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**CRUISES**

# Cleaning a floating petri dish: How is a cruise ship sanitized after a coronavirus outbreak?

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Published 2:28 p.m. ET Apr. 24, 2020 | Updated 9:26 p.m. ET Apr. 26, 2020

Earlier this year, coronavirus lurked on Princess Cruises' Diamond Princess cruise ship. It eventually infected 712 people on board and killed 13, according to Johns Hopkins data.

The coronavirus, which has since evolved into a global pandemic, has shut down the cruise industry, leaving many wary of getting on a cruise ship in the future – especially one that has seen as many infections as the Diamond Princess.

After the final passengers and crew disembarked with the ship's captain being the last person to depart the ship on March 1, according to a Princess Cruises Facebook post, cleaning was delayed. The U.S. Centers for Disease Control and Prevention then conducted an investigation on how the virus spread through the ship.

Then on March 31 – nearly a month after the chaos on board ended – Princess spokesperson Negin Kamali shared a statement with USA TODAY announcing that the vessel had been sanitized by BELFOR Property Restoration, which touts itself as "the world's largest disaster restoration company."

The cleaning job was complete and the vessel had been presented with a certificate from Japan's health ministry, which confirmed the Diamond Princess to be "fit to sail," with "no traces of COVID-19 on board," according to the cruise line. The ship was quarantined off the coast of Yokohama, Japan, from Feb. 5-19 after the first cases were diagnosed.

USA TODAY has reached out to the Japanese Ministry of Health, Labour and Welfare for comment.

The Michigan-based sanitation company, which participated in cleanup after the Sept. 11, 2001, attacks and Hurricane Katrina in 2005, has been active throughout the COVID-19 outbreak, aiding sanitation efforts in hospitals, fire departments, arenas and airports, according to CEO Sheldon Yellen. BELFOR also helped to construct a drive-thru testing facility in South Carolina.

"This is what we do, not just during this COVID-19 time, this is what we do," Yellen told USA TODAY. "We have approximately 9,200 employees around the world, and they are full-time employees. These are people with years and years and years of experience."

Cleaning the ship's 18 decks, 1,300+ cabins and numerous common areas on Diamond Princess took the efforts of 240 workers from the company's Japan and North American operations, including its environmental, HVAC and marine divisions. Yellen says all wore disposable biohazard suits, along with booties, gloves and full-face respirators. And it took nearly all of March to fully disinfect the ship.

Princess Cruises would not disclose the cost of the project.

## **How disinfection worked**

BELFOR disinfected all public and crew access areas, staterooms, crew cabins, dining and entertainment areas on the Diamond Princess.

Because the ship had a confirmed COVID-19 contamination, the company performed what is known as a "level-three" cleanup, the most thorough of all cleanings.

BELFOR followed protocols established by the Arkansas-based consulting firm Center for Toxicology and Environmental Health (CTEH), which served as the industrial hygienist on the job; the Japan Ministry of Health, Labour and Welfare; and Princess Cruises.

"'Level three' already existed in the cruise world," Kamali said, noting it was "originally written in response to norovirus but includes disinfectant that disinfects against coronavirus, as well."

The CDC was not directly involved, given that the ship was not under U.S. jurisdiction when it was under quarantine in Japan. And the Japanese health ministry required that the sanitation of the vessel be completed there, Alivia Owyong Ender, spokesperson for Princess Cruises, told USA TODAY.

"CDC provided feedback on the disinfection plan at the cruise line's request," Aimee Treffiletti, chief of the CDC's Vessel Sanitation Program, told USA TODAY, adding the plan was reviewed by the World Health Organization and the Japan Ministry of Health.

"We followed an extensive protocol, which included worker safety guidelines; disinfection chemicals that were to be used for each type of space; methods to be used for applying the disinfectants; and process for documenting the disinfection process," David Watts, the senior industrial hygienist at CTEH, told USA TODAY.

The process included:

- Removal of all linens, bedding and other material goods
- Disinfection of the entire vessel, including "high-touch surfaces"
- Disinfection of carpet and hard surface cleaning
- Disinfection and cleaning of HVAC systems throughout the ship

"Soft materials (linens, towels, etc.) were discarded and have been replaced," Owyong Ender said.

