an ATP machine, I would use it
I find the ATP machine easy to use
Using the ATP machine is important to ensure environmental cleanliness
I find the ATP machine useful in helping ensure our environment is clean
Using the ATP machine improves my ability to keep our environment clean

The TAM survey was distributed to all colleagues that had taken part in Swab Mob across the Sandown Road and Northern Supported Living services. Participants completed the TAM questionnaire after the recorded period of using the ATP machine at which point,

they also provided anecdotal feedback to provide greater insight into their perception of ATP testing.

4.0 Results and Discussion

This section reports on the findings from Swab Mob in two parts. Firstly, the RLU counts from the ATP screening will be described for both Sandown Road (section 4.1.1) and Northern Support Living (section 4.1.2). Following this, the findings from the TAM survey will be presented (section 4.2) along with anecdotal feedback (4.3).

4.1 Collecting ATP Scores

4.1.1 Sandown Road

Colleagues at our Sandown Road services swabbed each of the 10 nominated surfaces (see Table 2) once a week for a total of nine weeks (see Appendix 1). It was recommended to colleagues that the same room should be used throughout the project so that comparisons could be made week on week.

Table 2. The 10 nominated site surfaces at Sandown Road.

Nominated Surface
Resident's Door Knob
Ventilation Exit (Window Handle)
Main Telephone
Light Switch Resident Room Entry
Light Switch Bathroom Entry
Wall in Corridor 1m From Entry
Wall in Corridor 2m From Entry
Wall in Corridor 3m From Entry
Kitchen Surface Area
Bedding (Resident's Room)

Each of the 10 nominated surfaces recorded a "red" swab at least twice over the nine sessions. Seven surfaces (resident's door knob, ventilation exit, main telephone, light switch resident room entry, wall in corridor 1m from entry, wall in corridor 3m from entry, and bedding) recorded an "amber" swab at least once. A further six surfaces (ventilation exit, main telephone, light switch resident room entry, light switch bathroom entry, wall in corridor 1m from entry, and wall in corridor 2m from entry) recorded a "green" swab on at least one occasion (see Figure 2).

The kitchen surface area and the wall in the corridor 3m from entry recorded much higher values on week 3 and week 8, respectively. As a result, these two surfaces were removed from Figure 3 in order to better see trends in the other surface data.

All but three of the 10 nominated surfaces demonstrated an overall decrease in surface contamination over the swabbing period, whilst the wall in the corridor 3m from entry and resident's bedding both showed an increase in surface contamination. The wall in the corridor 2m from entry saw no change (see Appendix 1).

The mean RLU count for each week was calculated along with standard deviation error bars (see Appendix 2).

Figure 2. Findings from 10 swabbed surfaces at Sandown Road over a nine-week period. Note the Red, Amber, Green (RAG) rating limits.
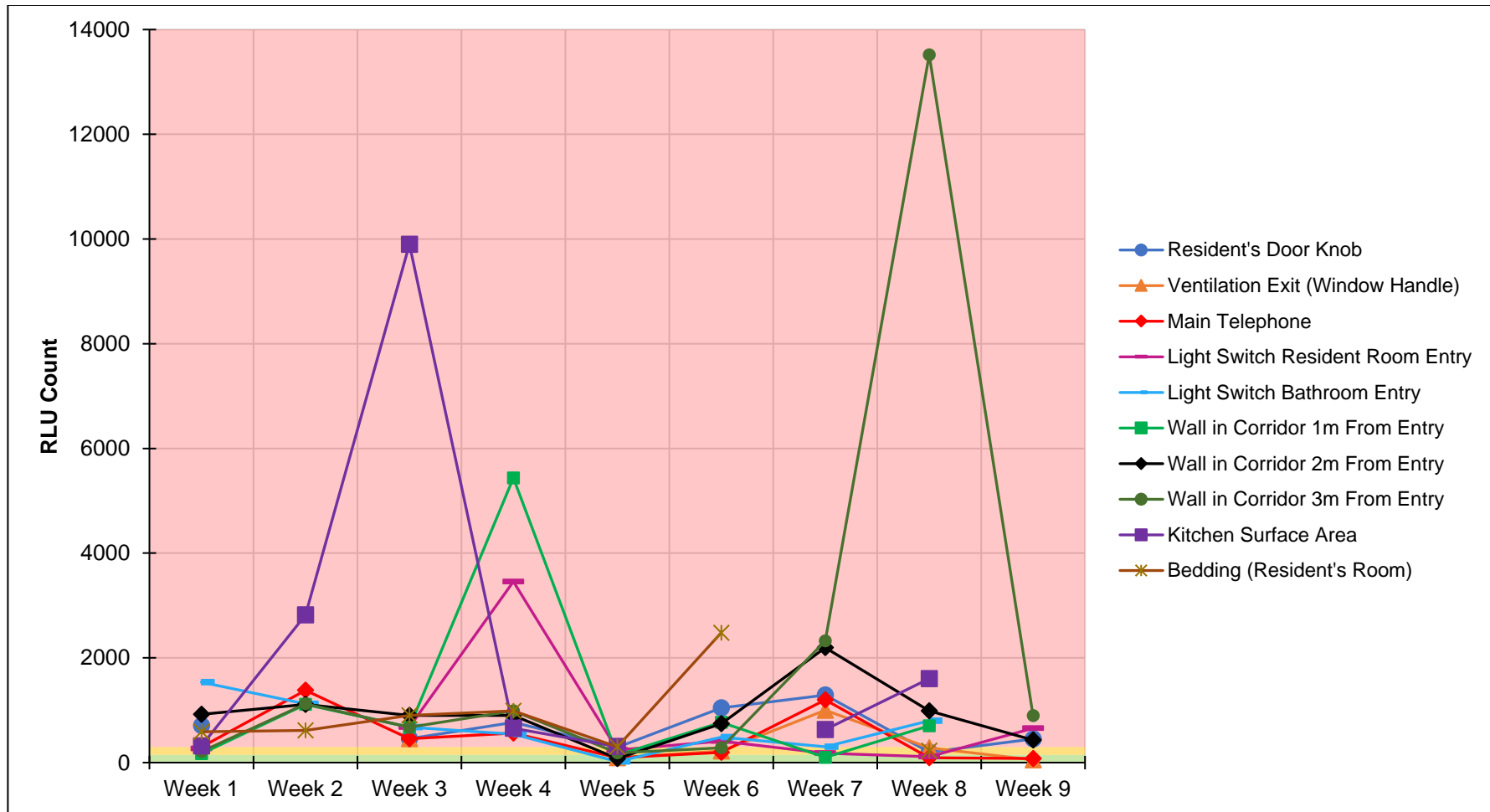
Figure 3. Findings from eight swabbed surfaces at Sandown Road (wall in corridor 3m from entry and kitchen surface area removed) over a nine-week period. Note the Red, Amber, Green (RAG) rating limits.
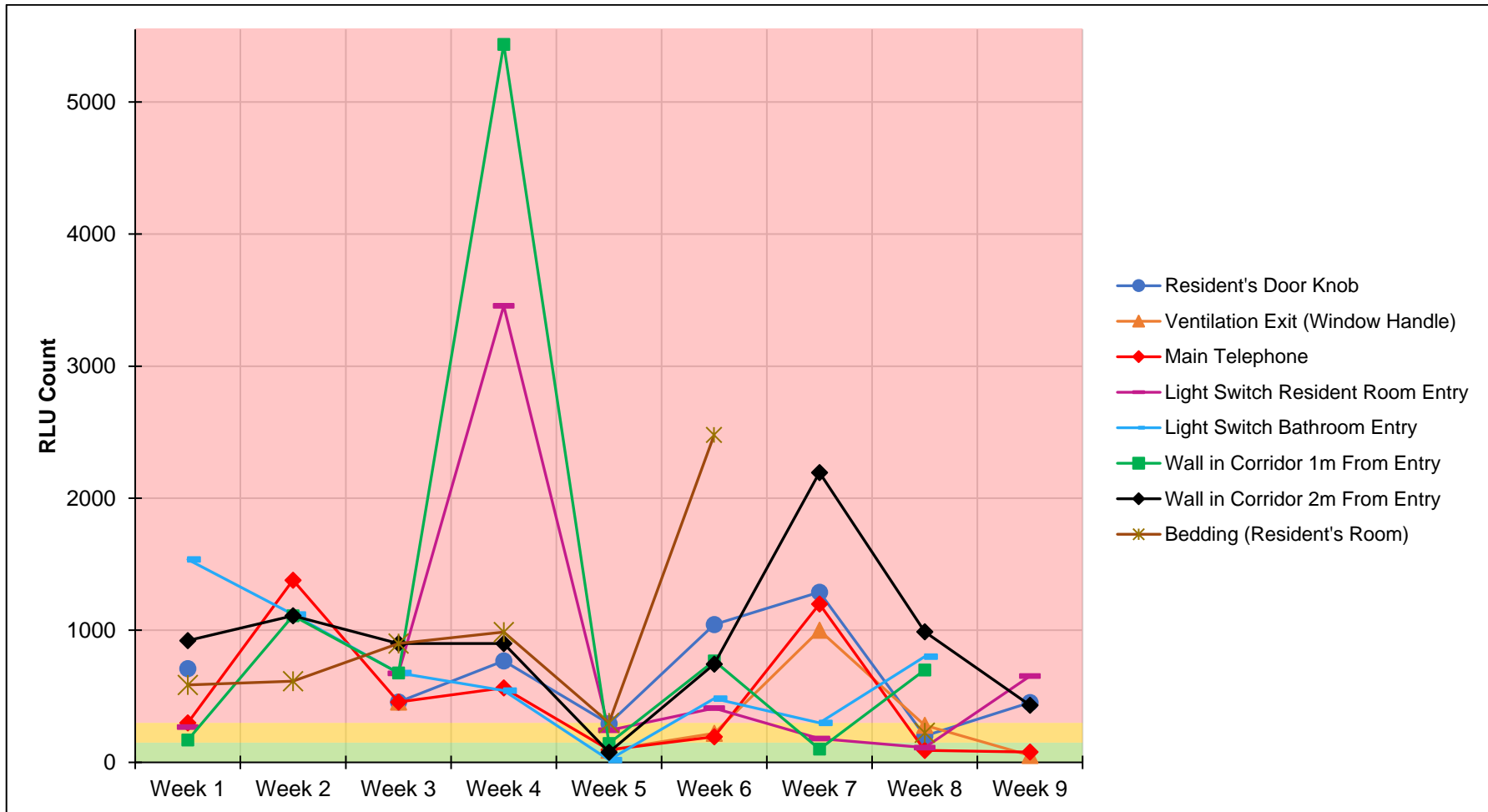
Key learnings from Sandown Road Swab Mob

