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SEXUAL HEALTH

Cost-effectiveness of an opt-out emergency department screening program for syphilis in North Queensland's Aboriginal and Torres Strait Islander population

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ABSTRACT

Background. This study aimed to evaluate the cost-effectiveness of an emergency department (ED) syphilis screening program for the Aboriginal and Torres Strait Islander population (aged 15–40 years) presenting to a regional Australian ED, compared with no screening program. **Methods.** A decision tree model was developed using clinical data from a previous audit and outcome probabilities from the literature. We included direct financial costs from a healthcare provider perspective and outcomes measured in quality-adjusted life years (QALYs) gained, over a 40-year time horizon. Costs were derived from the Medicare Benefits Schedule, Pharmaceutical Benefits Scheme, and hospital costs classified according to the Australian refined diagnosis-related groups. Both costs and outcomes were discounted by 5% per year. An incremental cost-effectiveness ratio was estimated and subjected to sensitivity analyses. **Results.** With a background syphilis prevalence of 0.68%, screening Aboriginal and Torres Strait Islander peoples, aged 15–40 years, presenting to a regional ED compared with no screening was A$134,802 per QALY gained. The program becomes cost-effective (using a willingness-to-pay threshold of A$50,000) at a syphilis prevalence of 1.55%. The incremental cost-effectiveness ratio was most sensitive to probabilities of syphilis progression, syphilis prevalence and specificity of the initial screening test. **Conclusion.** The ED syphilis screening program for Aboriginal and Torres Strait Islander peoples was not cost-effective with the current background rate of syphilis. However, similar screening programs in settings with a higher burden of syphilis may be cost-effective, and further refining the target population based on additional risk factors could help reduce costs.

Keywords: Australian Aboriginal and Torres Strait Islander peoples, cost-effectiveness analysis, emergency service, mass screening, quality improvement, sexual health, sexually transmitted infections, syphilis.

Introduction

Syphilis infection, caused by the bacteria *Treponema pallidum*, remains a significant public health concern, with ongoing outbreaks in regional and rural areas of Queensland, the Northern Territory, Western Australia, and South Australia.[1,2] Some 6000 cases were reported in 2023, more than triple the recorded rate 10 years ago.[1] Despite being curable, syphilis often remains asymptomatic, potentially leading to severe morbidity and mortality if undetected. Serious sequelae include late benign or gummatous syphilis (infiltration of any organ and its subsequent destruction), cardiovascular syphilis (aortic aneurysm, aortic valvulopathy), meningovascular syphilis (meningitis, stroke), tabes dorsalis (spinal cord degeneration), and general paresis (paralytic dementia).[3]

Aboriginal and Torres Strait Islander peoples are disproportionately represented in Australia's national notifiable diseases surveillance system, particularly in regional and remote communities, with overall rates of syphilis seven times that of non-Indigenous people.[1,2] Aboriginal and Torres Strait Islander peoples are the Indigenous population of Australia.

There is a need for innovative syphilis screening approaches in healthcare settings frequented by at-risk communities.[4] Aboriginal and Torres Strait Islander peoples face significant barriers in accessing primary care, including geographic isolation and culturally unsafe services.[5,6] The emergency department (ED) represents a critical point of contact for opportunistic screening among populations who may otherwise under-utilise primary health care and are at high risk for syphilis.[7]

Previous studies from the United States which have used routine opt-out screening programs have revealed high rates of undiagnosed syphilis, enabling earlier treatment, linkage to further care and prevention of transmission and long-term complications.[8–13] Screening strategies in EDs for other sexually transmitted infections (STIs), including chlamydia, gonorrhoea, and human immunodeficiency virus (HIV) have undergone cost-effectiveness analysis in international settings.[14–18] However, no prior research has assessed the cost-effectiveness of syphilis screening programs in the ED. Existing economic analyses of syphilis screening have largely focused on the pregnant population.[19] Conducting economic evaluations is crucial to identify optimal strategies, guide program development, and assess the need for continued operation. This study aimed to evaluate the cost-effectiveness of an ED syphilis screening program for the Aboriginal and Torres Strait Islander population presenting to a regional ED, compared with no screening, from a healthcare provider perspective.

Materials and methods

ED screening program

This analysis is based on the ongoing ED screening program in Townsville University Hospital (TUH), regional Queensland, which targets Aboriginal and Torres Strait Islander peoples identifying clients aged 15–40 years. For patients who received a blood test as part of routine care and did not opt out of the screening program, syphilis testing was automatically processed using the reverse sequence algorithm.[20] The results informed the design of this economic evaluation.[7] The screening program was granted exemption from full ethics review as it met criteria of a quality improvement activity by Townsville Hospital and Health Service Human Research Ethics Committee (reference number: HREC/17/QTHS/227 and EX/2022/QTHS/90148). It had ongoing support from the Aboriginal and Torres Strait Islander Health Leadership Advisory Council.

Decision tree model structure

The cost-effectiveness of screening all Aboriginal and Torres Strait Islander peoples aged 15–40 years presenting to ED was compared with no screening. A decision tree model was built using TreeAge Pro ver. 2024[21] (see Supplementary material; Fig. S1–S4) incorporating potential outcomes associated with various health events in detected or undetected syphilis.