High-touch surfaces including doorknobs, lobby doors, handrails and corridors were wiped down, Yellen said. Then, "low-contact nonporous surfaces" were cleaned using an electrostatic sprayer or an aerosolized mister for broader application, which is used on flooring, walls, furniture and metal, among other surfaces. The carpets and HVAC systems and any associated mechanical systems and ductwork were also cleaned.

For all COVID-19 related projects, BELFOR uses an EPA-registered product suitable for COVID-19 but was unable to disclose any brand names.

As the process continued, each room was checked, cleared and then taped off to avoid any chance of recontamination. When the entire job was finished, Japan's health ministry signed off.

"Princess Cruises, CTEH, MHLW and BELFOR agreed on what would make the vessel safe for reentry, and this was monitored real-time during the process, and at the end of the cleaning it was determined and agreed that this had been accomplished," said Kirk Lively, director of technical services at BELFOR.

After the disinfection process was complete, Diamond Princess moved from its location at Daikoku terminal in Yokohama harbor to a nearby shipyard for refurbishment

projects including the replacement of mattresses, linens, games, toys and some other technical tasks. This is expected to be complete in May, according to the March 31 statement.

## **A day in the life of a cruise ship cleaner**

Cleaning was conducted seven days per week, Yellen said, with employees working first in two rotating 12-hour shifts, before moving to three rotating shifts of eight hours.

Tom Yacobellis, who leads the National Service Team of DUCTZ, the mechanical and HVAC division of BELFOR, was part of the cleaning effort and recounted his experience to USA TODAY. He said most workers began their days around 6:30 a.m. and finished by 7 p.m., though he wasn't done until 9 p.m. most nights.

Each day began with employees taking chartered buses to the port in Yokohama where the Diamond Princess was docked. Once on site, employees went through medical checks and had their temperatures recorded.

"The teams would break into smaller workgroups and would all be assigned specific tasks through a strict supervisory structure," said Yacobellis. "The workers had to be scanned into and out of the ship with ship-assigned name badges every time they got off and on."

Then, after the laborious process of getting into their personal protective equipment (PPE), employees were inspected once again before entering the ship. PPE was to remain in place at all times while on board.

"The process of donning and doffing the PPE could take up to 45 minutes to be certain of proper protection," Yacobellis explained. "This process had to be meticulously applied in order to maintain safety for everyone involved."

While the PPE was necessary for the workers' safety, it also complicated their communication efforts.

"It was difficult for our managers to determine who they were speaking to while on board because everyone [had] a full white suit on and the full face respirator was covering most of their faces with only the ability to see their eyes," he recounted. So many of them ended up writing their names on their suits to help with identification.

While working on the ship, CTEH implemented and monitored a computerized tracking system to ensure that the sanitization process was completed in order and in accordance with the Japan Ministry of Health.

Throughout the process, BELFOR managers met with CTEH reps and Princess Cruises daily to keep them updated on the ongoing process and check on quality control.

Despite his time on the ship, Yacobellis said he didn't have any concerns.

Because of all the health checks required, he said that many of the employees working on the ship's sanitization felt they "were in the safest place on earth."

## **So is the cruise ship safe?**

"Following recommended social distancing guidelines, crew members and the public should feel confident about boarding the Diamond Princess," CTEH's Watts said.

Additionally, any traces of coronavirus would likely be dead by now, according to officials, he noted.

"The vessel has now been empty for more than 45 days – significantly beyond health officials' predictions for how long the virus is able to live on surfaces," he added.

Just how long that is ranges from hours to days depending on the surface in question and the humidity of that environment, according to the World Health Organization. The CDC's study found that genetic material from the coronavirus had lived on surfaces aboard the Diamond Princess as long as 17 days.

"Not a single space – not a room, a closet or a cubby hole on the Diamond Princess ship went without completing the disinfection protocol with scrutiny on several levels," Yacobellis said. "The cleaning checks and cross-checks were above reproach."

How confident is Yellen about the sanitation job his team did? He accepted Princess' invitation to sail on the Diamond Princess' first voyage after the pandemic has passed and says he plans to be on board – without any PPE this time.

