Analyzing the Impact of Spare Parts Equipment Proliferation on Health Facilities in Low- and Middle- Income Countries

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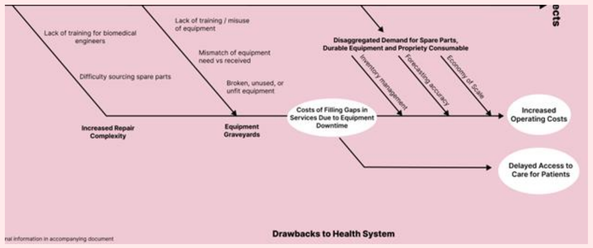
Problem Statement

LMICs lack **equitable access** to life-saving healthcare products, devices, and diagnoses. One resource PATH focuses on is **medical oxygen equipment**. Oftentimes, many LMICs will acquire many makes and models of the same device; this acquisition is also known as **equipment proliferation**.

Why is Proliferation a Problem?

The diagram highlights the **drawbacks** of equipment proliferation. Full diagram with benefits and drivers can be seen using the QR code.



Managing Spare-parts Inventory

Goal: quantify the impact of equipment proliferation on annual **inventory costs** and **forecasting accuracy**.

Major Model Assumptions

- Demand can be adequately captured through historical order quantities
- Device spart parts can be ordered as homogenized kits
- Brands can be consolidated together
- Spart-parts inventory will not roll over between periods for analysis simplification

Devices

POX

POX – Tri-anim Avant 9700

bCPAP

bCPAP – medicalequipmentblog.com

X-ray

X-ray – Philips radiography

PSA

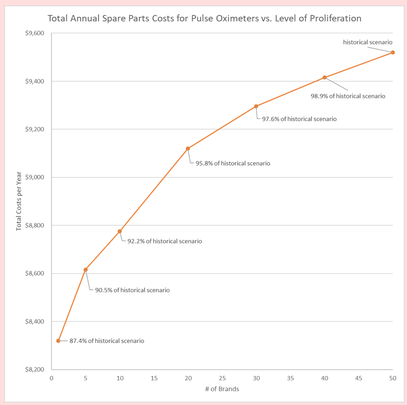
PSA – Trimech India PSA Oxygen Plant

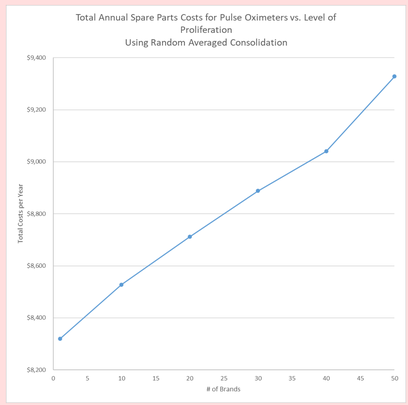
The Cost of Proliferation

Objective: model spare parts purchase and holding costs as the level of proliferation decreases while maintaining a 95% service level.

Device Specific Costs

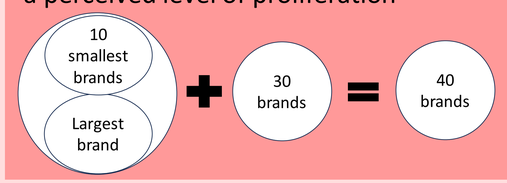
Device	Spare Parts Cost	Holding Cost (%)
POX	$40	10%
bCPAP	$100	10%
X-Ray	$3500	10%
PSA	$2500	10%





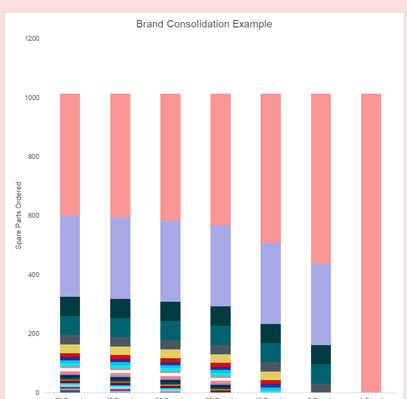
Brand Consolidation

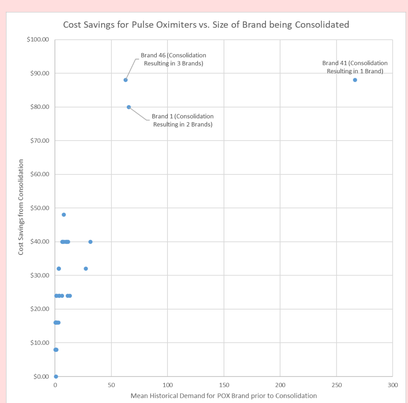
For analysis, the smallest brands were combined into the largest brand to create a perceived level of proliferation



Insights from Other Consolidation Orders

- When consolidated, larger brands will show increased savings
- Brands with higher variance in their demand will also see increased savings when consolidated





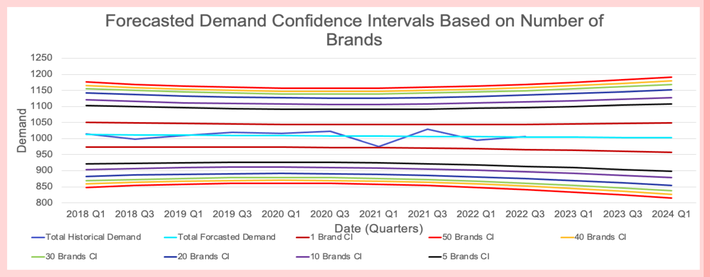
Demand forecasting

Goal: find impact of different proliferation levels on a forecasting accuracy metric.

Method:

Linear regression on each brand ➡ Confidence interval on demand

Metric: aggregate confidence intervals after consolidation, examine CI size



Result:

Lower levels of proliferation consistently improve forecasting accuracy

Maximum improvement in accuracy occurs at different levels of proliferation across devices

Impact and Recommendations

Brand consolidation results in **greater cost savings + forecasting accuracy**, ultimately improving **patient care** and **access** to medical oxygen equipment.

Long term goal: find a sweet spot of equipment proliferation

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Future work: spare parts inventory management through network facilities

thank you to patty, michelle, elizabeth, priya, and alex :)