



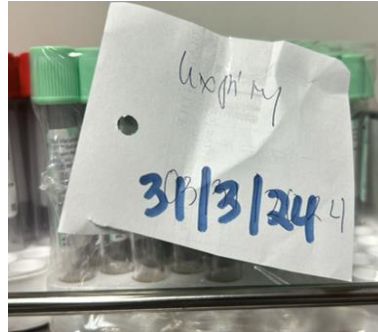
Reduce Clinical Consumable Waste using Inexpensive RFID Tracking **EcoEye RFID**



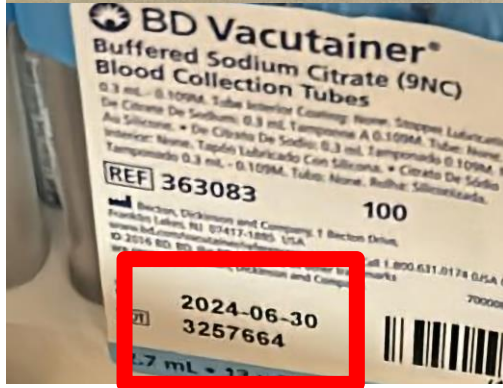


Source: Becton Dickinson

Situation on the Ground



Magnitude of the Problem



>4000 expired tubes in June 2024

Obtained from
44 wards (out of 65)
2 clinics (out of 25)



Carbon Footprint



1

Raw Material Acquisition

Includes PET plastic of the tube and cap, rubber gaskets, and other materials used to process the tube, label, and styrofoam.

2

Manufacturing

Includes the electricity estimated to be used in the manufacturing and assembly of a packet of vacutainer tubes.

3

Distribution

Includes the transportation of tube packets by air from New Jersey, USA (BD HQ) to Tuas, SG then by road transport to Tan Tock Seng Hospital.

4

Use

Includes temperature requirements to store the tubes at 25 degrees C for 30 days.

5

Disposal

Final waste disposal scenario: Incineration of used blood tubes, caps, and styrofoam.



60.69 kg CO₂e / pack of 100 Vacutainer tubes

Equivalent driving from Singapore to KL (430 km) for every pack

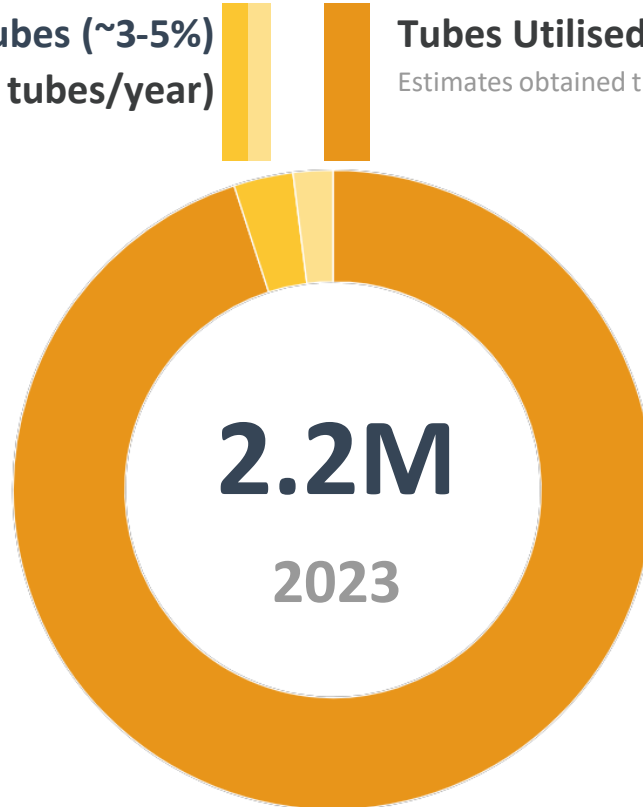


Direct Impact to the Hospital


**Unused Vacutainer tubes (~3-5%)
(60,000-110,000 tubes/year)**

Tubes Utilised (~95%)

Estimates obtained through Laboratory Accession Data




**S\$30,000-50,000
wasted per year**


**67.1 tonnes of CO2e wasted
or the equivalent of
74.2 trees**



First, we need to track tube stock... but how?