Appropriate probabilities of transition from one health state to another and appropriate costs associated with these health states were applied in the model. A 40-year analytic horizon was chosen as severe syphilis complications present late in the disease course.[22] Assuming the average age of acquisition is 31 years,[22] this timeframe will have the model end at 71 years old, near the average life expectancy of Aboriginal and Torres Strait Islander peoples of 73.75 years.[23]

Input parameters

Event probabilities

The prevalence of syphilis in Aboriginal and Torres Strait Islander peoples and resulting probability of adequate treatment were calculated directly from the results of the TUH ED screening program (Table 1). Screening of 3942 individuals identified 27 people with syphilis infections requiring treatment – a prevalence of 0.68%. Given syphilis prevalence in this cohort is rising and may vary in different settings and sub-communities, sensitivity analyses were conducted to assess the impact of prevalence with estimates ranging from 0.1 to 3%.

Since the primary outcome of the screening program was the number of people with new cases of syphilis detected in the cohort, the first positive or negative (in those who remained negative) test was included in the cost-effective analysis. The probability of re-screening was excluded due to insufficient data for a reliable assumption.

Base-case values and ranges for transition probabilities in the comparator of no screening were adapted from a 2019 decision model by Chesson and Peterman,[22] which updated the original model by Schmid[30] (Table 1). This model assumes onset of late syphilis complications, and thus onset of costs, at 30 years after initial syphilis acquisition. The model does not include congenital syphilis.

Costs

Financial costs (in Australian dollars; 2024 currency conversion rate) were evaluated from a healthcare provider's perspective. Expenses attributable to the screening program encompassed testing, treatment, and follow-up activities conducted by the Sexual Health Service, including the time required to review patient notes, contact the syphilis register, treat patients, and engage in preliminary contact tracing discussions with the patient.

In accordance with Australian Therapeutic Guidelines, syphilis was treated with benzathine penicillin G (BPG) 2.4 million units intramuscularly as one dose for early syphilis and three weekly doses for late latent or syphilis of unknown duration.[31] The cure rate with BPG was assumed to be 100% in the decision tree model.[32,33] We assumed the adverse effects of treatment are not serious so incurred no extra costs.[32,33] For those with penicillin allergy, guidelines

Table 1. Base-case values and ranges used in sensitivity analysis.

Parameter	Variable name	Base-case value	Range	Reference
ED screening program				
Syphilis prevalence	Prevalence	0.00685[A]	0.001–0.030	7,24,25
Sensitivity of enzyme immunoassay (EIA)	Sensitivity	0.990[B]	0.820–1	26
Specificity of EIA	Specificity	0.946[B]	0.670–1	7
Probability of false positive test being old and adequately treated infection	pPastPos	0.966	0.676–1	7
Probability of true positive treated as early syphilis	pEarlyTreated	0.778	0.545–0.815[C]	7
Probability of true positive treated as late or unknown duration syphilis	pLateTreated	0.185	0.130–0.222[C]	7
Probability of early symptomatic neurosyphilis or ocular syphilis, among those with detected syphilis through the screening program	pNeuroOcular	0	0–0.078	7,22
No ED screening program				
Probability that infection is detected (symptomatic prompting presentation to a doctor or through contact tracing and other avenues)	pSyphDetected	0.800[D]	0.500–0.950	22
Probability of condition being early syphilis	pEarlySyph	0.815[E]	0.570–1	7,27
Probability of early symptomatic neurosyphilis or ocular syphilis, among those with detected syphilis	pNeuroOcular2	0.032	0–0.078	22
Probability of remaining alive and still infected 30 years after acquisition, among those with undetected syphilis	pRemainsInfected	0.897[F]	0.033–1	22,28 Assumption
Probability of latent syphilis in those still infected after 30 years	pRemainsLateSyph	0.680	0.480–0.880	22
Probability of late benign syphilis in those still infected after 30 years	pLateBenignSyph	0.160[G]	NA	22
Probability of cardiovascular syphilis in those still infected after 30 years	pCardioSyph	0.090[G]	NA	22
Probability of surgery among patients treated for cardiovascular syphilis	pCardioSurg	0.500	0.250–0.750	22
Probability of meningovascular syphilis in those still infected after 30 years	pMeningovascSyph	0.030[G]	NA	22
Probability of stroke among patients treated for meningovascular syphilis	pStroke	0.750	0.500–1	22
Probability that stroke patients require long-term care	pLongCare	0.170	0.070–0.390	22
Probability of tabes dorsalis in those still infected after 30 years	pTabesDorsalis	0.020[G]	NA	22
Probability of general paresis in those still infected after 30 years	pGeneralParesis	0.020[G]	NA	22
Probability of death attributable to syphilis among those with severe complications (cardiovascular, meningovascular, tabes dorsalis or general paresis)	pDeath	0.730	0.510–0.870	22

[A]This prevalence is calculated from the program data (27 people requiring treatment/3940 people tested). It is the prevalence of syphilis in the cohort of 15–40-year-old Aboriginal and Torres Strait Islander peoples presenting to a regional ED. In 2023, the prevalence of syphilis in Aboriginal and Torres Strait Islander peoples was 0.158% nationally.[24] Higher rates were reported among Aboriginal and Torres Strait Islander peoples aged 25–34 years (0.223%) and those in remote and very remote areas (0.292%).[25] A wide range was chosen to reflect this published data, with the highest prevalence of 3% chosen to determine when the program may become cost-saving.