1. Findings from the individual surface RLU counts (see Appendix 1) inferred a downward trend in surface contamination at touchpoints. For example, while 7 touchpoints displayed a decrease in surface contamination over the project period, the wall in the corridor 2m from entry and the wall in the corridor 3m from entry saw either no change or an increase in contamination, respectively. This implies that these areas are overlooked during cleaning activities as they may not be viewed as typically dirty surfaces but may be reservoirs of transmission.

2. Surface contamination of the resident's bedding also increased over the nine-week period (see Appendix 1). However, as bedding is predominately contaminated by an individual's normal body flora (Fallon, 2017) there is a lower risk of transmission and adverse health effects compared to surfaces that multiple people come into contact with. Therefore, although the ATP may infer high contamination, bedding is still frequently washed and is of low risk.

3. Colleagues had an overall positive experience with the ATP machine and highlighted its importance in flagging up contaminated hot spots. This finding suggests that the ATP machine is a sufficient method for raising awareness of environmental cleanliness at Sandown Road.

4.1.2 Northern Support Living

Colleagues at our NSL services swabbed an example of each of the 7 nominated surfaces (see Table 3) twice a week, once before cleaning and once after, for 12 weeks (see Appendix 3). Colleagues alternated the chosen area of the nominated surfaces in order to cover the widest area of the service (e.g., "bedding" includes both resident and staff bedding).

Each nominated surface recorded both a "red" and "amber" reading at least once over the 12 weeks (see Figure 4). Excluding bedding (which recorded a "green" reading on 6 out of the 14 times it was swabbed) all nominated surfaces reported "green" on most recorded swabs.

As bedding recorded much higher results on weeks 2, 5, and 12 it has been removed from Figure 5 to show the results from the other reported surfaces more clearly.

Six out of the seven nominated surfaces illustrated an overall decrease in surface contamination over the swabbing period. Whereas the wall in the corridor 1m from entry showed an increase in surface contamination.

The mean and standard deviation of the RLU count before and after cleaning were calculated for each week, (see Appendix 5).

Table 3. The seven nominated site surfaces at NSL

Nominated Surface
Residents Doorknob
Ventilation Exit
Main Telephone
Light Switch Resident Room Entry
Wall 1m From Entry
Kitchen Surface Area
Bedding

Figure 4. Findings from seven swabbed surfaces at NSL over a 12-week period. Note the Red, Amber, and Green (RAG) rating limits.
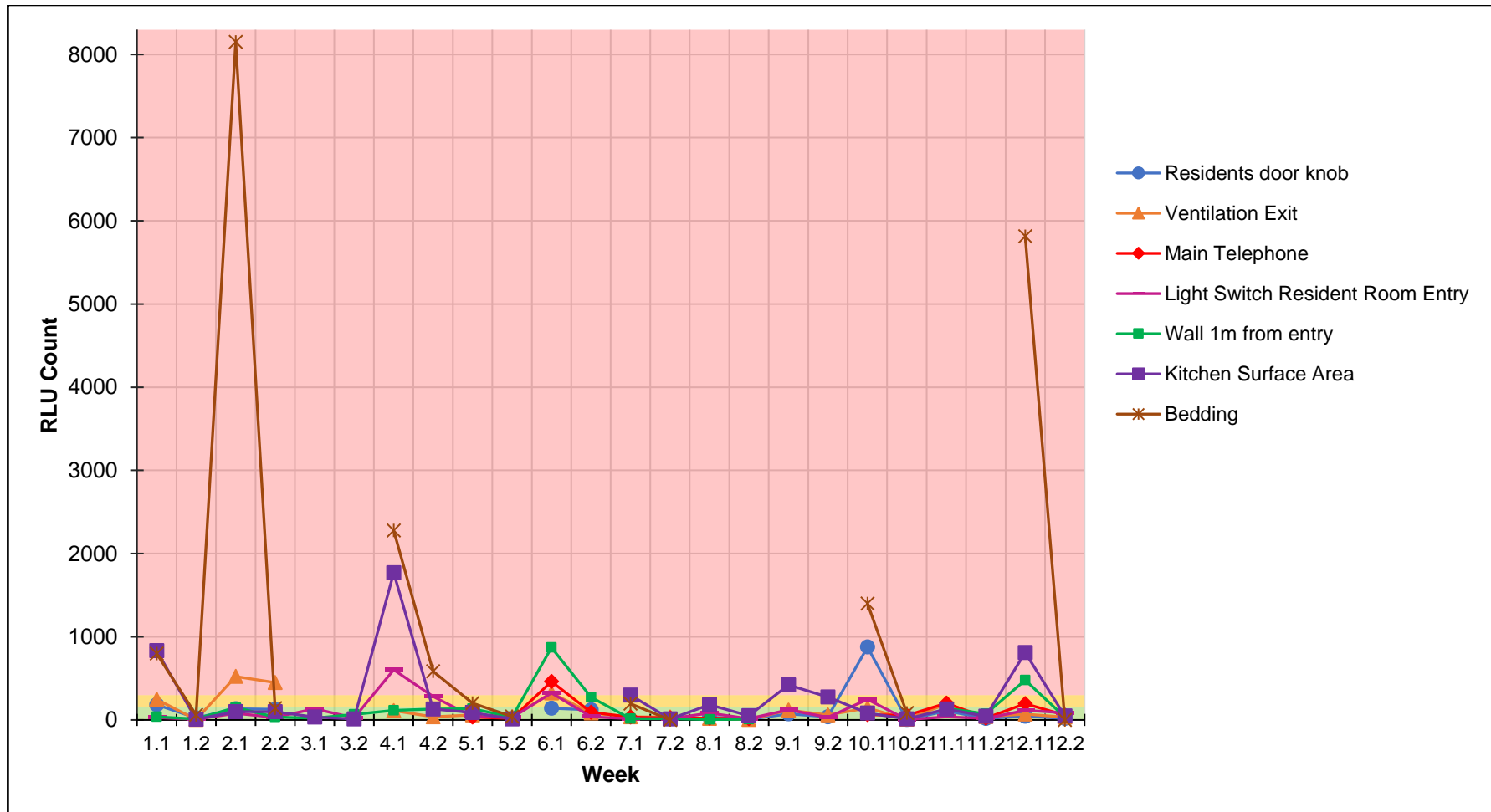
Figure 5. Findings from six swabbed surfaces at NSL (bedding removed) over a 12-week period. Note the Red, Amber, and Green (RAG) rating limits.
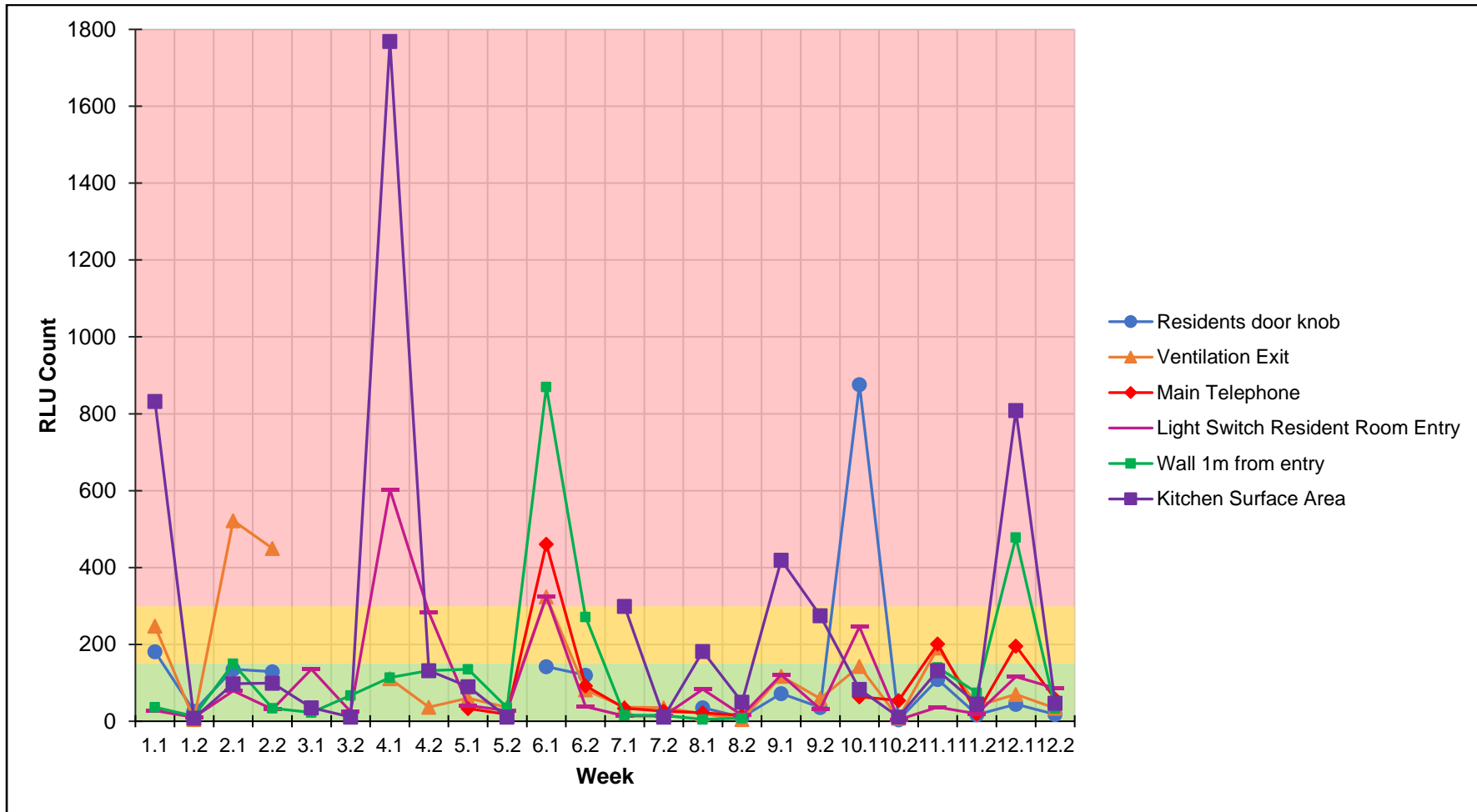
Additional Measures

