



Economic Evaluation of the Use of Drones for Tuberculosis Care in Remote Madagascar.

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Authors: L. Bahrainwala¹, E. Fair¹, J. McKinney², S. Grandjean Lapierre², A. Knoblauch², M. Mustafa¹, N. Rakotosamimanana³, B. Andriamihaja³, P. small²; ¹San Francisco/US, ²Stony Brook/US, ³Antananarivo/MG

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Background

1. Madagascar has a significant tuberculosis (TB) burden with >29,000 cases identified in 2016.
2. "Drone Observed Therapy System" (DrOTS) was launched in remote Madagascar in 2017 with the goal of improving case finding, diagnosis, adherence and outcomes for drug susceptible active pulmonary TB with a package of 3 innovative technologies.
 - Drones
 - GeneXpert
 - EvriMed : Electronic adherence pill reminders
3. We compared the cost-effectiveness of standard of care Directly Observed Therapy Shortcourse (DOTS) vs DrOTS.
4. We aimed to present data on the critical thresholds of TB prevalence, case finding and adherence at which DrOTS becomes cost-effective in this context.

Fig. 1: Standard of care for TB diagnosis and treatment initiation in Ifanadiana district
References: Global Health Sciences, University of California, San Francisco - San Francisco/US

Fig. 2: DrOTS Regimen

References: Global Health Institute, Stony Brook University- NY/USA

Methods

1. A decision tree with arms as DOTS vs DrOTS was built to calculate the Incremental Cost Effectiveness Ratio (ICER) of DrOTS compared to current standard of care DOTS.
2. Mixed top-down and bottom-up approaches were used to identify the costs associated with both, using empirical literature, cost estimates, and observed data from the field.
3. Disability Adjusted Life Years (DALYs) associated with the health outcomes were calculated for each arm.
4. Using a threshold value of three times the GDP per capita of Madagascar, sensitivity analyses were conducted around key inputs to identify thresholds at which DrOTS becomes cost effective.

Fig. 3: Part of decision tree showing DrOTS Arm of Cost effective analysis.
References: Global Health Sciences, University of California, San Francisco
 - San Francisco/US

Key Variable	Definition	Source
Treatment Success	Number of diagnosed TB cases who complete treatment out of all the cases who are initiated on treatment, in a year. This definition does not include the condition in which the patient is cured i.e. there is laboratory confirmation that the patient has cleared the bacilli from the sputum. ⁶²	National Tuberculosis Program record books at urban center
Smear-positive	Microscopic confirmation that the TB bacilli is present in	International Standards of TB care 2014.

the sputum.
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Failure

Failure of treatment is noted when patient's smear or culture returns positive for the bacillus anytime at or after the 5th month of treatment. If a MDR strain is found prior to 5 months (or after) it still counts as treatment failure, even if patient is smear-negative.⁶³

National Tuberculosis Program record books at urban center

Adherence rate

Taking their medications as instructed.

NTP, Adherence monitor reports, Published literature.

Findings

1. DrOTS was nearly double the cost of DOTS (\$307.00 vs \$183.32 per patient).
2. Its greater impact resulted in it being more cost-effective (**ICER of DrOTS vs DOTS was \$1015.27/DALY averted**).

	Net Costs	#Cost	DALYs	#DALYs (averted)	ICER
DOTS	\$10.79	n/a	0.09	n/a	n/a
DrOTS	\$57.23	\$46.43	0.05	0.04	\$1015.27

3. For DrOTS to be cost-effective at a threshold willingness to pay of \$1294.00 (three times the GDP per capita) requires a

- TB prevalence of 780/100,000,
- an active case finding rate of 66%
- an adherence rate of 77%

in remote Madagascar.

Interpretation

1. DrOTS could be cost-effective compared to DOTS for treatment of drug susceptible active pulmonary TB at less than three times the GDP per capita, as per WHO standards.
2. Based on the data, the threshold values are minimum values to meet in order to ensure cost-effectiveness of the intervention, leading to focusing efforts on increasing case finding and adherence rates.
3. Further studies are necessary to validate these results, generalize them to other settings, and assess the impact of future advances in drone technology.
4. By addressing the contextual factors hampering TB care, **creating access via drones, increasing diagnostic efficiency via GeneXpert and increasing adherence using adherence monitoring technologies**, we found the cost-effectiveness of DrOTS is an advantage that could be put to good use in global health.
5. As prices for drones and other technologies continue to drop, as they become more efficient, this is likely to make DrOTS or similar approaches even more cost effective in the near future.

Fig. 4: Tornado Diagram-Sensitivity analysis of change of multiple variables on the ICER of \$1015/DALY averted.

References: Global Health Sciences, University of California, San Francisco - San Francisco/US

[Drones Deliver Healthcare in Rural Madagascar](#)

References

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Short Bio (max. 150 words or less)

In partnership with Madagascar's National Tuberculosis Control Program, the Institut Pasteur Madagascar and Stony Brook University's Valbio Research Center, the DrOTS project was launched in August 2017 in the Ifanadiana District of Madagascar. With support from the Stop TB Partnership and government of Canada through a TB REACH wave 5 grant, this project integrates innovative technologies in the fight against the global tuberculosis epidemic.

Contact information- lulua.z@gmail.com, (443)-636-0989