RFID



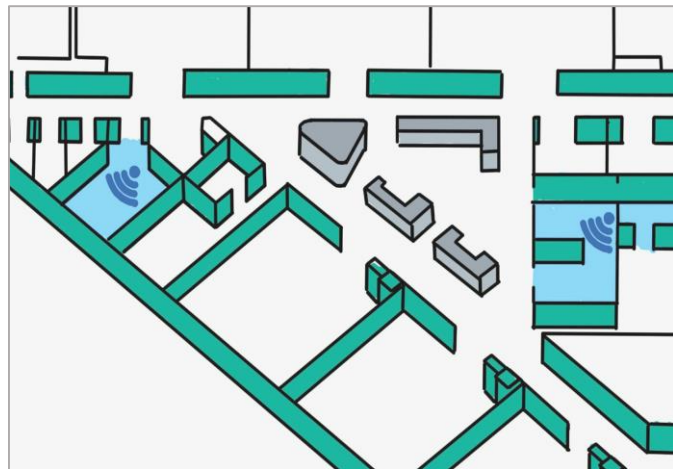
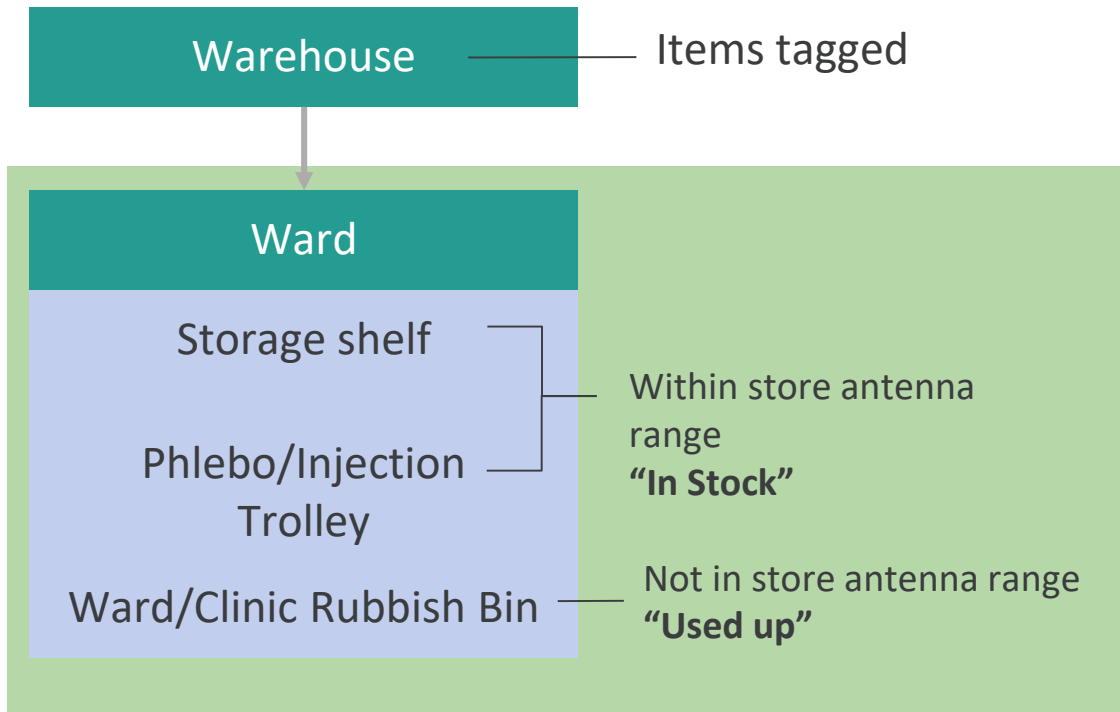
Barcode

Colour-Coded
Stickers

	RFID	Barcode	Colour-Coded Stickers
A Data Capacity	✓	✓	✗
B Durability	✓	✓	✗
C Seamless with Nursing Workflow	✓	✗	✗
D Tracking of Impact and Real-time monitoring	✓	✓	✗



