Pharmacy Informatics

Shining Light on the Matter: The Role of Augmented Reality in the Medication Use Process and How RFID Can Make it Work

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https://www.pharmacyinformatics.net

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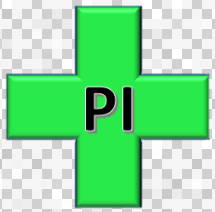
Basic Definitions

- AR: Augmented Reality (Mixed Reality): an interactive experience that combines the real world and computer-generated content
- RFID: Radio-frequency identification. wireless, non-contact use of radio frequency waves to transfer data and identify objects. RFID systems usually comprise an RFID reader, RFID tags, and antennas.
- Computer vision: is a field of artificial intelligence that trains computers to interpret and understand the visual world using digital input
- Sensor Fusion: Combining multi-data sources (like motion data and computer vision) to precisely identify an object

https://en.wikipedia.org/wiki/Augmented_reality
https://www.atlasrfidstore.com/rfid-beginners-guide/
https://en.wikipedia.org/wiki/Sensor_fusion
https://www.sas.com/en_us/insights/analytics/computer-vision.html#:~:text=Computer%20vision%20is%20a%20field,to%20what%20they%20%E2%80%9Csee.%E2%80%9D



Scientific Use Case of Using Augmented Reality and RFID

- Article, IDCam: Precise Item Identification for AR Enhanced Object Interactions
  - How do you link a RFID tagged object, in a world of many RFID tagged objects, to the one that a user is interacting with?
  - Like a retail store with many products…or pharmacy for that matter
  - That is what this paper describes, where they can correlate the movement of the users hand + RFID tag to do just that (in the sphere of an adapted HoloLens)

https://alansonsample.com/publications/docs/2019%20-%20RFID%20-%20IDCam-%20Precise%20Item%20Identification%20for%20AR%20Enhanced%20Object%20Interactions.pdf

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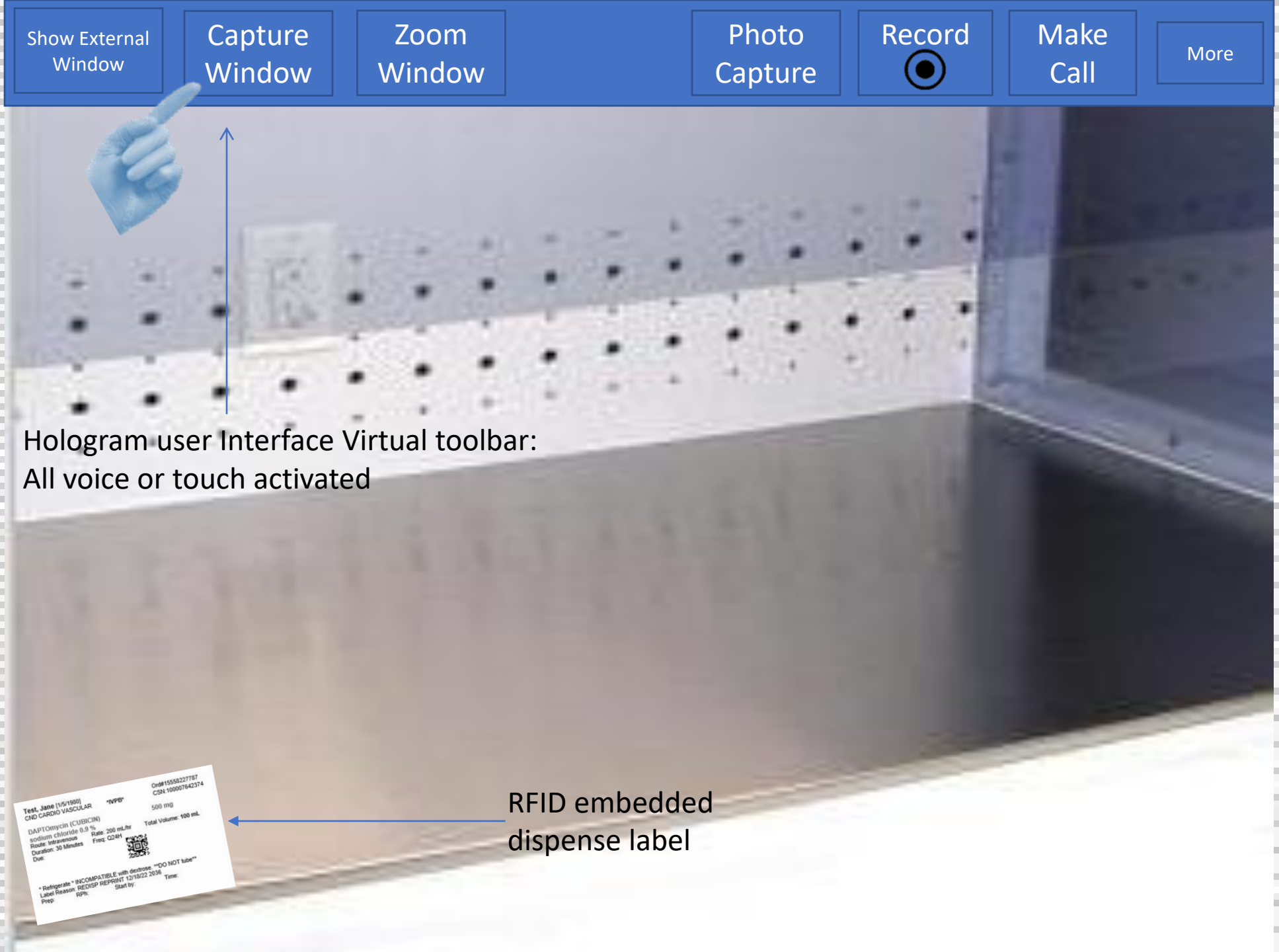
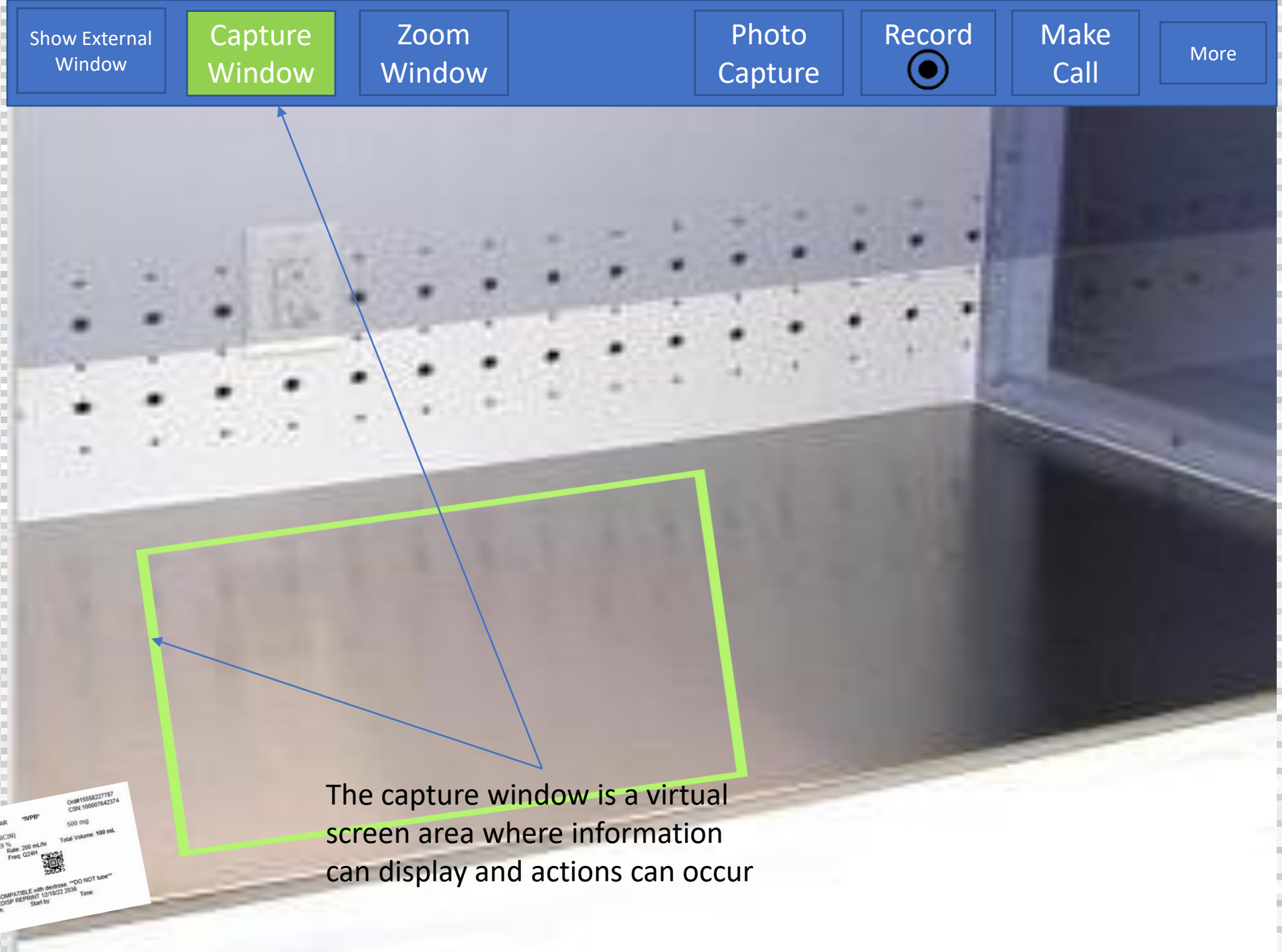