## **Will the cruise industry make lasting changes?**

Looking forward, Yellen said the best way to avoid another outbreak similar to the one that occurred on the Diamond Princess is to take preventative measures. Ongoing maintenance and housekeeping is "key," he said.

Going forward, Princess Cruises said that new health protocols are going to be put in place.

"In addition to the sanitation efforts, our team of medical experts is actively developing a comprehensive set of new health protocols," spokesperson Kamali told USA TODAY.

Some protocols have been enhanced or added since the COVID-19 outbreak began, such as health screenings including a thermal scan, free flowing hand sanitizer and increased cleaning. The enhancements are posted on the Princess Cruises website.

The Diamond Princess was not the only ship to be ravaged by coronavirus: the CDC released a report that identified more than 20 ships affected by the virus that made port calls or disembarked in the U.S., including other Princess ships.

At least 100 cases were linked to the Grand Princess with at least two people dying in March, and the Coral Princess had more than a dozen cases and at least two COVID-19 deaths when it docked in Miami earlier this month. A third died at a local hospital shortly afterward. And the Ruby Princess prompted a criminal investigation after it docked in Australia and disembarked 2,700 passengers and crew. It became the largest source of coronavirus in the country with more than 300 cases and more than 20 deaths linked to the ship.

**'Inherently high-risk setting':** Are cruise ships unsafe – and will they change?

When cruise lines do begin sailing once again, after the CDC's no-sail order expires this summer, there could also be industrywide steps taken to help avoid or deal with this kind of outbreak in the future.

Though the industry's leading trade organization has not announced any long-term changes on ships in response to the coronavirus outbreak, some may be on the table.

"As cruise lines begin planning for the future, they are exploring ways to go further still to improve upon their already robust public health protocols, including additional screening requirements and enhanced sanitation measures," Bari Golin-Blaugrund, senior director of strategic communications for Cruise Lines International Association, said Monday.

The U.S. Centers for Disease Control and Prevention confirmed that it is working on plans for preventing and containing further outbreaks of COVID-19 and other viruses on board cruise ships and noted they will be similar to its Vessel Sanitation Program, a protocol for dealing with gastrointestinal illnesses on board.

In fact, when the CDC issued its no-sail order extension on April 9, it required all ships that sail in U.S. waters to create plans to address coronavirus prevention and response.

"Ships are currently formulating similar plans to address outbreaks of COVID-19, and these plans could also be modified to prevent and respond to other communicable illnesses in the future," Aimee Treffiletti, chief of the CDC's Vessel Sanitation Program, told USA TODAY.

It remains to be seen what those tougher measures might entail. If rapid testing for the coronavirus becomes more readily available, that's a possibility. It's also unclear whether crew or passengers would be required to wear masks on board.

Cruise lines "have a duty to mitigate foreseeable risks," said Jeff Ment, an attorney who specializes in representing travel companies. It "requires a plan, screening people, kicking off people who are sick."

## **Would former passengers get back on?**

John and Melanie Herring were on board the Diamond Princess when the ship was quarantined in Japan after the first few cases surfaced in early February. Over the course of the next two weeks, hundreds of people tested positive, including John.

John became ill during that period and was transported to Chiba University Hospital on Feb. 13, where he tested positive for coronavirus. He later recovered and returned home to Utah. Melanie left Japan on a U.S. charter flight on Feb. 16 and spent two weeks in isolation at Travis Air Force Base in California, along with other American passengers from the Diamond Princess. The couple didn't see each other again until Melanie was released from quarantine and flew home to Utah in early March.

Despite that ordeal, John told USA TODAY that they would be willing to sail on the Diamond Princess again. (They are able to do so for free, thanks to Princess' offer of a full cruise credit.)

"We are not afraid and look forward to traveling again as soon as possible," he said. "If the Diamond Princess was going to ports we wanted to see, we would go back aboard."

**'Inherently high-risk setting':** Are cruise ships unsafe – and will they change?

**Diamond Princess, Grand Princess:** Cruise line had high rates of illness even before coronavirus

*Contributing: Chris Woodyard*