Colleagues independently decided to measure the ATP levels of other surfaces in the service.

Table 4: Additional ATP measures carried out by NSL staff.

Area	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	8.1	8.2	9.1	9.2	10.1	10.2	11.1	11.2	12.1	12.2
Light Switch Bathroom Entry											124	62	9	9					284	107	67	22	42	36
Tablet	379	4	1672	899	308	115	2253	474	1811	94	4531	41			685	110	170	26	1399	81			1302	52
Sofa	2077	894	2979	558			6803	2395	547	320	586	218	481	109							5922	2345		
Kitchen Taps			469	149					64	28			37	11					163	6				
Wall 2m from Entry	14	5																						
Wall 3m from Entry	20	2	310	88																				
TV Control					289	71																		
Knife					132	8																		
Staff Tablet					137	31																		
Dining Chair							554	31	38	38			28	8			322	26						
Safe keypad															27	6								
Above Washing Machine																	225	91						
Tumble Dryer Knob																			495	5				
Lamp																					478	26		
Draining Board																							237	27

Key learnings from Northern Supported Living Swab Mob

1. Findings from the individual surface RLU counts (see Appendix 3) showed an overall downward trend in surface contamination at touchpoints. Whereas surface contamination increased for wall 1m from entry implying areas that are not directly touched may be neglected when cleaning, possibly not being viewed as dirty surfaces.

2. Surface contamination of bedding remained in the "red" across the time- period. From the additional swabbing carried out by colleagues (see Table 4) the recorded results from the sofa presented consistently high ATP levels. This indicates that fabric surfaces are also not seen as potentially dirty surfaces or require more rigorous methods of cleaning. High ATP levels for bedding do not present a high risk of infection, however communal fabric surfaces, such as a sofa, do pose a significant risk.

3. When excluding bedding, the average RLU before cleaning was relatively consistent (see Appendix 6). However, the average after cleaning followed a downward trend over the 12-week period indicating that cleaning practices became more rigorous.

4.2 Perceptions on Use of ATP Screening

Encouragingly, colleagues' overall attitudes towards and experience of the ATP machine were positive. For example, colleagues indicated a strong intention to use the ATP machine if available and further perceived the ATP machine as useful in helping ensure their environment stays clean (see Table 5).

Table 5: Results from TAM Survey

Survey Statement (Rated 1 = Strongly Disagree, 7 = Strongly Agree)	Mean	TAM Construct
If I had access to an ATP machine, I would use it	6	I
I find the ATP machine easy to use	6.7	PEU
Using the ATP machine is important to ensure environmental cleanliness	6.7	PU
I find the ATP machine useful in helping ensure our environment is clean	6.7	PU
Using the ATP machine improves my ability to keep our environment clean	6.7	PU

I = Intention to Use, PEU = Perceived Ease of Use, PU = Perceived Usefulness.

When providing further feedback one respondent stated:

"The ATP machine was really helpful in us recognising where hot spots are."

Colleagues were also positive about the ease-of-use of the ATP machine (see Table 5). At the end of the survey, there was an opportunity for colleagues to leave further comments detailing their experience. One colleague recounted their involvement, stating:

"All was very good and we could see what cleaning products were best. Staff would just require time to complete the procedures and carry out use of the machine. This made staff cleaning regime more robust and staff competitive [at achieving better ATP scores]."

This feedback was promising; where colleagues considered the swabbing sessions a competition, a culture of cleaning was therefore encouraged. This culture paves the way for a healthy cleaning regime. The engaging nature of the ATP testing process provided goals and incentivised improving standards.

4.3 Anecdotal Feedback

Colleagues at the NSL services took it upon themselves to record their method of cleaning each week. Colleagues found that using the ATP testing allowed them to evaluate their own methods of cleaning. For example, they found that scrubbing with soap and water or Milton Anti-bacterial Spray was more effective at getting rid of surface contaminants over various other brands of anti-bacterial spray and wipes (see Appendix 4).

5.0 Final Remarks and Recommendations

The study successfully looked at the impact of ATP testing on hygiene standards and perception of cleanliness within a care service environment. The ATP testing presented an overall decline in RLU scores at both services whilst also revealing that areas that are not viewed as touchpoints did not experience a decrease in ATP. The reflective nature of testing allowed colleagues to evaluate their own methods of cleaning and identify what products were most effective. The TAM survey and qualitative feedback from participants allowed these findings to be furthered showing an acceptance of the technology leading to the creation of a culture of cleaning. Findings from the initial testing and the secondary feedback have informed recommendations regarding how to best use the ATP machine to improve environmental cleaning within social care settings.

1. Colleagues should call attention to surfaces with high RLU counts and use this data to inform their cleaning processes and manage the risk of transmission. Particular

attention should be paid to non-touchpoint areas that are not typically deemed dirty. It must be noted that due to the nature of the environment, maintaining standards of hygiene is not straightforward i.e., challenging behaviours from residents means areas that are not typically seen as points of contact (e.g., walls) may be touchpoints for residents so require more attention when cleaning. This is also important for surfaces that saw an overall decrease in surface contamination but were still consistently rated red (fail).

2. Consistency is key when it comes to Swab Mob; regular swabbing of the nominated surfaces allowed for week-on-week comparisons. However, on numerous occasions at both services, there were weeks with missing data. This should be flagged up to colleagues immediately to prevent biased estimates.

3. As the RAG thresholds were set based on standards within food manufacturing and colleagues at the NSL services were able to meet the "green" goal, the RAG ratings can be viewed as targets driving improved cleaning standards. Going forward, a more appropriate set of thresholds fitted to the social care environment could be chosen. However, it has been evidenced that such standards of cleaning are an achievable goal, and they could be treated as adjustable targets to further drive improved environmental cleaning.

4. The use and acceptance of the ATP machine by colleagues at both services conclude that ATP testing is efficient in changing the perception of environmental cleaning and can be used to improve standards of cleaning in a supported living environment. This could be used as support for more widespread use of ATP testing across supported living services to review evaluating methods and standards of cleaning to identify areas that are at risk of spreading infection.

Acknowledgements

References

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Appendices

Appendix 1: Individual surface RLU counts across a nine-week swabbing period at Sandown Road.