Show External Window
Capture Window
Zoom Window
Photo Capture
Record
Make Call
More
Hologram user Interface Virtual toolbar:
All voice or touch activated
RFID embedded dispense label


Show External Window
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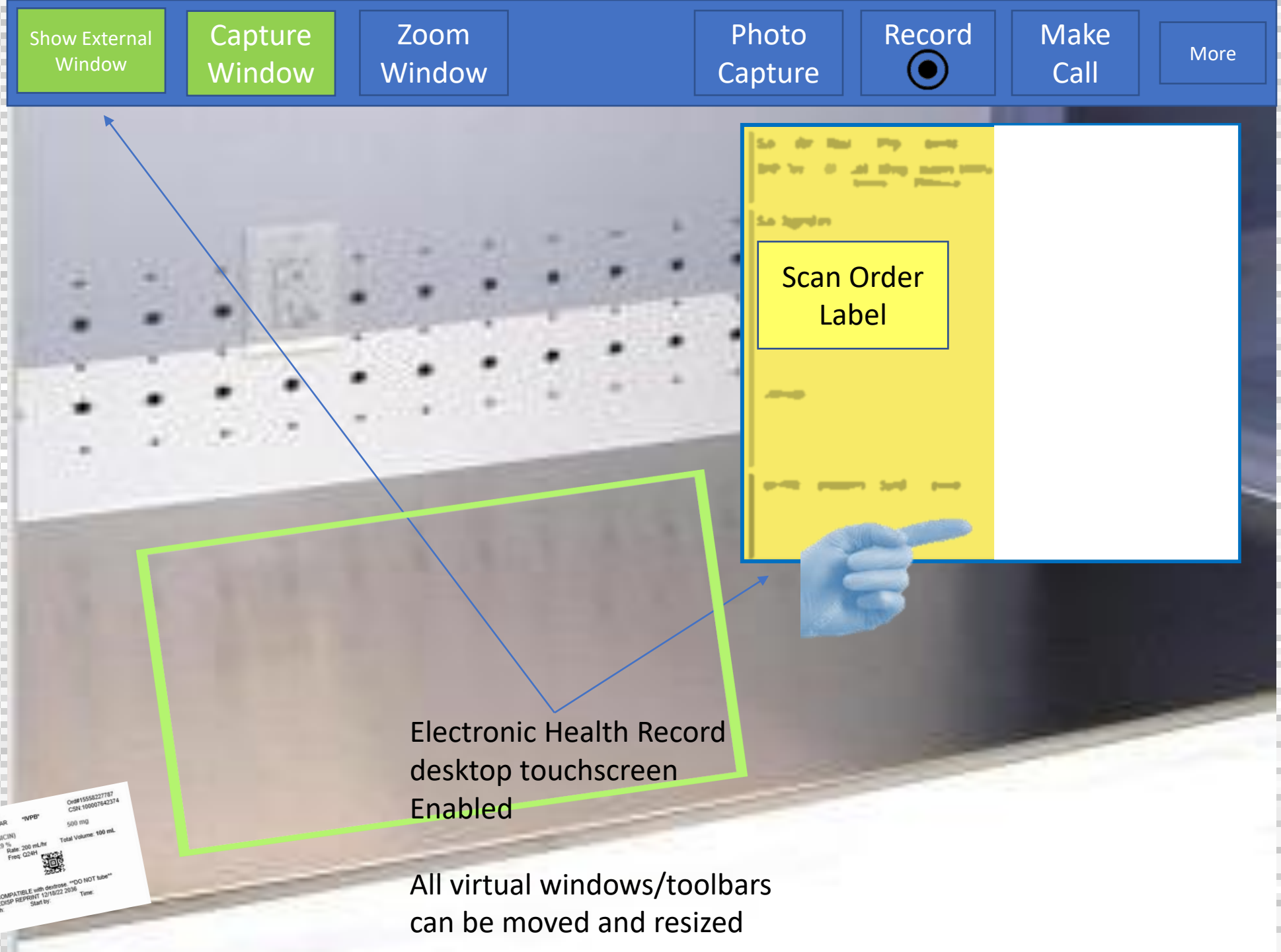
More
The capture window is a virtual screen area where information can display and actions can occur

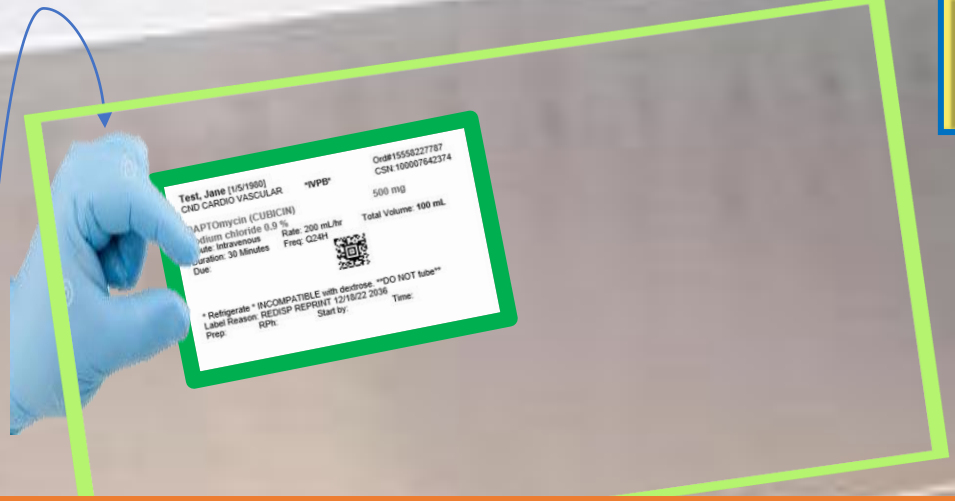

Show External Window
Capture Window
Zoom Window
Photo Capture
Record
Make Call
More
Scan Order Label
Electronic Health Record desktop touchscreen Enabled
All virtual windows/toolbars can be moved and resized

Show External Window | Capture Window | Zoom Window | Photo Capture | Record | Make Call | More

PREP In Progress
Daptomycin 500mg IVPB in NaCl 0.9%
Ingredients: Daptomycin 500mg vial
Sodium Chloride 0.9% 100ml
Diluent: Sodium Chloride 0.9% 10ml
Prep: Reconstitute daptomycin vial to 50mg/ml
- **Draw 10ml of reconstituted vial into 100ml sodium chloride bag**

Scan Ingredients
Daptomycin
500mg vial
Sodium Chloride
0.9% 100ml Bag

3) Prep in progress window appears with prep detail



1) RFID label is moved to capture screen

2) This action “scans” label into EHR for prepping activity on that dispense

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Obtain necessary ingredients

Show External Window | Capture Window | Zoom Window | Photo Capture | Record | Make Call | More

PREP In Progress
Daptomycin 500mg IVPB in NaCl 0.9%
Ingredients: Daptomycin 500mg vial
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- **Draw 10ml of reconstituted vial into 100ml sodium chloride bag**

