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Robotic Workbench To Prepare Hazardous Drugs

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BETHESDA, MD, 20 December 2007 — The pharmacy staff at the University of Colorado Hospital near Denver is getting a helping hand in safety—a robotic one.

A CytoCare robotic workbench (see figure at right) arrived in mid-November from Health Robotics in Italy to improve the safety of pharmacy-prepared injectable chemotherapy doses, said Pharmacy Director Nancy Stolpman.

The robotic workbench is about 7-ft. wide, 6-ft. high, and 3-ft. deep. At left is the dose-preparation area with the robotic arm at rest. To the right is the loading chamber and the user's touchscreen. Photo courtesy of University of Colorado Hospital

"I.V. rooms, I believe, are one of the most dangerous places left in a hospital," Stolpman said.

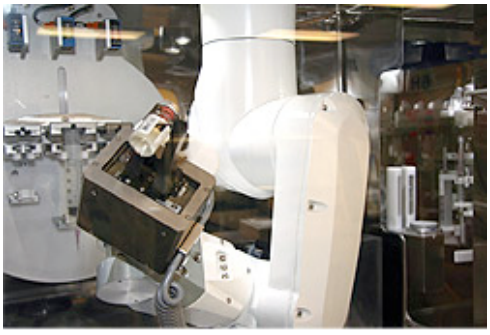
The last frontier. The use of bar-code technology at patients' bedside has improved the safety of medication administration, Stolpman said. Computerized prescriber order entry has decreased the number of prescribing errors. Pharmacy information systems help detect adverse drug reactions, potential drug–drug interactions, and dosages outside normally acceptable ranges.

But a nurse about to administer a pharmacy-prepared i.v. admixture, she said, "does not know what's in that bag. They've got 100% faith in us that we made the product correct."

Stolpman said her pharmacists catch calculation and mixing errors before the technician-prepared doses leave the i.v. admixture room. But, she admitted, not all errors have been caught.

"If you ask anyone running a hospital operations or a compounding room if an error ever leaves their i.v. room, I think they'd be remiss to say it never happens," Stolpman said.

Total containment. Stolpman said the robotic workbench's dose-preparation area (see figure at right) is a chamber whose air quality meets the requirements of class 5 in the International Standards Organization's categorization of air cleanliness. Air from the chamber vents to the outside.

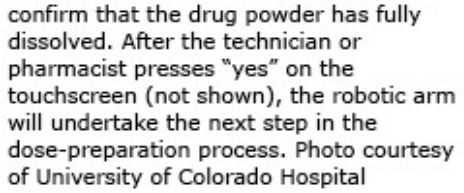


The robotic arm shows an ampicillin vial after reconstitution so that a pharmacy technician or pharmacist can visually

Aerosolization of drug solution in the chamber is prevented through the robot's use of a ventilated needle system that depressurizes the vial, she said.

Stolpman said validation and calibration tests, including assays for dose confirmation, were under way in late November. Tests of the environmental quality of the dose-

preparation area will follow.


confirm that the drug powder has fully dissolved. After the technician or pharmacist presses "yes" on the touchscreen (not shown), the robotic arm will undertake the next step in the dose-preparation process. Photo courtesy of University of Colorado Hospital

Once the robotic workbench passes all the tests and takes on the chemotherapy workload, about 120 admixtures daily, Stolpman said the pharmacy's biological-safety cabinet will become a backup unit for when the workbench has expected and unexpected downtimes.

She said the robot can perform 40 manipulations, such as transferring a drug solution from a vial to an i.v. bag, each hour.

Most of the chemotherapy workload, Stolpman said, comes from the University of Colorado Cancer Center, a National Cancer Institute-designated comprehensive cancer center.

Workflow. Stolpman described the expected workflow for the robot-assisted preparation of a chemotherapy dose.

1. A pharmacist enters the medication order into the pharmacy computer system.
2. The pharmacy computer system, via an interface, sends the medication order to the robotic workbench's software, CytoPlan.
3. The software puts the medication order on hold.
4. A pharmacist validates the order, typically after review of the patient's laboratory test results.
5. The software releases the medication order and generates a pick list for the pharmacy technician.
6. The technician obtains the medication and supplies, applies a dummy bar code to the final dispensing container, and places the material in the workbench's loading chamber.
7. The workbench's optical system scans the dummy bar code and assigns it to the medication order.
8. The workbench's optical system scans the bar code on each container of medication, diluent, and i.v. fluid and validates that the correct material is in the loading chamber. For a medication vial lacking a bar code, the optical system takes a 360-degree picture of the vial and searches the workbench's picture library for a match. (The workbench's manufacturer is building the database of pictures of chemotherapy drug vials marketed in the United States.)
9. The workbench's robotic arm moves the validated containers into the dose-preparation chamber and prepares the dose in accordance with the validated medication order.
10. The robotic arm delivers the final dispensing container to the loading chamber.
11. The technician retrieves the final dispensing container and a computer-generated human- and machine-readable label specific to the patient and the medication order.
12. The pharmacist uses a scanner to read the former dummy bar code on the final dispensing container and the bar code on the human-readable label. If the bar codes are identical, the pharmacist affixes the human-readable label over the dummy bar code on the final dispensing container.

Stolpman said another bar code on the human-readable label links the chemotherapy dose with the medication administration record system.

Before administering the dose, she said, a nurse will use a bar-code scanner to verify that the dose matches the medication order.

New responsibility. Vickey Houk, lead technician in the pharmacy, said some of the department's 32 pharmacy technicians initially worried that they would lose their job once the robotic workbench starts preparing chemotherapy admixtures.

"The machine is not going to run itself," Houk, a certified pharmacy technician with 28 years' experience, said she assured her colleagues.

Besides, she said, there are jobs for the technicians to do other than compound sterile chemotherapy doses.

Houk said an advantage to having the robotic workbench is that "we won't have to worry about exposure [to cytotoxic drugs] anymore."

A disadvantage, she said, to the new workbench as well as other computerized technologies in the department is that "some of the thinking process is gone." The technicians no longer need to regularly perform calculations, for example.

Houk, contacted on November 26, said company-conducted training sessions had started that morning. The sessions were scheduled to last two hours apiece and occur twice daily for two weeks.

So far, Stolpman said, the staff tends to say "she" or "her" when referring to the robotic workbench. And a name will surely follow.

"Our leading name right now is kemosabe," Stolpman said.