Light Switch Resident Room Entry

Light Switch Bathroom Entry

Wall in Corridor 1m From Entry

Wall in Corridor 2m From Entry
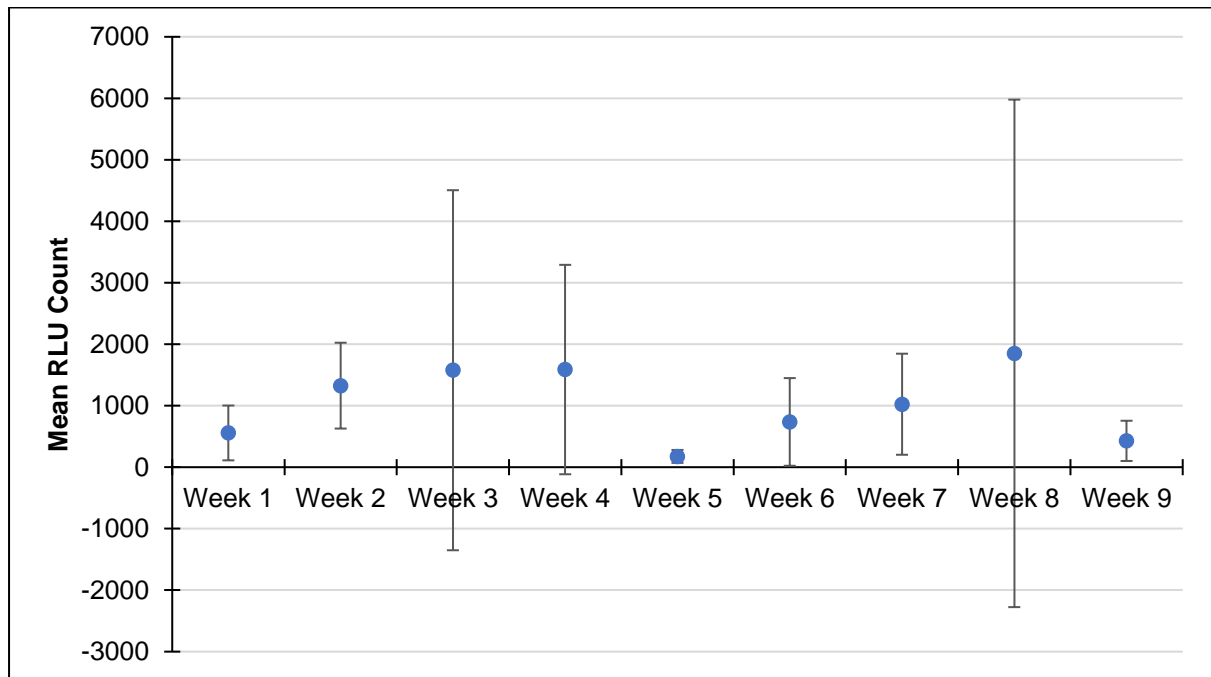

Wall in Corridor 3m From Entry
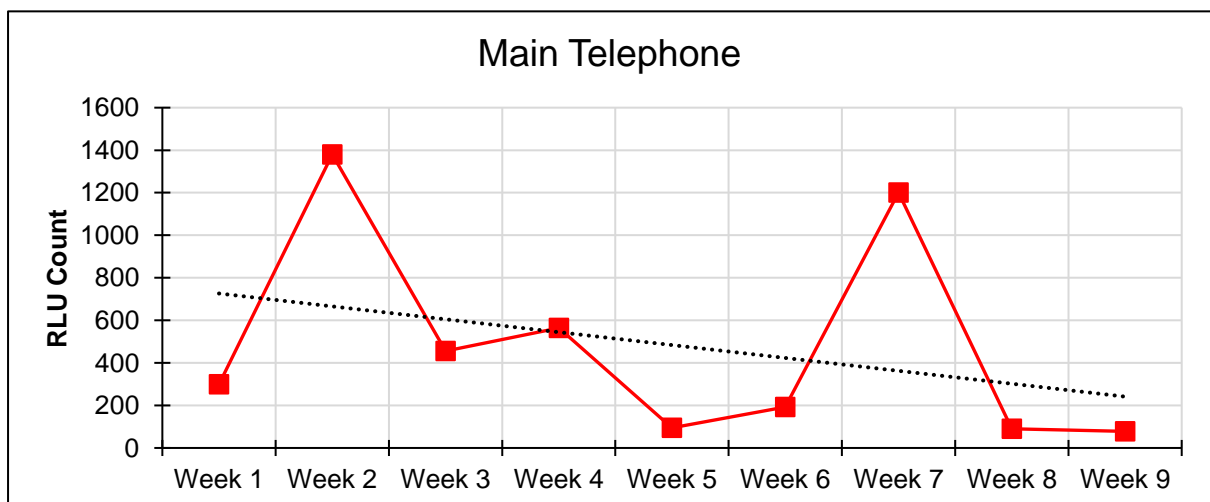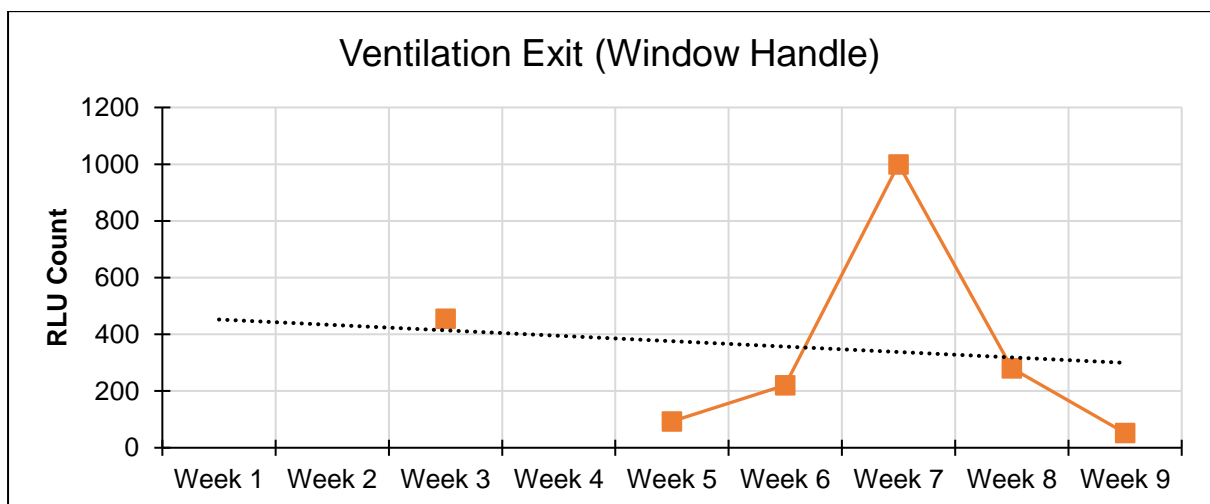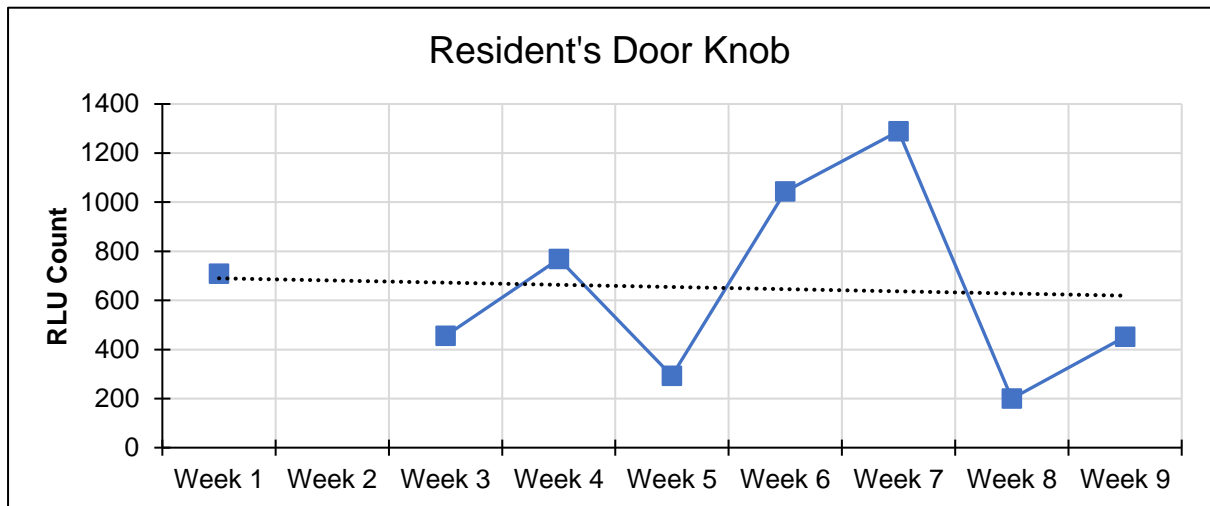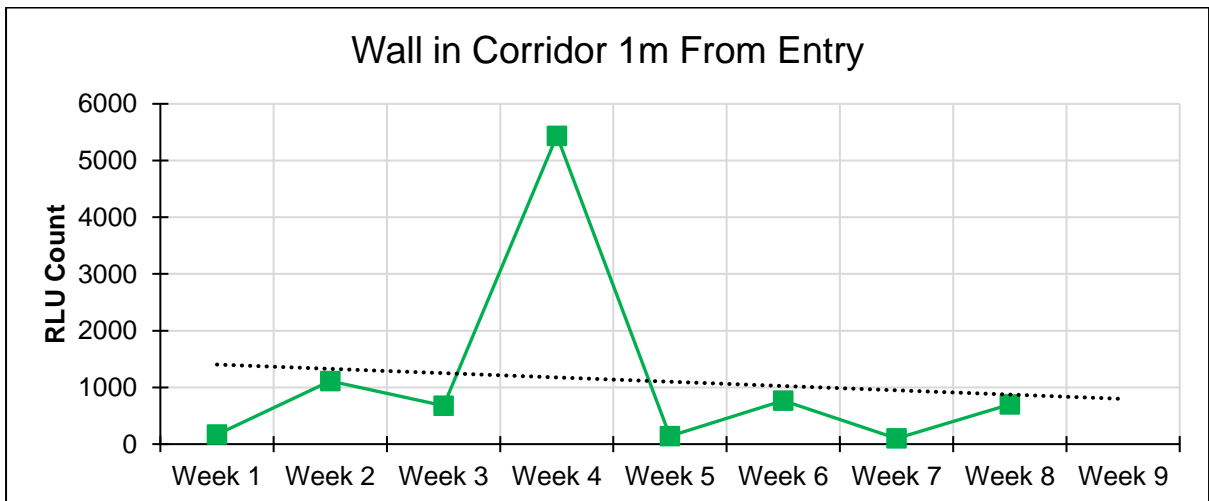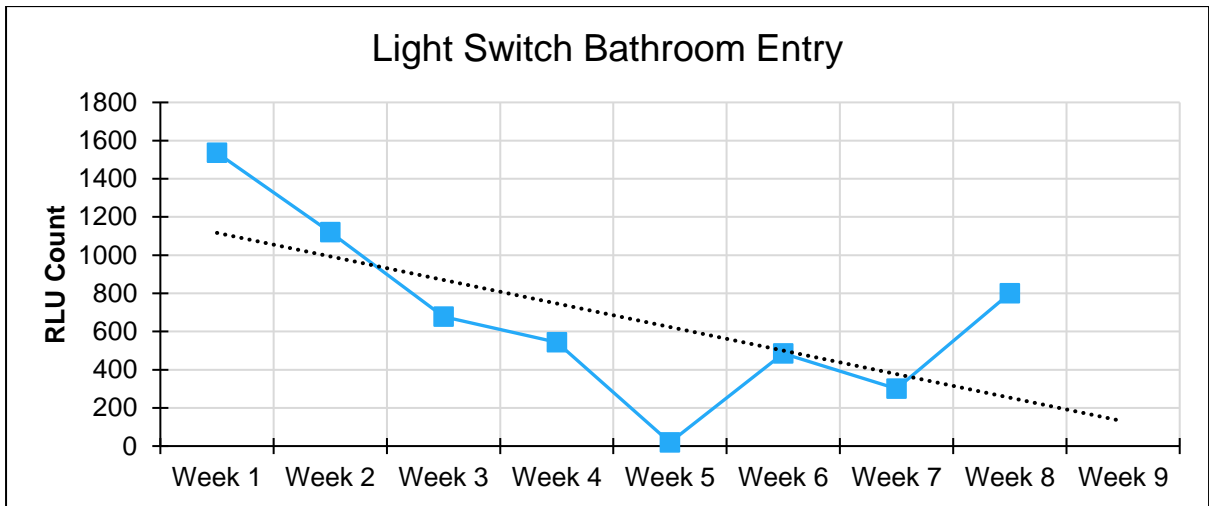