Scan Ingredients
Daptomycin
500mg vial
Sodium Chloride
0.9% 100ml Bag

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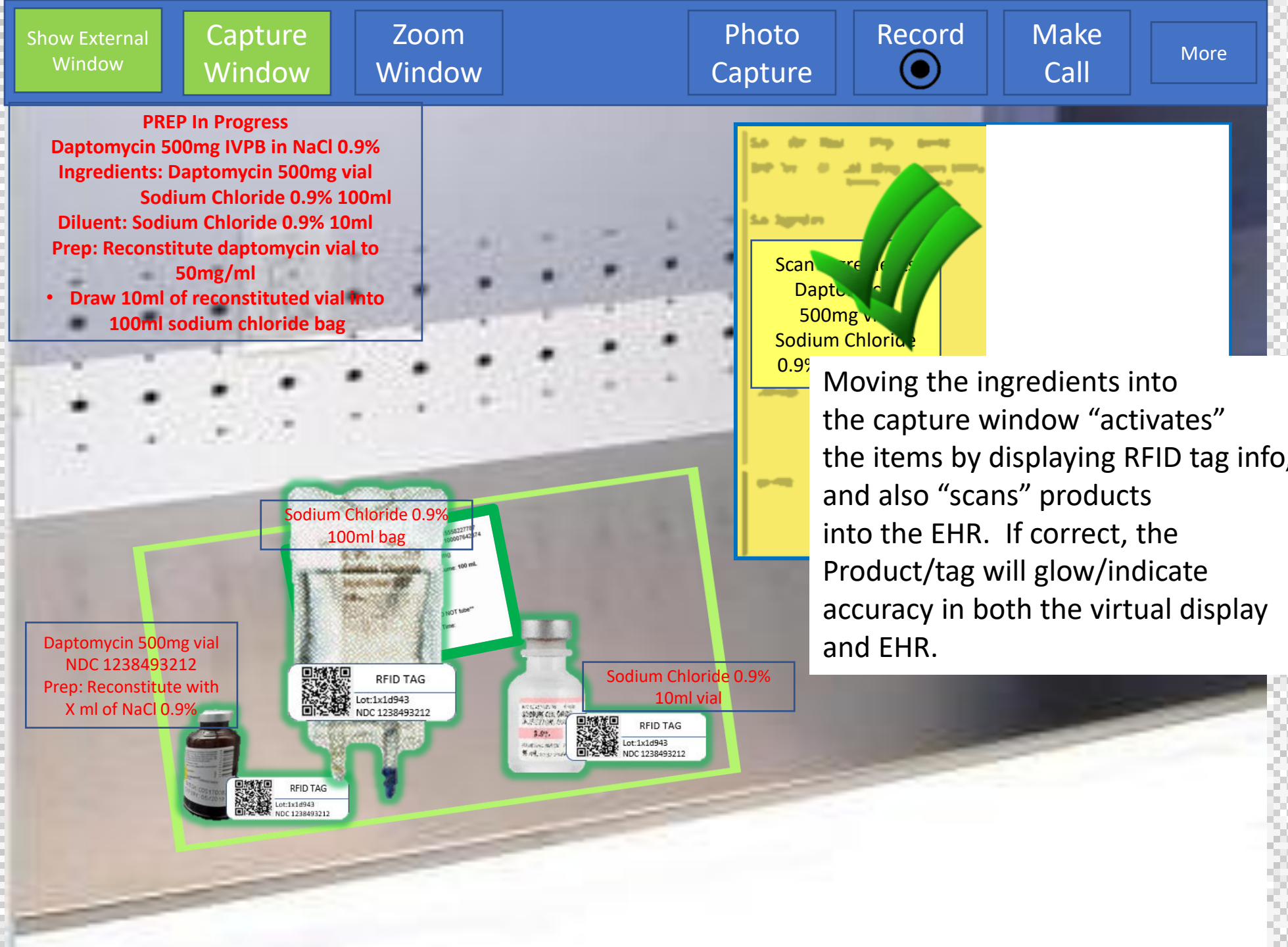
Show External Window
Capture Window
Zoom Window
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Record
Make Call
More
PREP In Progress
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Ingredients: Daptomycin 500mg vial
Sodium Chloride 0.9% 100ml
Diluent: Sodium Chloride 0.9% 10ml
Prep: Reconstitute daptomycin vial to 50mg/ml
• Draw 10ml of reconstituted vial into 100ml sodium chloride bag
Sodium Chloride 0.9% 100ml bag
Daptomycin 500mg vial NDC 1238493212 Prep: Reconstitute with X ml of NaCl 0.9%
Sodium Chloride 0.9% 10ml vial
RFID TAG
Lot:1x1d943
NDC 1238493212
Moving the ingredients into the capture window "activates" the items by displaying RFID tag info, and also "scans" products into the EHR. If correct, the Product/tag will glow/indicate accuracy in both the virtual display and EHR.
