Ergonomics and Efficiency of Electrostatic Devices: Results from a Real-World Time and Motion Study

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OBJECTIVES

Real-world evaluations of electrostatic sprayers are just as important as manufacturer testing, because they confirm that a product can deliver what it claims in practice. We wanted to determine the time to apply disinfectant using Clorox® Total 360® cart and Clorox® TurboPro™ handheld electrostatic sprayer devices (ESS), and to compare ergonomic risk factors between devices and manual trigger spray application.

Time to Apply Disinfectant

Ergonomic Risk Assessment

METHODS

We recruited eight custodians to test how long it takes to apply disinfectant using the Clorox® Total 360® cart and Clorox® TurboPro™ handheld electrostatic devices in five different rooms (restroom, classroom, cafeteria, shared office space and weight room). Our study participants came from different experience levels, both as custodial workers and with electrostatic devices (Table 1). To compare ergonomic risks, we compared our devices to a manual trigger spray in the classroom. We collected video of the entire disinfecting process and measured the time to apply disinfectant. For the ergonomic assessment, we reviewed the video footage and provided a score for each device and trigger spray based on the Rapid Entire Body Assessment (REBA) scoring system.

Clorox® Total 360® cart

Clorox® TurboPro™ handheld

Manual Trigger

Table 1. Custodial participants had varying experience levels as custodians and with electrostatic devices.

Custodial Participants	Years of Custodial Experience	Experience Using Electrostatic Devices	Age	Height
A	10+ years	✔	58	5′7″
B	20+ years	✔	64	5′8″
C	< 1 year	X	31	6′1″
D	20+ years	✔	45	5′7″
E	15+ years	✔	41	6′
F	10+ years	X	37	5′8″
G	10+ years	X	40	5′7″
H	< 1 year	X	65	5′8″

TIME TO APPLY DISINFECTANT USING ELECTROSTATIC DEVICES

We hypothesized that as our custodians disinfected each space, they would learn the ideal workflow for the space and would perform faster. Additionally, we expected that they would also improve their spray times as they became more comfortable with the devices (from disinfecting multiple rooms). To prevent these biases in disinfecting times, we randomized the order in which each participant used the devices in each room, and we randomized the order that they sprayed the rooms.

Overall, we found that most rooms (regardless of size) could be disinfected in under 5 minutes using Clorox® Total 360® cart and around 3 minutes using Clorox® TurboPro™ handheld.

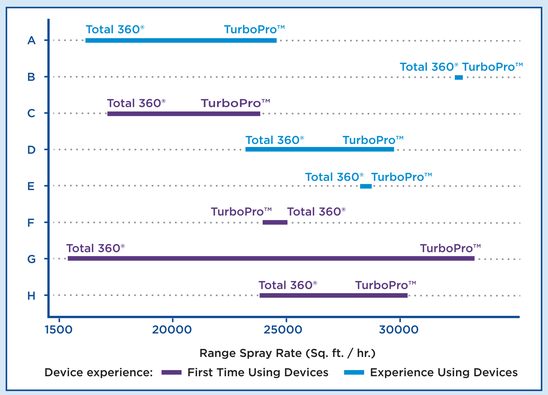
We also noted that there was a wide range in disinfecting rates between participants: Some custodians could disinfect all rooms in about 2 minutes, whereas others needed more than 5 minutes (Table 2).

Table 2. Fastest, slowest and average time to apply disinfectant in each space using Clorox® Total 360® cart and Clorox® TurboPro™ handheld.

Location – Square Footage	Device	Fastest (minutes)	Slowest (minutes)	Average (minutes)
Cafeteria 1014 sq. ft.	Total 360® cart	2.2	6.9	4.2
	TurboPro™ handheld	2.3	4.7	3.2
Classroom 1521 sq. ft.	Total 360® cart	2.3	6.3	3.6
	TurboPro™ handheld	2	3.7	2.6
Office 912 sq. ft.	Total 360® cart	1.2	3.5	2.3
	TurboPro™ handheld	1.4	3.1	1.8
Restroom 850 sq. ft.	Total 360® cart	1.4	2.8	2.2
	TurboPro™ handheld	1.6	3.1	2.3
Weight Room 1230 sq. ft.	Total 360® cart	2.2	5.5	4
	TurboPro™ handheld	2.1	4.6	3.2

We wanted to understand what could explain the range in disinfecting times in the same rooms between different people. We compared disinfecting rates between participants who had previous experience using devices and those who were first-time users. We found that custodians who had more experience using ESS devices were faster on average.