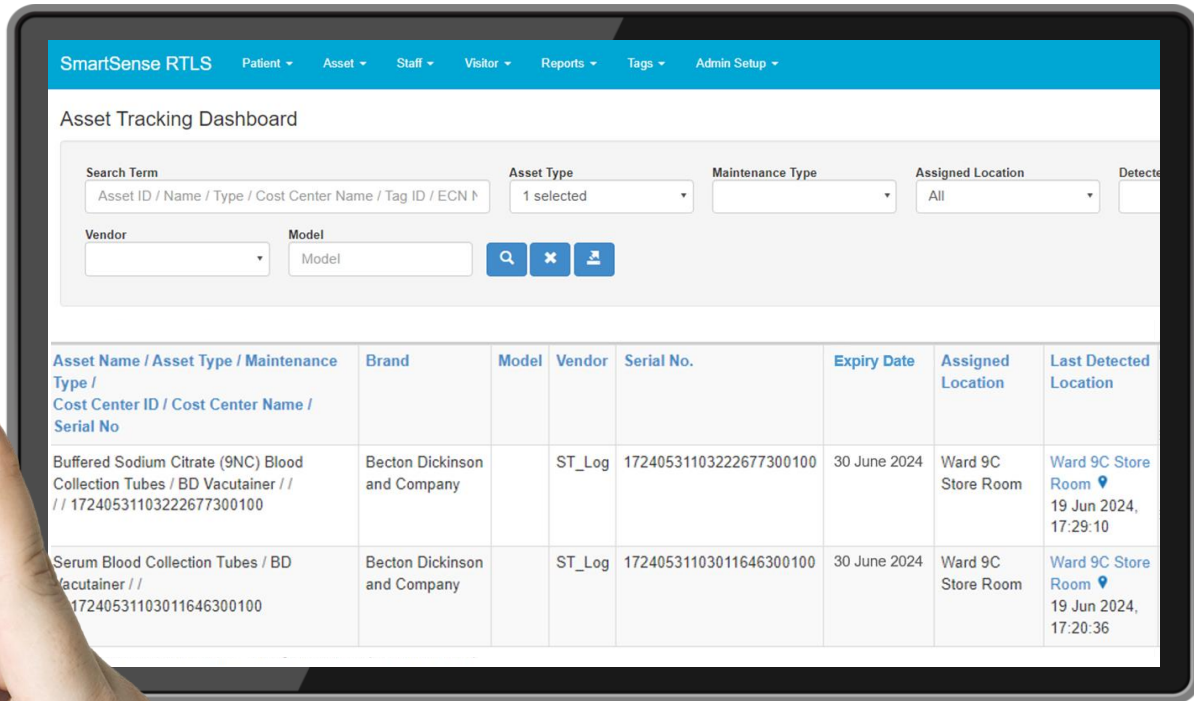
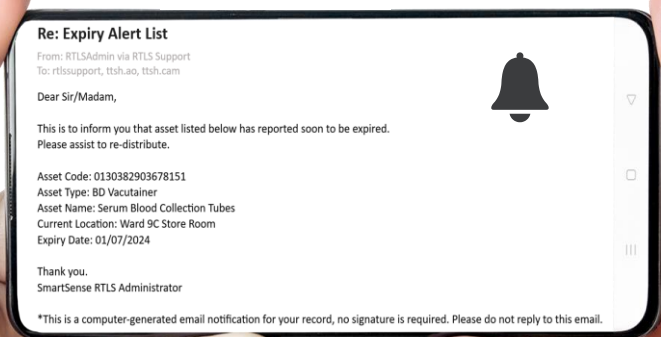
Seamless Solution



Integration with existing TTSH asset dashboard



Nearing **expiration dates**, email alerts will be sent to nursing officer.



Nursing officer will redistribute the tubes to **higher usage areas**.

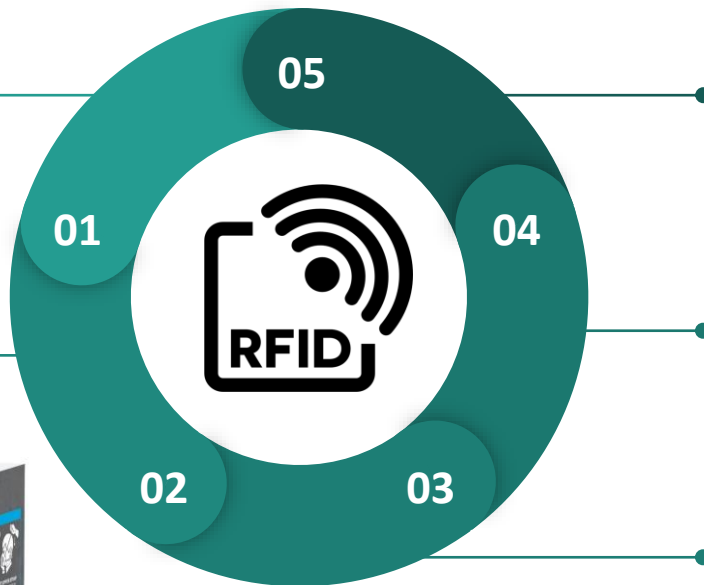
Beyond Tubes, Beyond TTSH

Conduct Inventory Analysis

Look for items with high turnover rate, high stocking consistency, high expiration sensitivity, high criticality, and theft risk.