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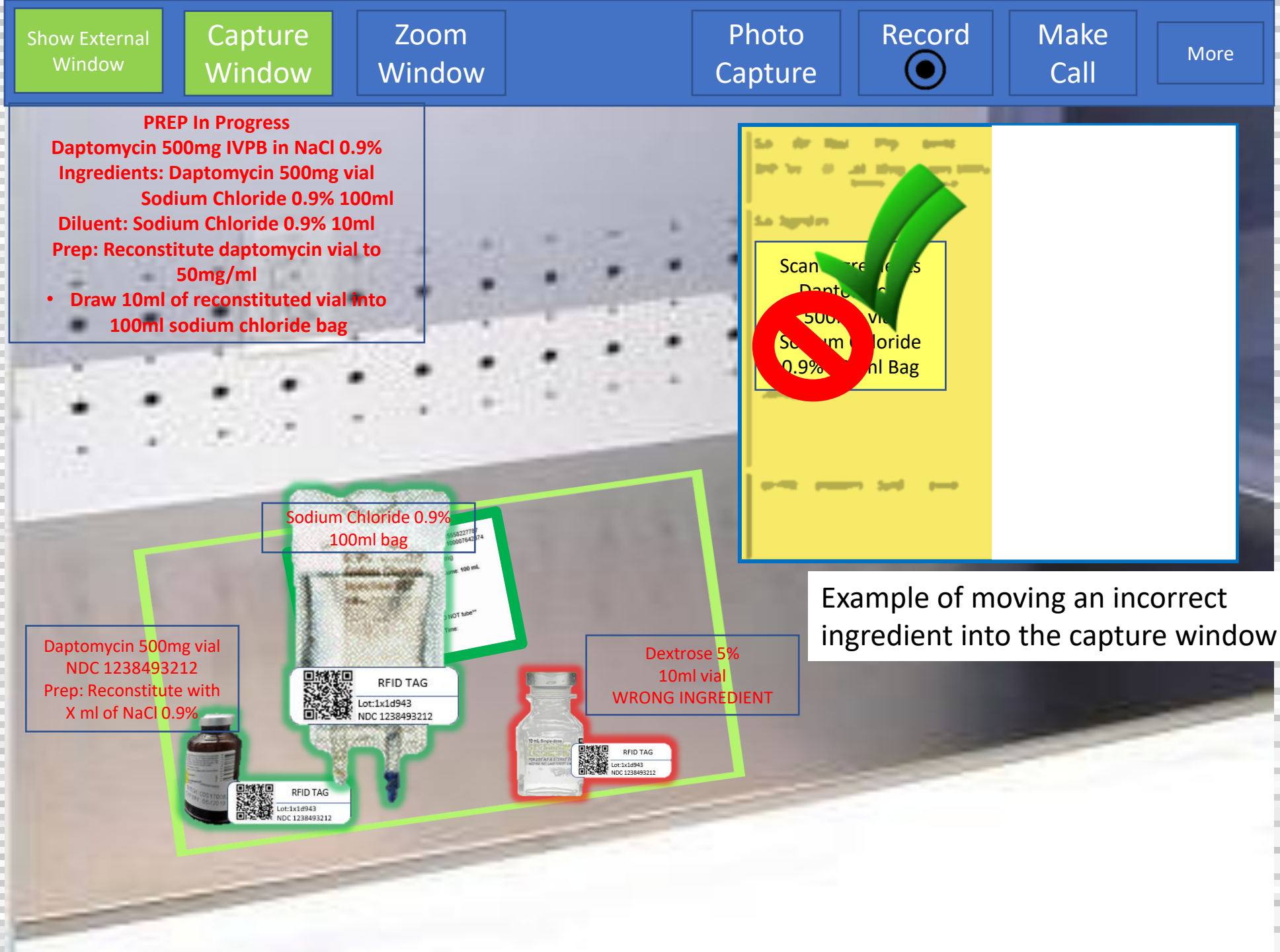
Show External Window
Capture Window
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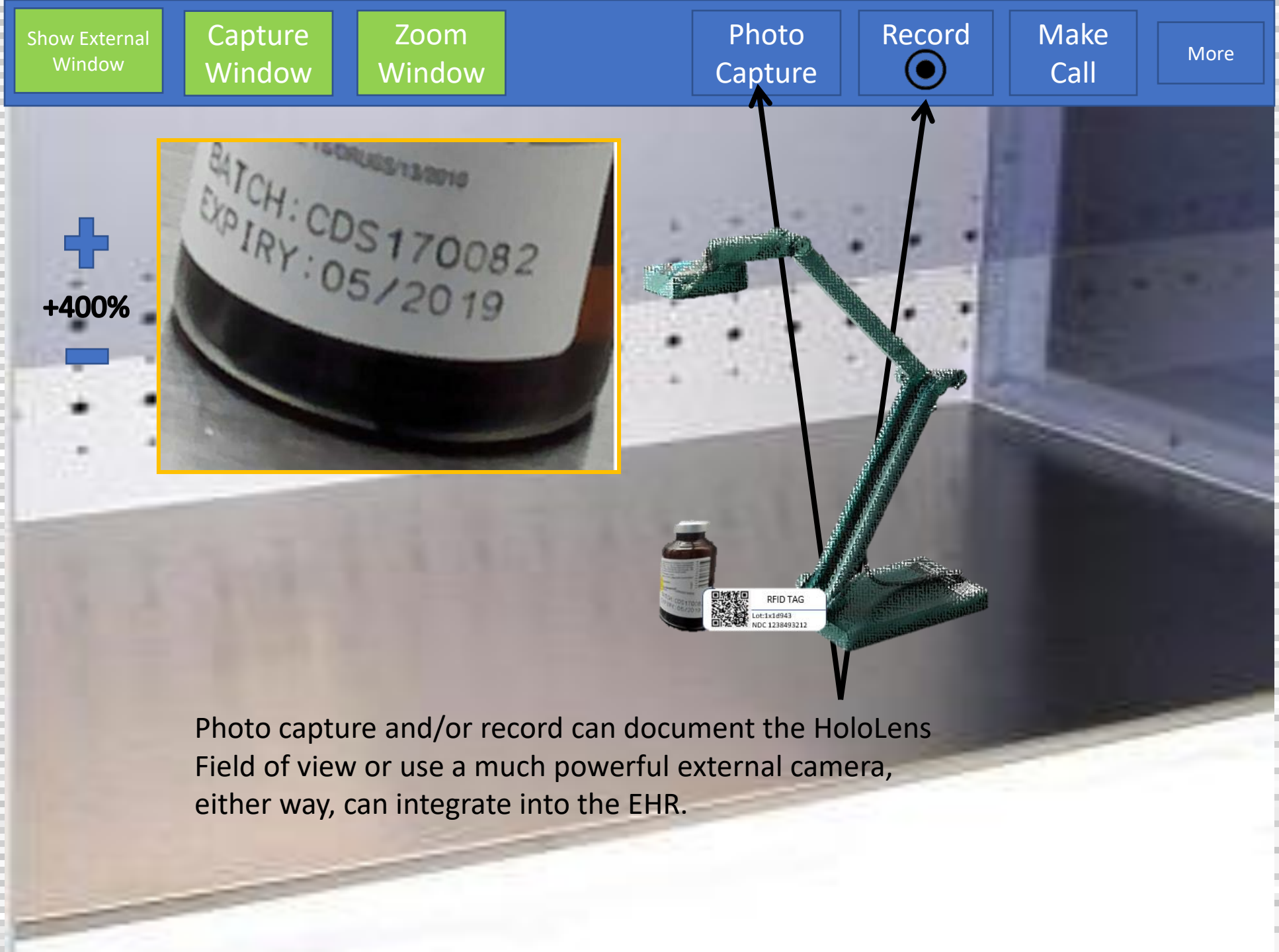
Record
Make Call
More
PREP In Progress
Daptomycin 500mg IVPB in NaCl 0.9%
Ingredients: Daptomycin 500mg vial
Sodium Chloride 0.9% 100ml
Diluent: Sodium Chloride 0.9% 10ml
Prep: Reconstitute daptomycin vial to 50mg/ml
• Draw 10ml of reconstituted vial into 100ml sodium chloride bag
Sodium Chloride 0.9% 100ml bag
Daptomycin 500mg vial
NDC 1238493212
Prep: Reconstitute with X ml of NaCl 0.9%
Dextrose 5% 10ml vial
WRONG INGREDIENT
RFID TAG
Lot:1x1d943
NDC 1238493212
Example of moving an incorrect ingredient into the capture window


