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Optimising Digital Chest X-Ray for TB Screening: Evidence to Inform a Practical Implementation Toolkit

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Background

The World Health Organization recommends digital chest X-ray (dCXR) for TB screening.

South Africa's first National Tuberculosis Prevalence Survey found that out of 234 people found to have TB, 58% had abnormal chest X-rays without experiencing any TB symptoms.

Rationale

- The NDoH and its partners aim to **optimise the use of dCXR+AI** as a screening tool in **high-TB burden communities** through partnership with implementing agencies in SA
- Use dCXR+AI technology for community-based TB screening to **optimise and improve TB case-finding**
- Screening and testing **groups that are less likely to present to clinics** and **at high risk of TB**
- **Reduce the burden on clients to return for a TB test result** when a TB test is not required
- **Rapidly screen large populations** with high-quality images and deliver a lower radiation dose and reduced costs **compared to traditional X-rays**

Objectives

1. Evaluate the current practices and workflow of dCXR for TB screening in various settings

2. Provide recommendations and an implementation plan to optimize dCXR process and increase throughput

Methods

Study Design: Time-motion study.

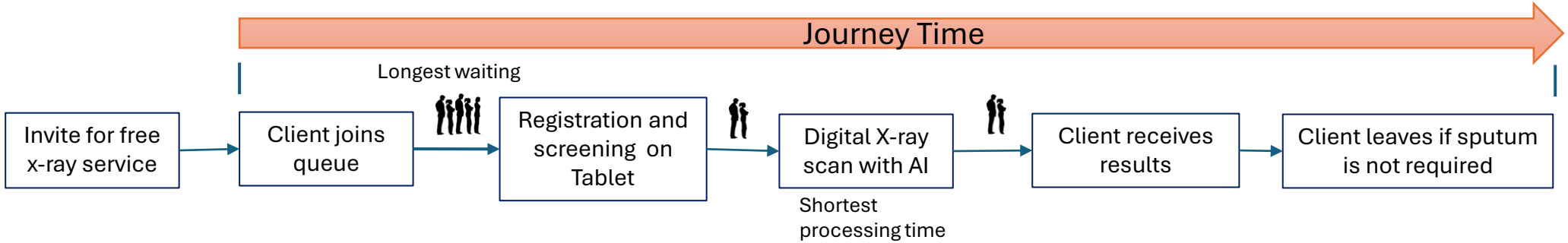
Setting: 8 sites across 5 provinces (Sept–Oct 2024).

Sites differed by throughput (high/low) and mode of operation (fixed/mobile).

Data sources: staff engagement, observation, and record review.

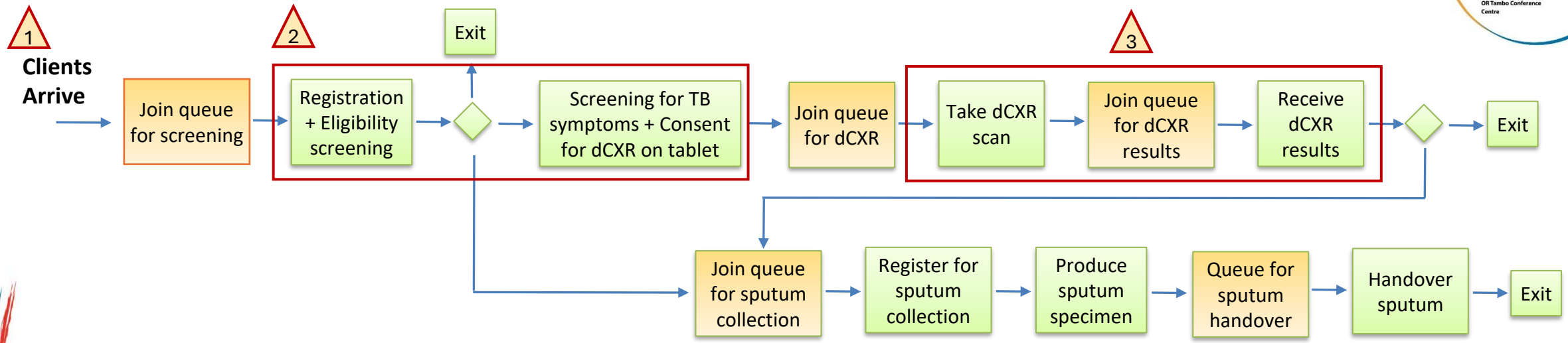
Metrics: process times, client numbers, queue lengths, and total journey time (arrival to departure).

Results



- Journey time: 7–45 minutes (varied by team size & setup)
- Longest wait: Registration (37 min) due to dual paper + digital data capture
- Shortest step: dCXR image capture (1–2 min)
- Better performance: Teams with community engagement staff processed and recruited more clients

Process + Bottleneck Points



1

- Slow arrival rate of clients can be a problem if the location to be used is not studied in advance to ensure the day of the week and times that are selected have enough prospective clients

2

- Registering and screening one client on the tablet takes longer time than taking a dCXR scan for the same client. If there is a long queue of clients and only one tablet used, clients will wait longer at this point and the Radiographer will wait for clients in between their registration and screening. To balance flow especially when there are many clients there should be 2 people actively registering and screening clients on the tablets

3

- If the Radiographer takes a scan and waits for the results with the client inside this will increase the total time per client and increase the waiting time for other clients. It is better to take a scan and then ask the client to wait outside and then call in the next client to take a scan.
    - This process requires a balance between taking scans and then giving feedback. Avoid taking more many scans before giving results. Take 1-2 scans to avoid build-up of queue for results
    - Avoid opening and closing the outside door except in extreme weather cases. This will save a few seconds per client which add up for a busy site

Recommendations

Team structure: 2 for registration, 1 sputum collector, 1 radiographer

Data capture: Simplify tools; eliminate paper forms

Connectivity: Use intranet/offline data sync solutions

Community engagement: Strengthen mobilisation and hotspot mapping

Queue management: Use simple digital/physical systems

Conclusion

dCXR throughput is hindered by inefficient data capture and variable team support.

Tablet Registration = primary bottleneck (starting point for improvement).

Demand management is as critical as technical capacity.

Standardisation of processes, digital integration, and clear roles increase throughput.

Target: consistent 100–150 screenings/day achievable with minimal investment (depending on travel time, season and location)

Integrated or collaborative planning with the District TB/PHC ecosystem is vital for the dCXR team

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