Pilot Testing

Implement RFID tagging for a small selection of high-priority items (e.g., blood tubes, N95 masks, airway devices). Monitor effectiveness and implementation challenges.



Continuous Improvement

Regularly review and refine the RFID system to ensure it meets the needs and habits of the nurses and inventory stock.

Training and Integration

Train nursing staff on the new RFID system to ensure smooth operation. Integrate system with existing inventory management system in hospital.

Scale-Up

Expand RFID tagging to other shortlisted items and to other healthcare clusters based on the results of the pilot. Ensure system is scalable and within physical limitations of hardware.



Results of our Pilot

Reliable

The pilot encountered minimal errors.

We experienced **100% auto-detection rate** when items are arrived and put into shelf and when item is fully used and components are fully disposed.

- Tested at different wards and store configurations.
- System auto detects item is no longer in store
- Disassociates the RFID tag and updates inventory.

Streamlined

The solution does not disrupt workflow.

Nursing buy-in is obtained, and with the support of **Nursing Officers**, we can introduce a system that targets habits first, and then implement tech to minimise disruptions.

- The main goal is to create a system that works for the nurse's workflow. This requires a combination of instilling habits plus technology to enable changes.
- "First-In, First-Out" + RFID Tagging

Cost-Effective

The solution can save the hospital money.

The wasted tubes have an annual loss of around S\$30-50k. The costs for installing the system is around S\$3-5k per ward/clinic including parts and labour. Potential to **recover significant value**.

- Parts include receiver, antennas, and passive RFID labels.
- Labour includes installation (integration with existing hospital servers) and nursing training sessions.



Summary of our Solution



Logistics

Inventory Oversight
Expiry Date Alert



Benefits

Real Time Inventory
Enhanced Accuracy
Cost Savings



Scalability

Beyond Vacutainer Tube
N95 Masks
Tracheostomy Tubes



Long-term plan

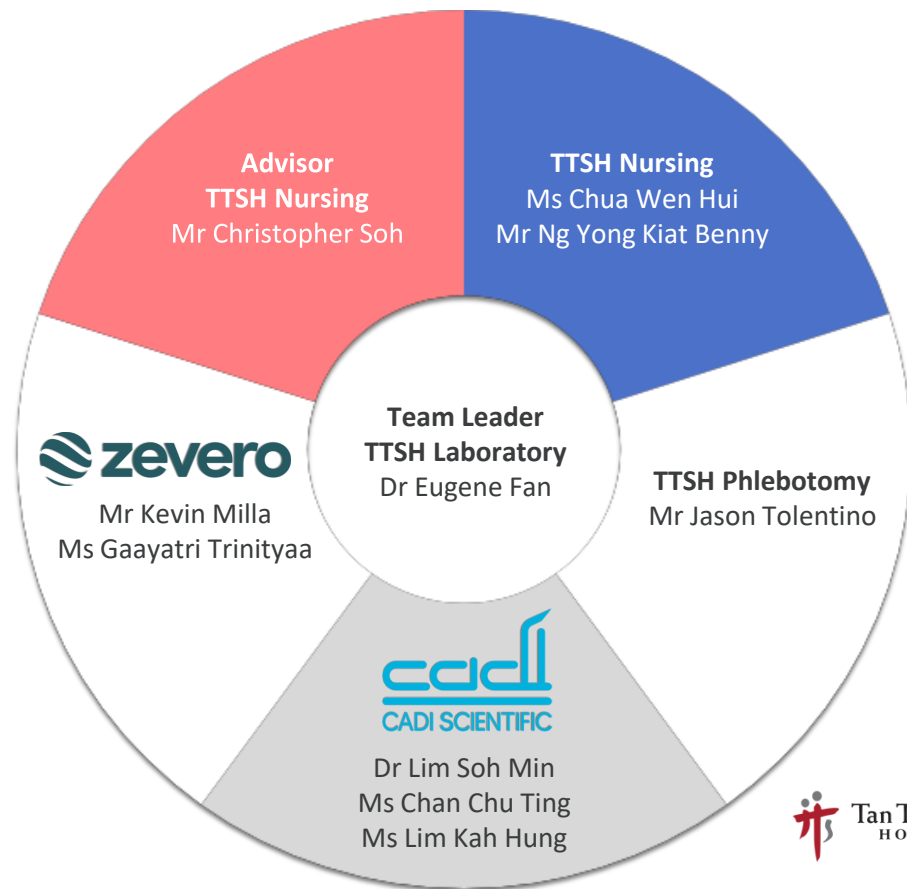
Prevent Wastage
Instill Habits
Engage Vendors
Support Incentives
Reduce Carbon
Footprint