Show External Window
Capture Window
Zoom Window
Photo Capture
Record
Make Call
More
+400%
BATCH:CDS170082
EXPIRY:05/2019
RFID TAG
Lot:1x1d943
NDC 1238493212
Photo capture and/or record can document the HoloLens Field of view or use a much powerful external camera, either way, can integrate into the EHR.
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Show External Window
Capture Window
Zoom Window
Photo Capture
Record
Make Call
More
+400%
BATCH:CDS170082
EXPIRY:05/2019
RFID TAG
Lot:1x1d943
NDC 1238493212
Communicate to the outside world for supplies, alert RPh to check, etc
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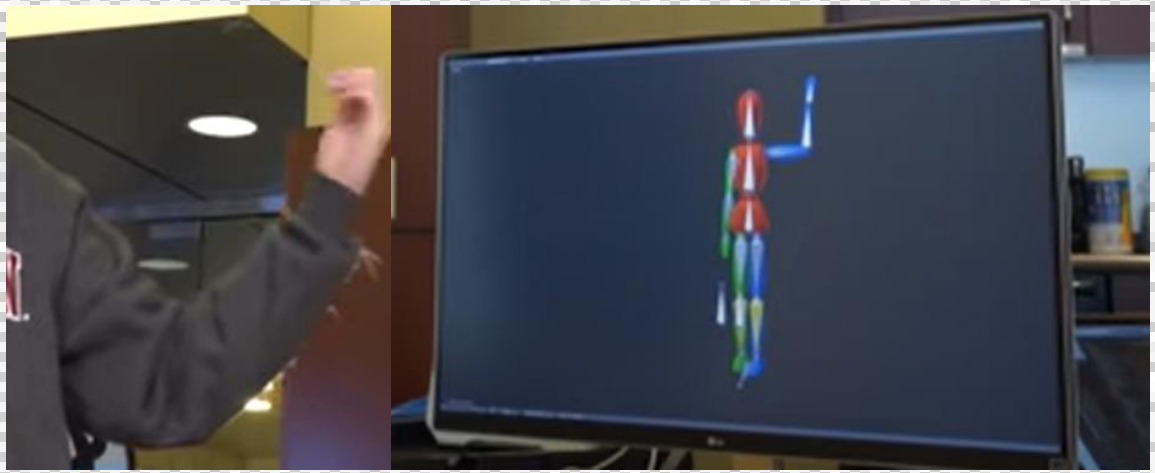
Bringing things together…

Medication Admixtures and Calibrated Spatial Measurements of Syringes

Carnegie Mellon University: Using Battery-free, Passive RFID, to Detect Changes to the Shape of and Object



"By attaching these paper-like RFID tags to clothing, we were able to demonstrate millimeter accuracy in skeletal tracking"

"As backscatter comes back from multiple tags embedded in clothing, for example, subtle differences in signal timing
from one sensor to another can be used to calculate the motion of and changes of shape to an object"

https://www.zdnet.com/article/rfid-tag-arrays-can-be-used-to-track-a-persons-movement/
https://www.youtube.com/watch?v=X4uwrTG0WpU&t=8s

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RFID Micro Tags

Micro tag vs. other methods

		Barcode 2D code	RFID label	Murata Micro tag
Reading method		Optical	Electromagnetic induction (HF band) Radio wave (UHF band)	
Minimum size		Around 4x4mm	Several x several cm	1.2x1.2mm
Read/Write	Rewrite data	Not possible	Possible	
	Read range	Up to 1m	Up to 30cm (HF band) Up to 10m (UHF band)	Up to 20mm (HF/UHF band)
	Subject of reading	1 by 1	Bulk	1 by 1 / Bulk
	On-metal application	Readable	Not readable (Except for special label)	Readable in some cases
	Readability with shielding 	Metal: No Paper: No Plastic: No	Metal: No Paper: Yes Plastic: Yes	
Environment resistance	Dirt	No	Yes	
	Injection molding	No	No	Yes
	Robustness	No	No	Yes

Murata micro tag is small, has good readability with 1 by 1, and resistant to harsh environment, in addition to existing RFID feature.