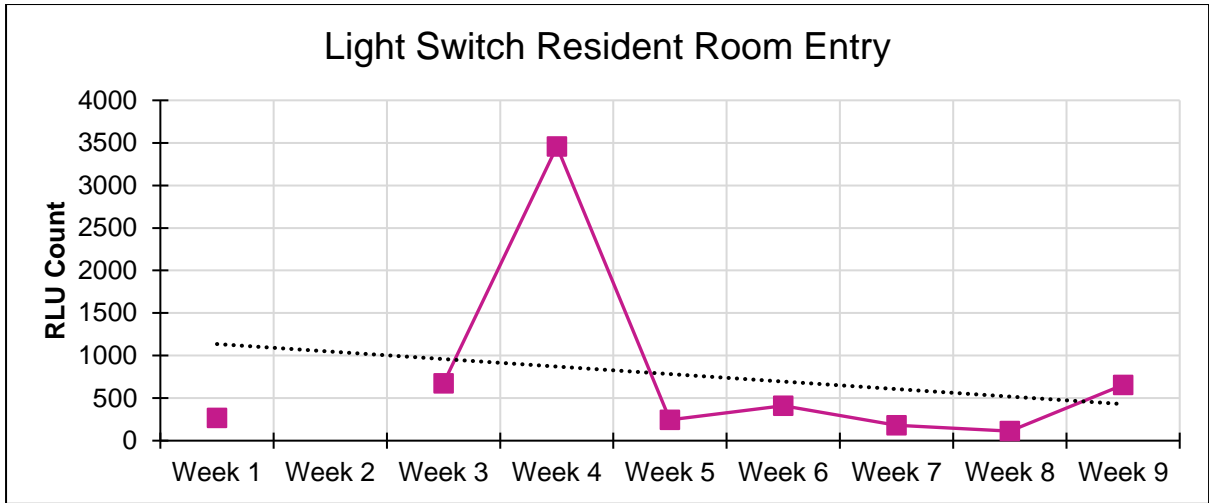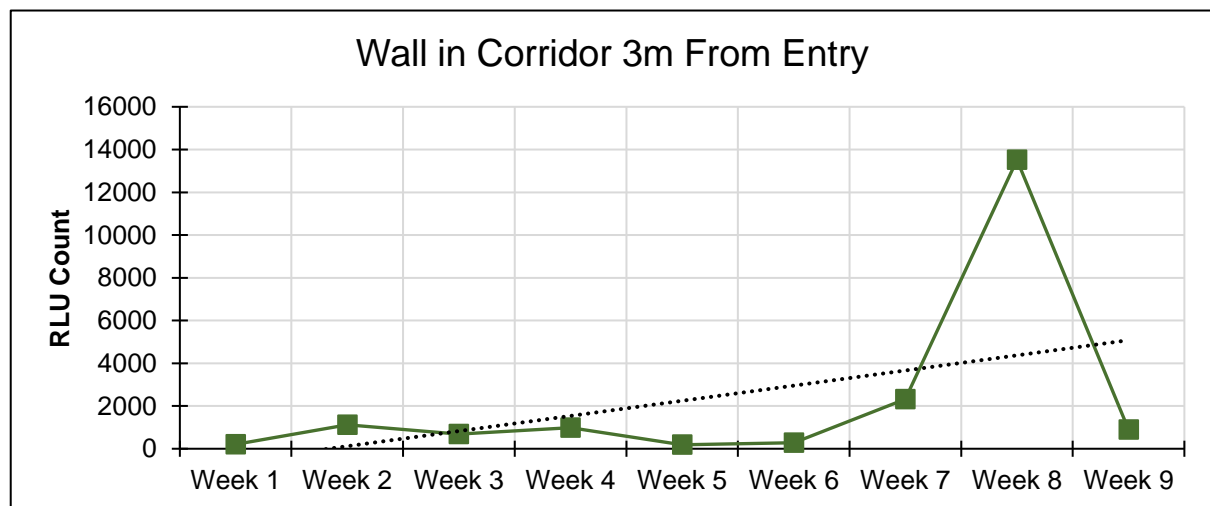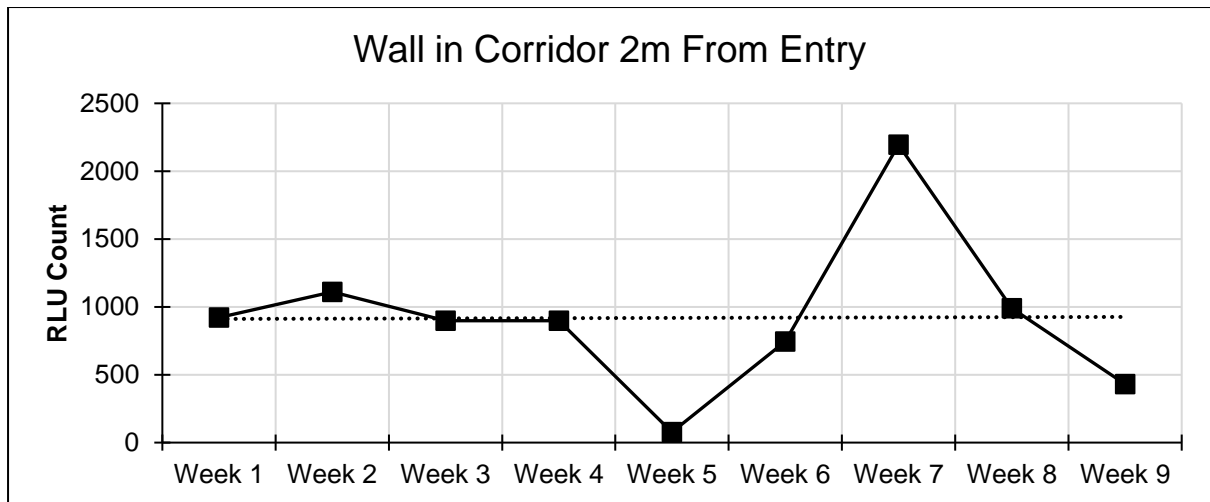
The wall in the corridor 3m from entry showed an increase in surface contamination. In particular on week 8 where it returned an RLU count of 13516. This may have been a human error, but it also must be noted that it is a high-touch surface.