Our Multidisciplinary Team - Q&A



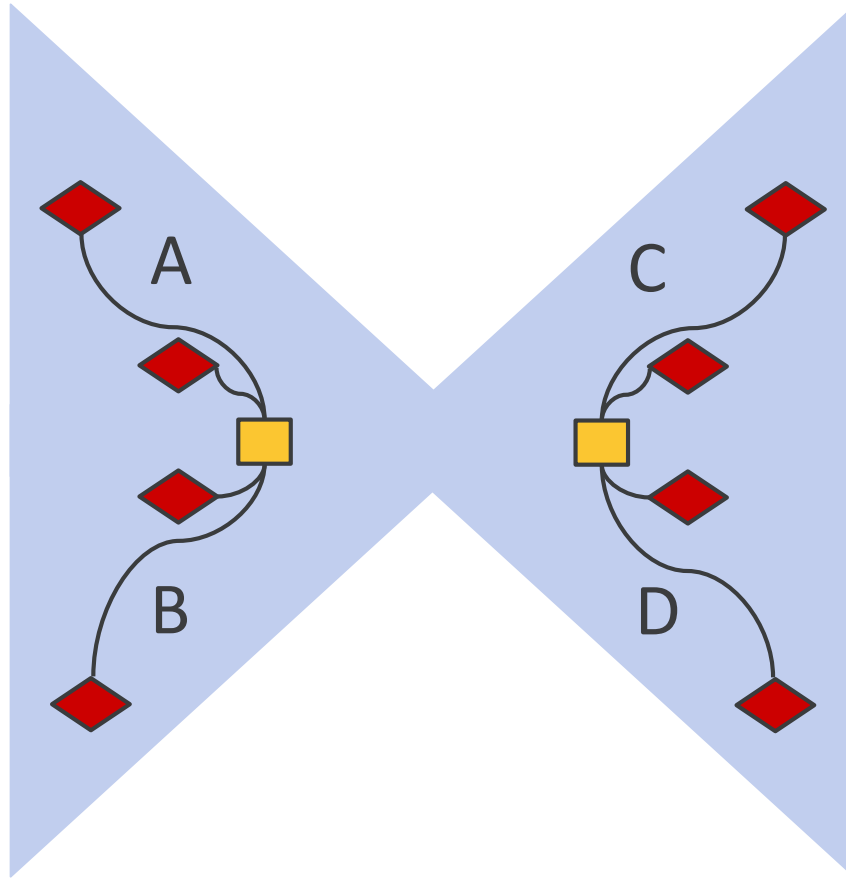
Coaches
A/Prof Ricci Loh
A/Prof Malcolm Low





Thank You 

Supplementary Figures



Schematic



-  RFID Reader
-  RFID Antenna



Impact Measurement

 RFID	 Barcode	Visual Cues
<p>Initial Costs: High</p> <p>Tags: \$0.30 to \$1 each Readers: \$5000 each Software: \$10,000</p> <p>Operational Costs: Moderate Maintenance: \$1,000 annually Reduction in Wastage: 20-40%</p> <p>Efficiency: High</p>	<p>Initial Costs: Moderate</p> <p>Labels: \$1 each Scanners: \$1000 each Software: \$10,000</p> <p>Operational Costs: Low Maintenance: \$1,000 annually Reduction in Wastage: 10-20%</p> <p>Efficiency: Moderate</p>	<p>Initial Costs: Low</p> <p>Labels: \$1 each Training: \$500-\$2,000</p> <p>Operational Costs: High Manual Labor: Ongoing cost Reduction in Wastage: 5-10%</p> <p>Efficiency: Low</p>