https://www.murata.com/en-global/products/rfid/rfid/overview/single

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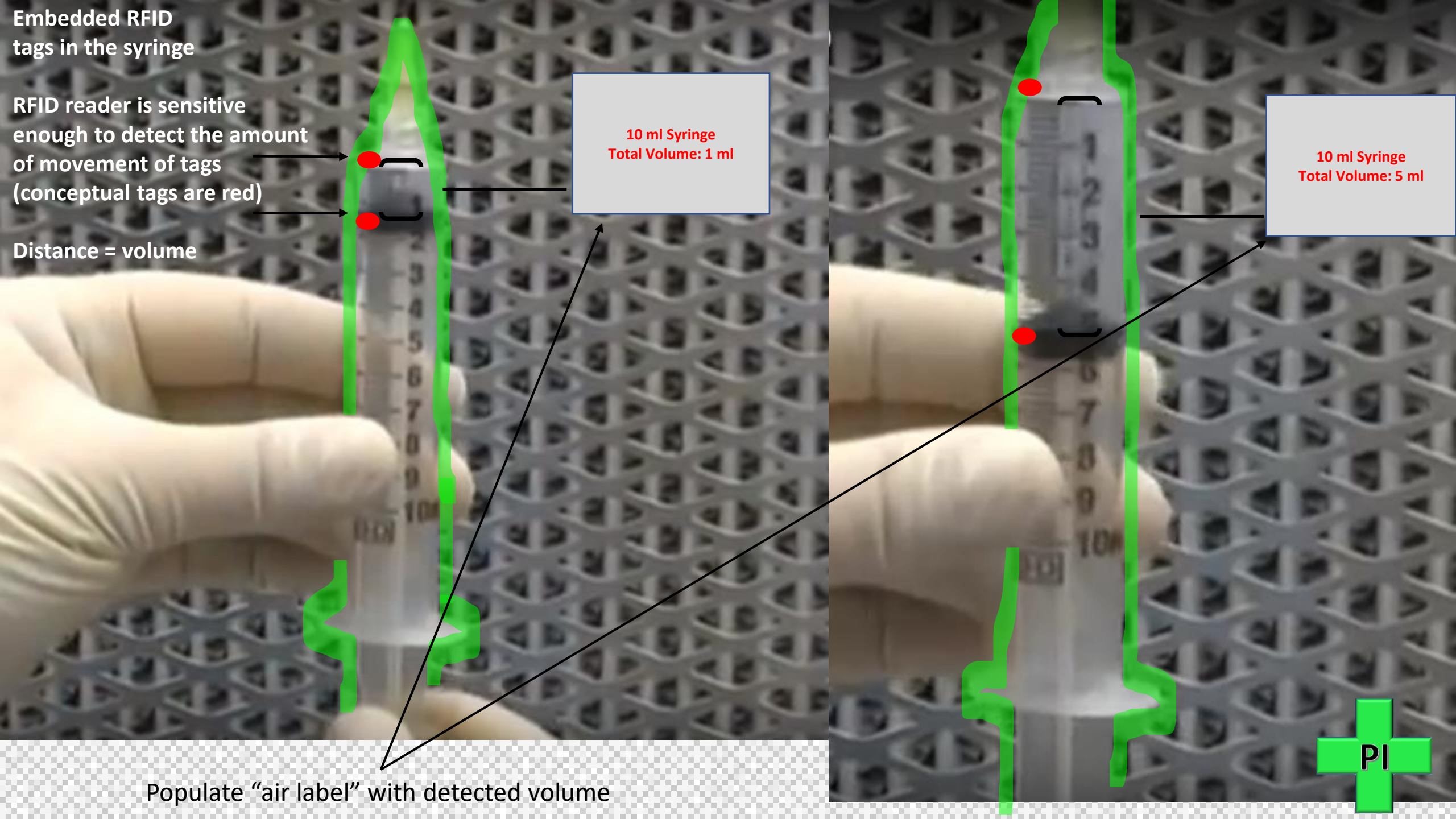
Embedded RFID tags in the syringe
RFID reader is sensitive enough to detect the amount of movement of tags (conceptual tags are red)
Distance = volume
10 ml Syringe
Total Volume: 1 ml
10 ml Syringe
Total Volume: 5 ml
Populate “air label” with detected volume
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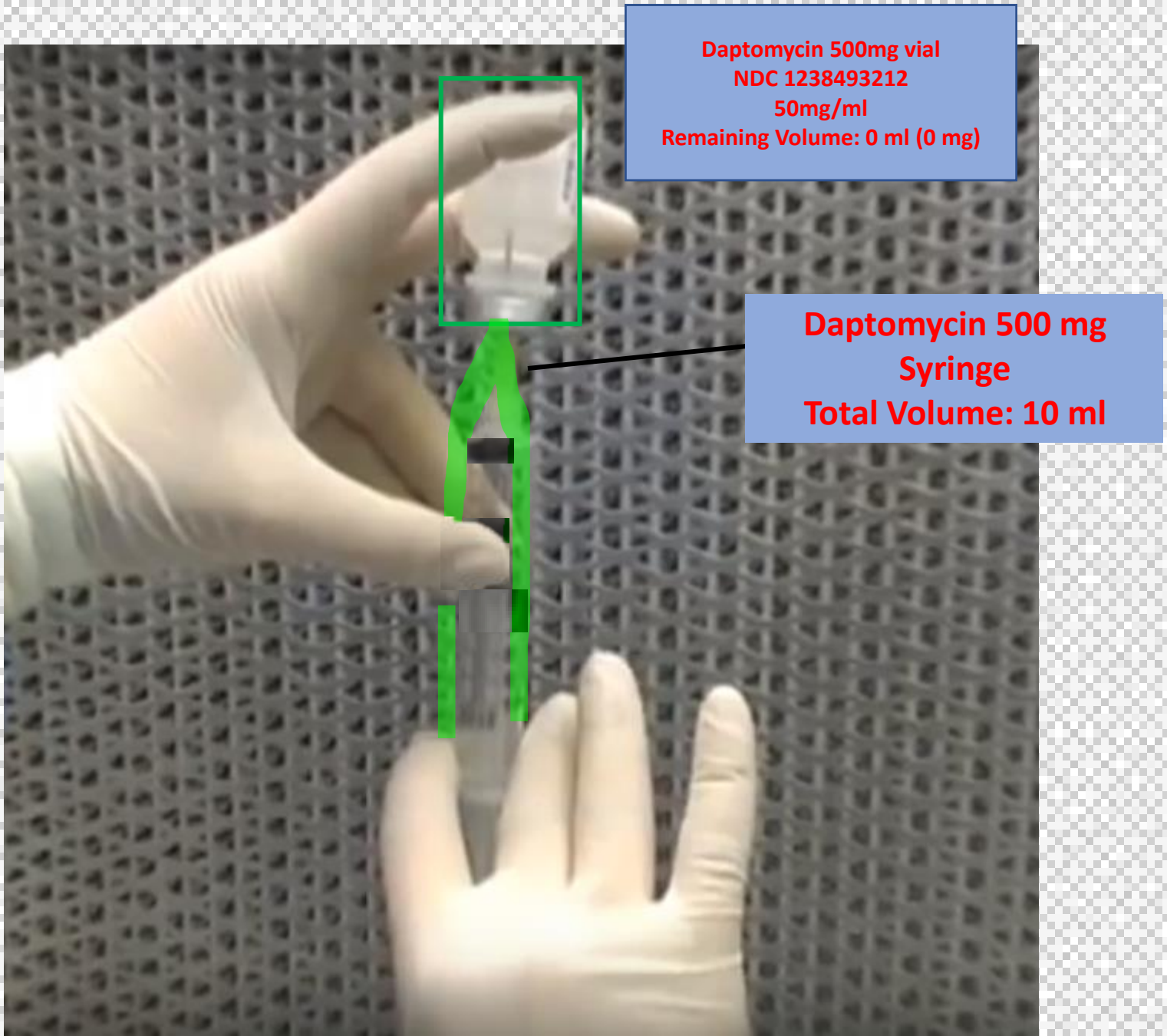
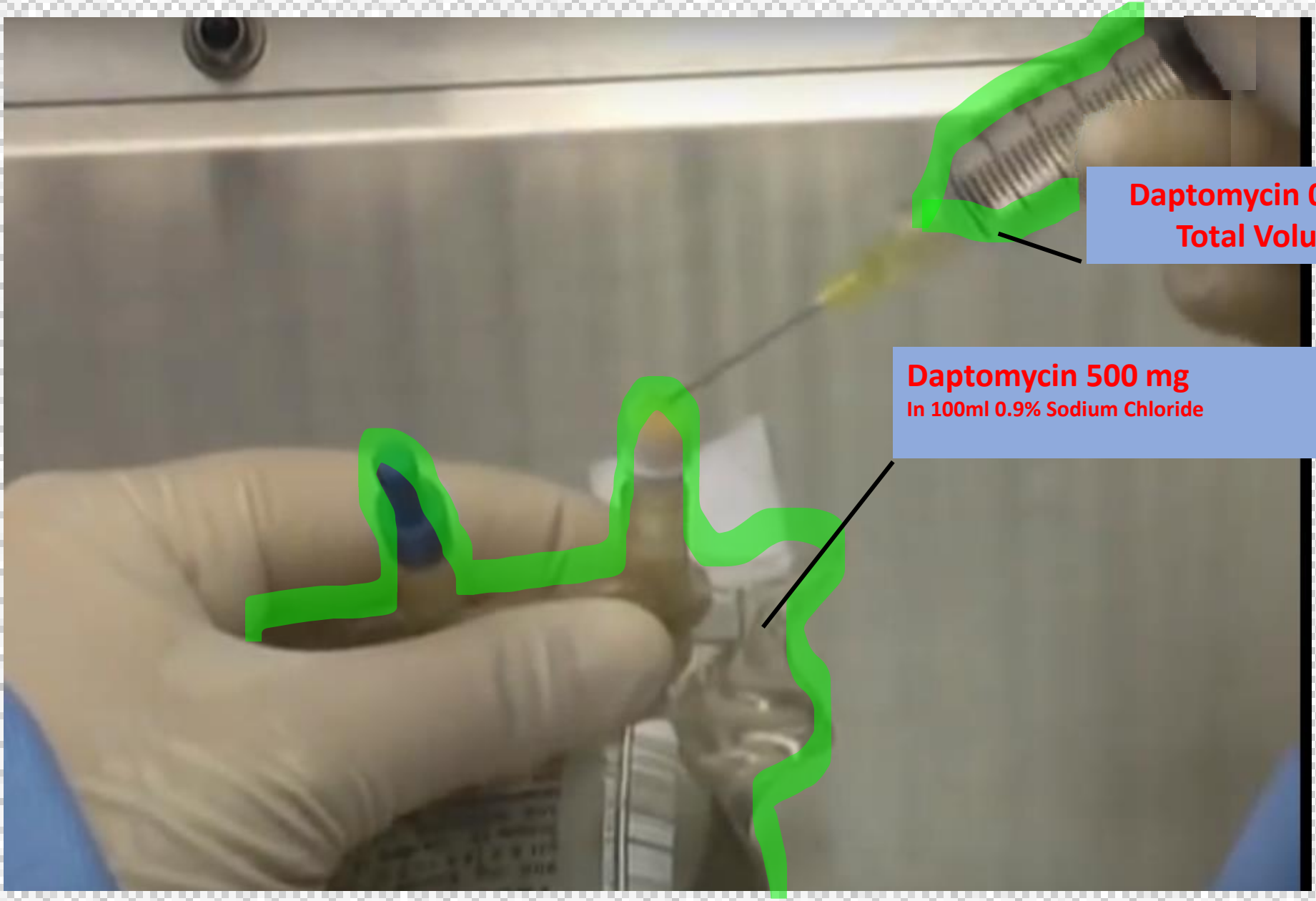
As the syringe draws up drug volume, the vial's volume is going down, and the application tracking these objects updates that information as the prep is being done in real time





Smart enough to track the components that came together

Limitations

- Future of robotics
- Costs
- Interference with medical equipment and the environment (e.g. a metal laminar hood)
- Standardization and interoperability of hardware and software
- Privacy and surveillance
- Investment in the dream

https://www.himss.org/resources/benefits-and-barriers-rfid-technology-healthcare#:~:text=RFID%20readers%20can%20provide%20false,%2C%20glass%2C%20and%20moist%20environments.

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