Kitchen Surface Area

Bedding (Resident's Room)
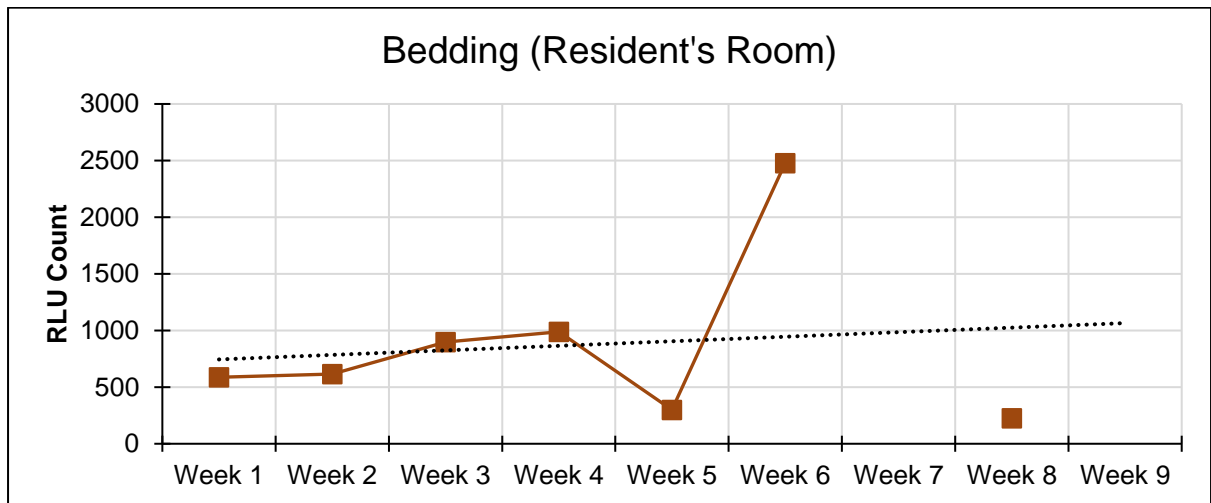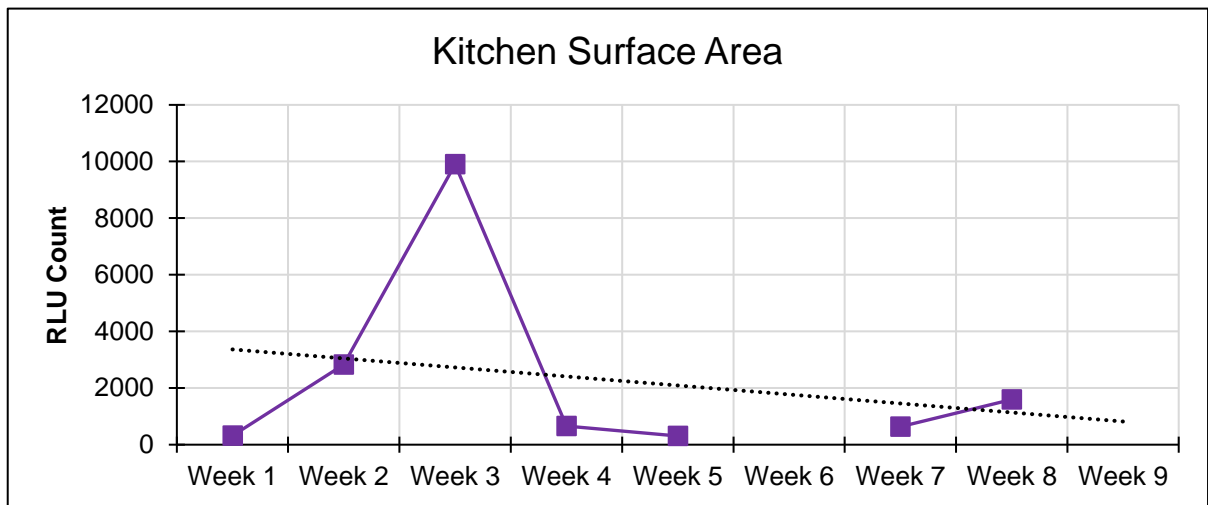
Surface contamination of the resident's bedding increased over the nine-week period. However, as bedding is predominately contaminated by an individual's normal body flora there is a lower risk of transmission and adverse health effects.
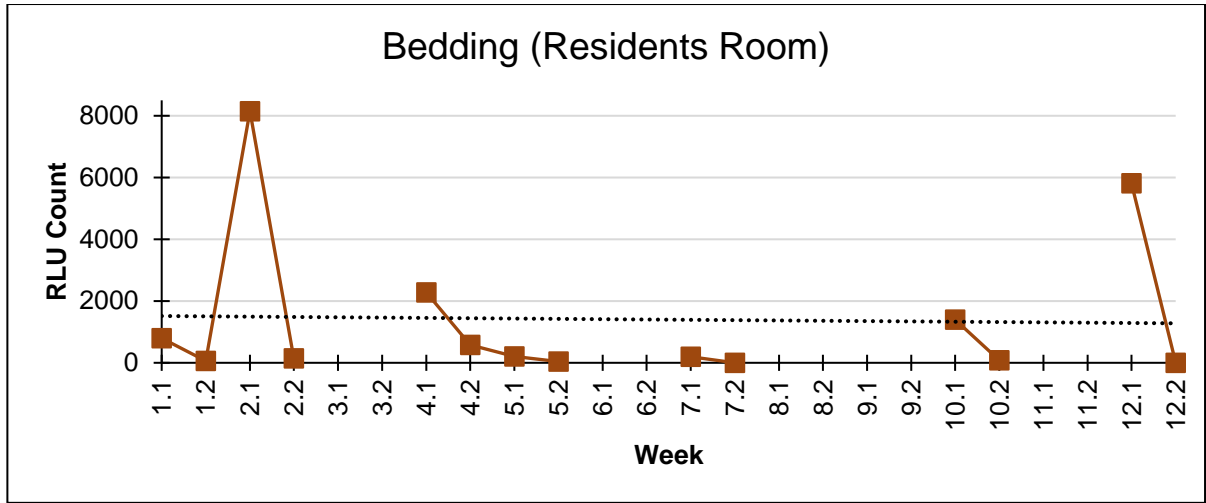
Appendix 2: Mean RLU count with standard deviation error bars (Sandown Road).

Appendix 3: Individual surface RLU counts across a 12-week swabbing period at NSL.


Residents door knob

Ventilation Exit (Window Handle)