Figure 1. Previous training using ESS devices correlated with more consistent and faster disinfecting speeds.



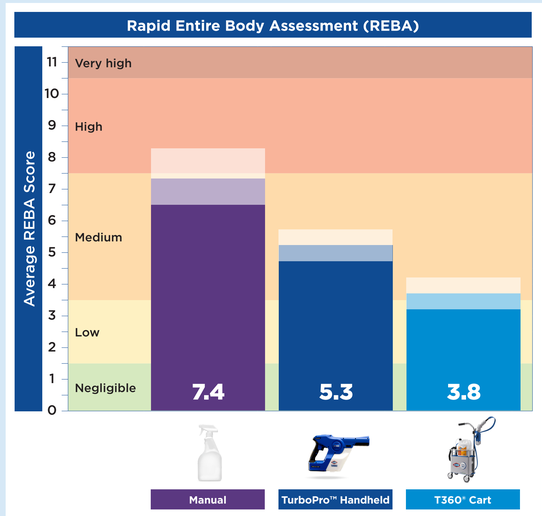
This finding highlights that over time and with training, the disinfecting task can be made faster using ESS devices.

ERGONOMIC RISKS AND BENEFITS OF ELECTROSTATIC DEVICES

There was a significant ergonomics risk reduction using Clorox® Total 360® cart and Clorox® TurboPro™ handheld over a manual trigger spray.

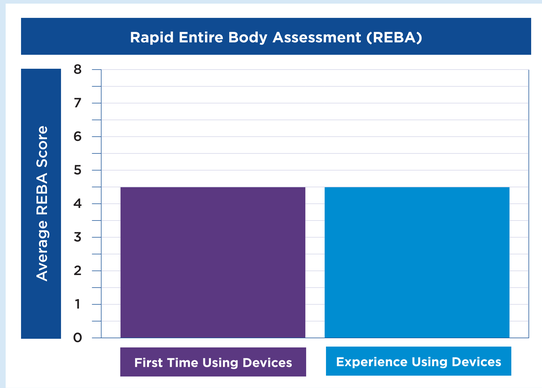
Based on the REBA scale, using a manual trigger spray scored an average 7.4 points, placing it in a medium-high risk category for injury. On average, using the Clorox® Total 360® cart reduced REBA scores by 3.6 points (p = 2.7 x 10-5) and 2 points for Clorox® TurboPro™ handheld (p = 0.001). These scores correspond to lower risk levels, with the Clorox® Total 360® cart system having the least risk of ergonomic injury in the low-medium category and Clorox® TurboPro™ handheld in the medium risk category (Figure 2).

Figure 2. Ergonomic risk levels based on REBA scale for manual trigger spray, Clorox® Total 360® cart and Clorox® TurboPro™ handheld.



Unlike the results for disinfecting time, ergonomics benefits were realized in all participants, regardless of their previous experience with devices.

Figure 3. Ergonomic benefits from devices were not limited to more experienced custodians.



CONCLUSIONS AND DISCUSSION

This is the first study, to our knowledge, assessing the time to disinfect and ergonomics of devices in a real-world setting with custodial participants.

We found that rooms of varying square footage could all be disinfected using both cart and handheld ESS devices between 2–5 minutes.

We have heard, anecdotally, that facilities that use ESS devices become more efficient with their spraying over time. Our results confirm these experiences and suggest that with time and experience, custodians may benefit more from the time savings. Future studies will assess the impact of training on disinfecting times. **However, regardless of experience using ESS devices, all participants benefited from reduced ergonomic risks with devices. Reducing ergonomics risks to custodians is critical in preventing injuries, and this represents a significant benefit to facilities implementing electrostatic technology**.

TIPS FOR USING DEVICES EFFICIENTLY

Use the devices efficiently:

- **Plug in the device as close to the center of the room as possible**. This reduces the need to unplug the device and move to another outlet.
- **Keep the cord close to the wall and move in straight lines**. Walking in straight lines down rows of desks or objects will reduce cords getting wrapped around objects.
- **Move methodically and learn your space**.

Conserve disinfectant:

- **Target your spray to high-touch objects.**
- **Count out 3 to 4 seconds of spray per object.**
- **Turn off spraying in between objects**. This will ensure that disinfectant is conserved.

Reduce ergonomic risks:

- Limit bending at the waist when disinfecting.
- Alternate between right and left hands.
- Create movement from the shoulders rather than the wrists and elbows.

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Please reach out to Kirsten.Hochberg@clorox.com if you have questions.