Main Telephone

Light Switch Resident Room Entry

Wall in Corridor 1m From Entry

Kitchen Surface Area

Bedding (Residents Room)
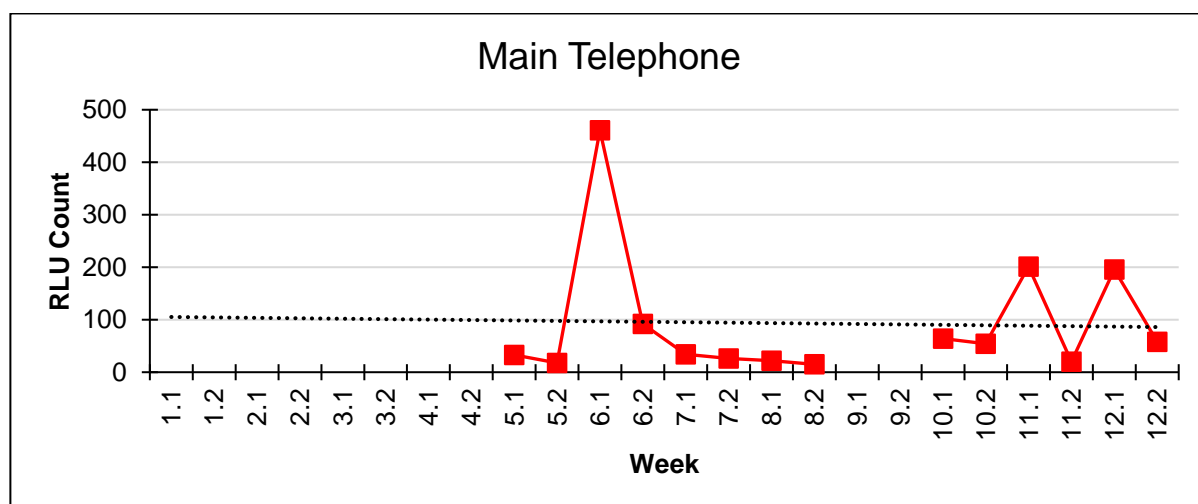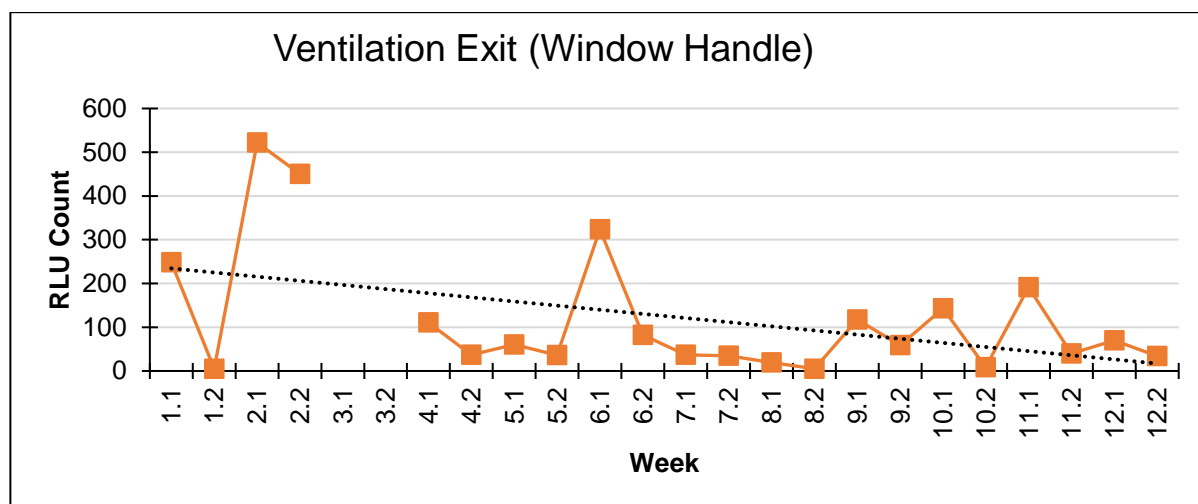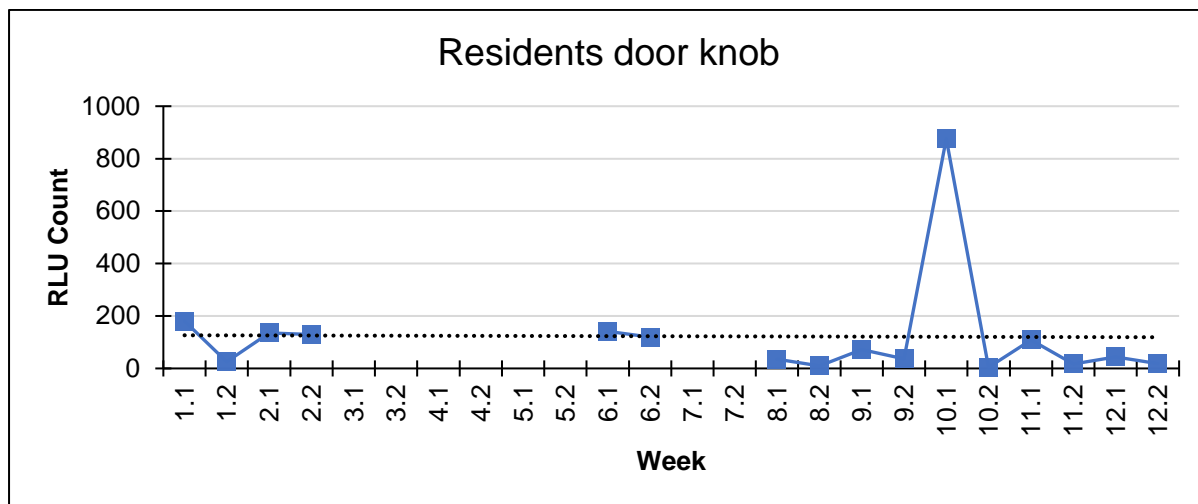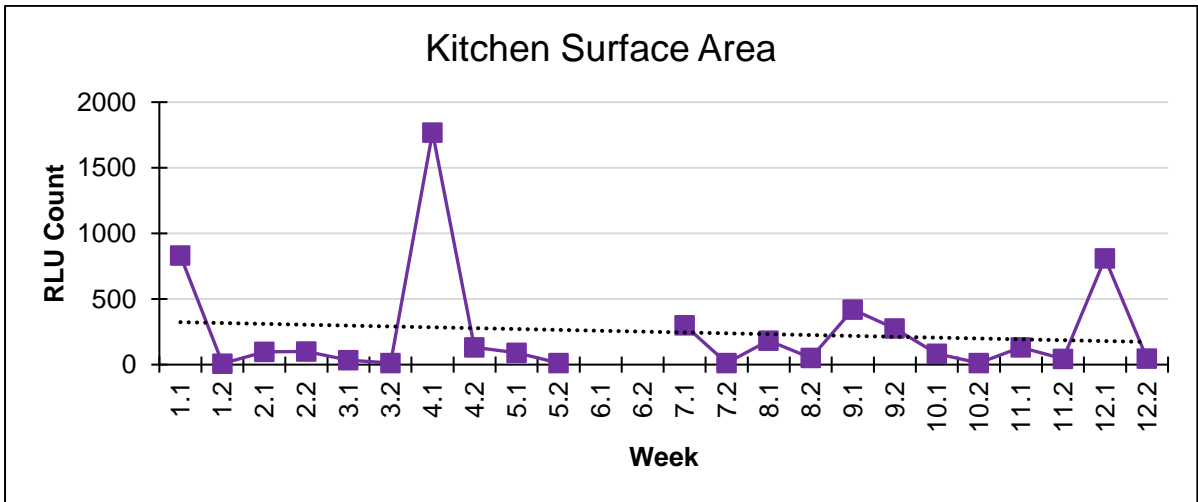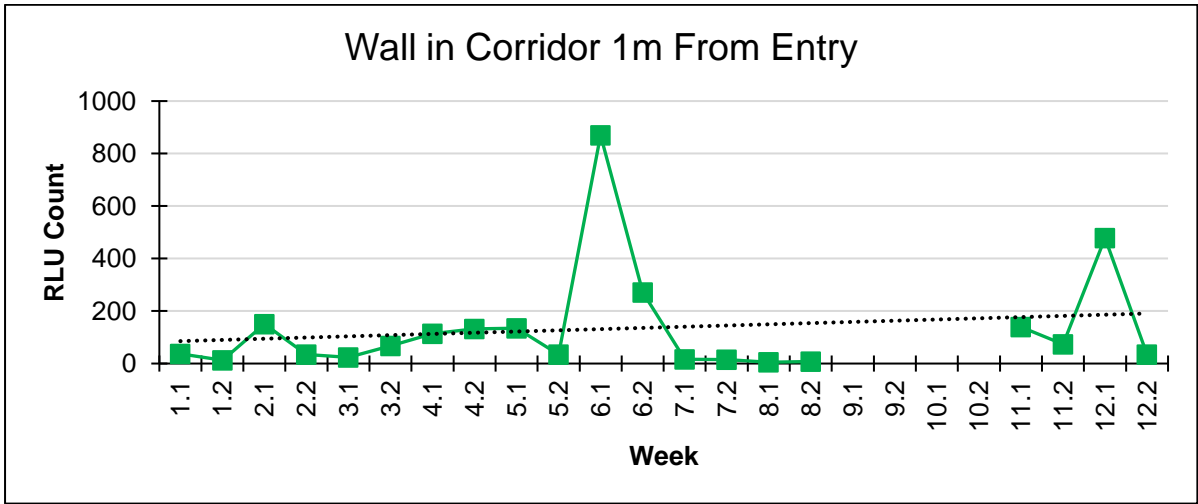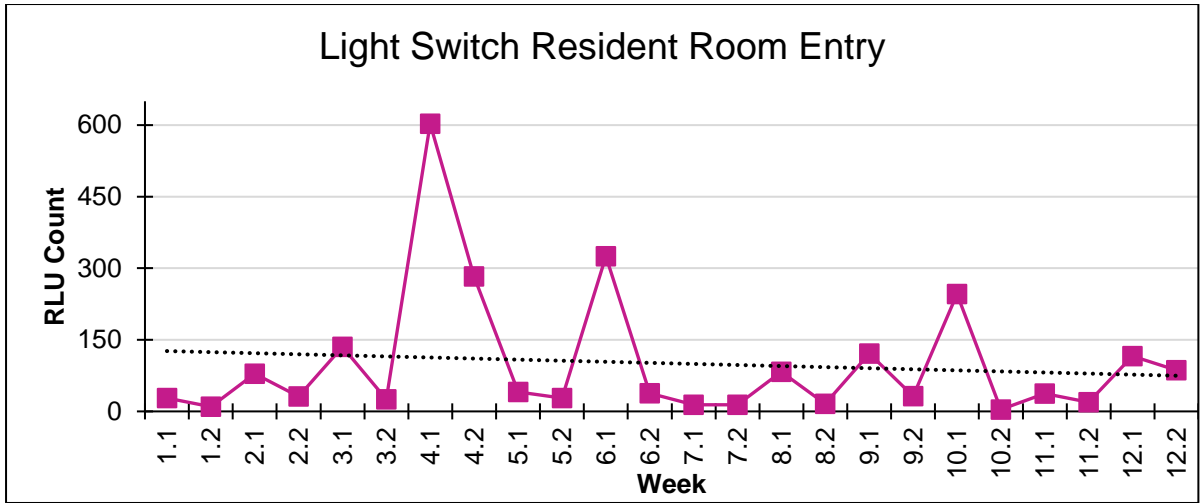
Appendix 4: Mean RLU count before cleaning and after cleaning along with the cleaning product used.
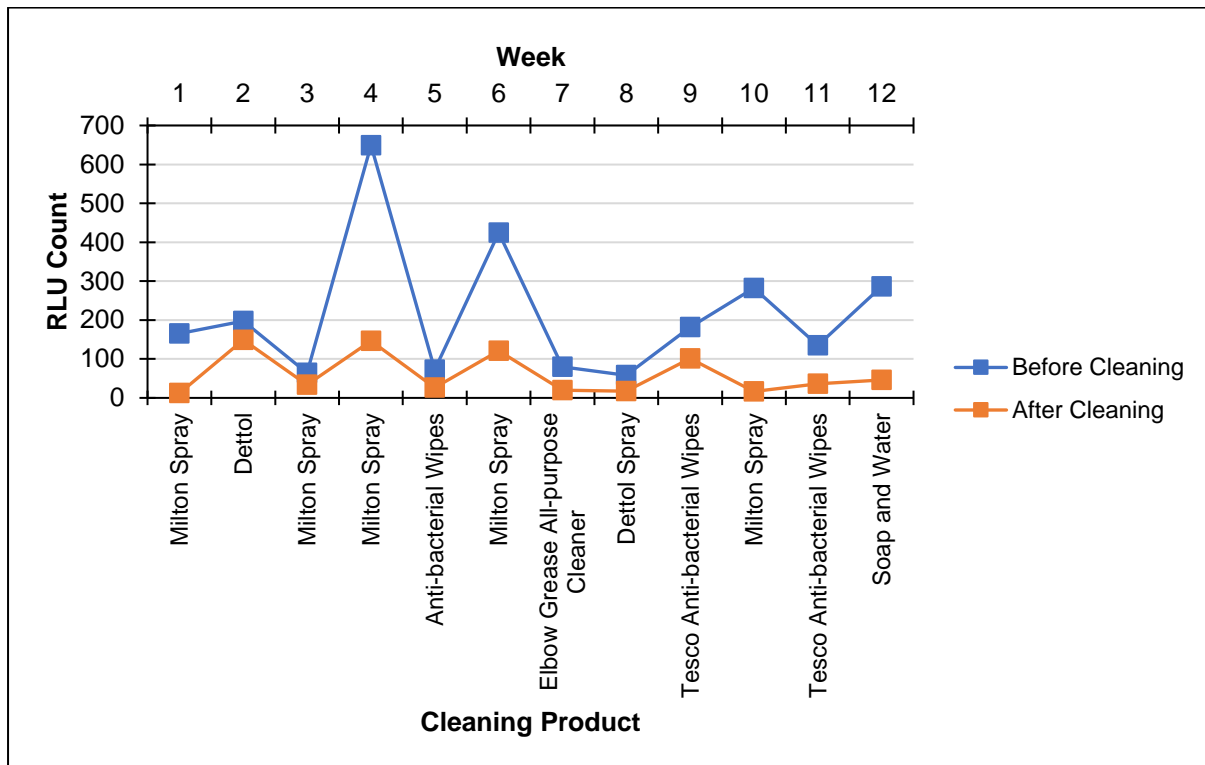
While "before cleaning" counts were inconsistent it can be seen that Milton anti-bacterial spray and soap and water are shown to cause the biggest decrease in RLU whereas the use of popular brands such as Dettol and Tesco made little difference to contaminant levels.

Appendix 5: Mean RLU count with standard deviation error bars (NSL).
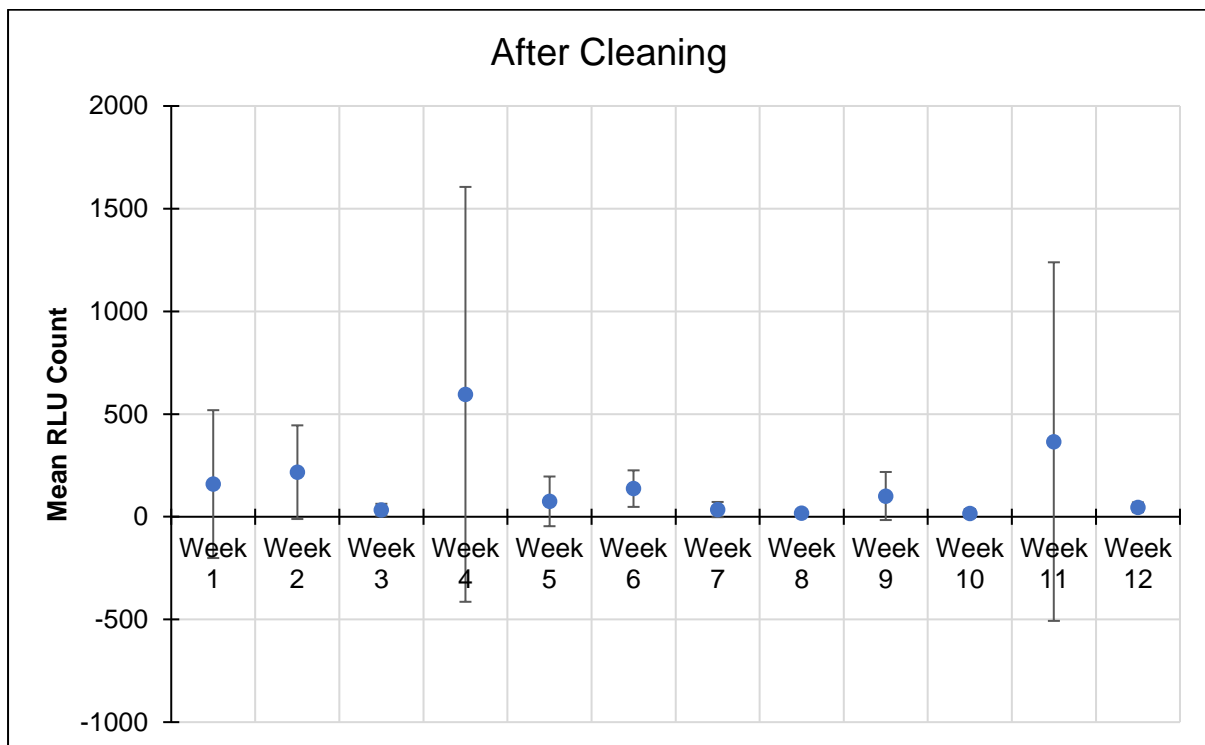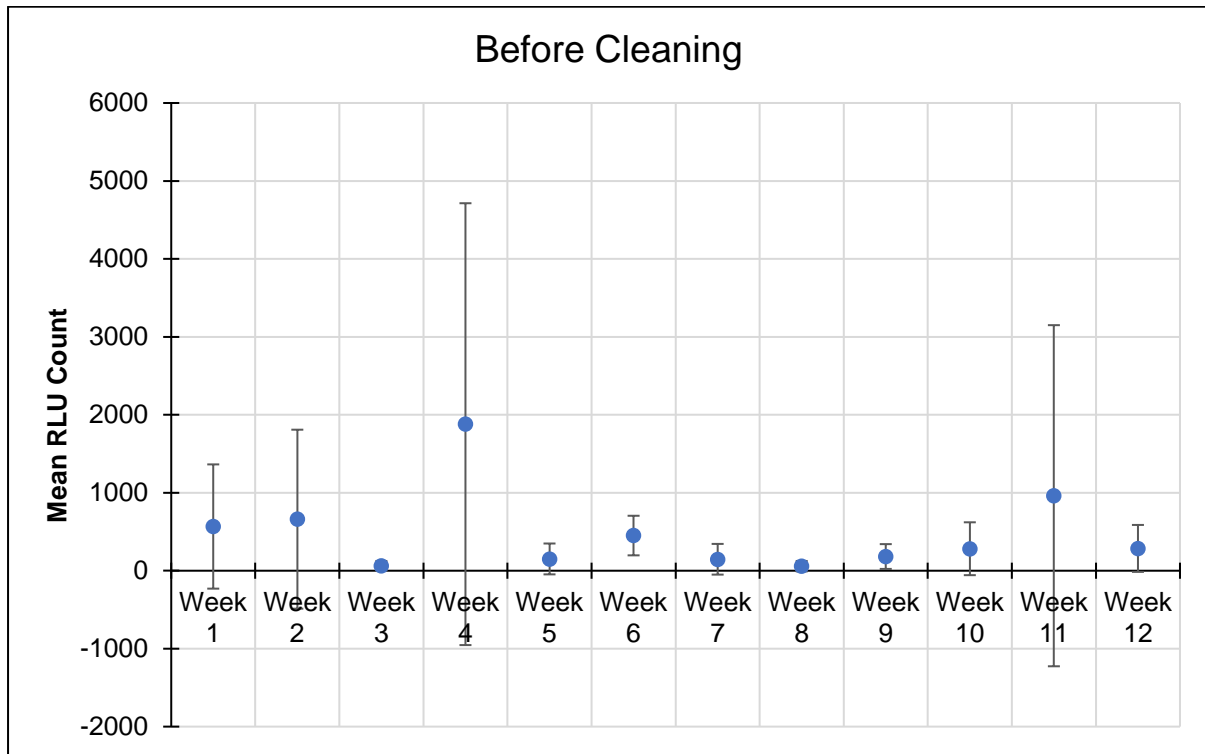
Appendix 6: Mean RLU count with standard deviation error bars (NSL, excluding bedding).