[B]Specificity was calculated using program data as the number of false positives was known through further testing, equalling 94% (range ±30%). Sensitivity was sourced from the literature as 99% (range 82–100%) as the number of false negatives through the screening program is not known.[26]

[C]The maximum value was reduced so the node probability would not equal more than one. These variables were excluded from Monte Carlo analysis due to the probability exceeding 1 when the highest values of the ranges were used.

[D]The probability of 80% infections being diagnosed and reported as a syphilis case is an assumption originally from a 1999 incidence study.[29] Given lack of supporting data, a large range of plausible values is applied in sensitivity analysis, as in Chesson and Peterman.[22]

[E]This probability is calculated from the program data (22 early syphilis diagnoses/27 total diagnoses). In 2023, Australian surveillance data reported 6511 early syphilis and 2821 late latent/unknown duration syphilis diagnoses nationally for Aboriginal and Torres Strait Islander peoples and non-Indigenous people. This responds to a 0.6977 probability that a positive condition is early syphilis, which is lower than found in the screening program, but within the applied range of ±30%.[27]

[F]Since patients in Australia would be unlikely to receive the correct treatment unless diagnosed with syphilis, the scenario of inadvertent treatment was excluded from the decision model.[28]

[G]For sensitivity analysis, the base-case probability of syphilis remaining latent was varied within the given range. Consequently, the base-case probabilities for the other late complications of syphilis were also adjusted via a formula. The resulting distribution of probability of the complications was aligned with the base-case values, ensuring that the total node probability remained equal to 1.

recommend twice daily 100 mg doxycycline for 14 days.[31] This was not included in the model for simplicity. Since patients in Australia would be unlikely to receive the correct treatment unless diagnosed with syphilis, the scenario of inadvertent treatment was excluded from the decision tree model.[28]

As the testing facility (ED) and clinicians, and laboratory facilities were in place prior to implementation of the

screening program, costs for these individuals and entities were excluded from the analysis. Cost of supplies (blood tubes, collection kits) were also excluded since blood tests were already indicated as a part of the patient's regular care and no extra blood tubes were required to be taken. Contact tracing costs and associated positive cases were excluded due to missing data from COVID-19 impacts and management of patients by other health services rendering data inaccessible. Indirect costs, such as those associated with the patient time and travel costs for seeking treatment, were also excluded.

Chesson and Peterman[22] provided details on the type and quantity of resources required to manage syphilis and its complications, which served as the basis for determining unit costs using newly sourced costs in Australian dollars. Adjustments were made to better align with the Australian healthcare system, including a revised referral process for specialist appointments and the use of Australian refined diagnosis-related groups (DRGs) to determine the cost of inpatient stays in a Queensland public hospital.[34–36] Other unit costs were obtained from multiple sources including the Medicare Benefits Schedule,[37] Pharmaceutical Benefits Scheme,[38] consultation with sexual health clinicians, and existing literature. The DRG codes were verified with clinical coders at TUH.

All costs were discounted at an annual rate of 5% per year if incurred beyond one year in the base-case.[39] The unit costs and ranges used in sensitivity analysis are in Table S1, while the estimated total unit costs corresponding to the various outcomes are in Table S2.

Outcomes

Quality-adjusted life years (QALYs) gained through screening were estimated by applying utility (health-related) weights of the various health states as sourced from existing literature.[40,41] QALYs were also discounted by 5% per year.[39] These are detailed in Tables S3–S4. The overall outcome was the incremental cost-effectiveness ratio (ICER; measured as A$ per QALY gained and A$ per case detected and treated) calculated for the ED screening program compared to no screening program.

Sensitivity analysis

To assess the impact of the uncertainties associated with the model parameters, deterministic and probabilistic sensitivity analyses were performed for all uncertain parameters to test the robustness of the outcomes of the analysis. The following variables were varied over plausible ranges to explore the impact of different parameter values on the results: prevalence of syphilis, costs of medical care, probability of syphilis detection outside of the ED screening program, number of years syphilis remains asymptomatic before causing late complications, probabilities and duration of symptoms of these complications, and utility weights.

In the probabilistic sensitivity analysis, second-order Monte Carlo simulations were performed using β distributions for probabilities and gamma distributions for costs, varying the range of each parameter by 30% if no 95% confidence intervals were identified. The analysis included 5000 simulations.

Results

Base-case analysis

The total discounted cost of screening for syphilis in the Aboriginal and Torres Strait Islander population aged 15–40 years (n = 3942) presenting to a regional ED was $142,328. The undiscounted total cost was $144,103. The discounted cost of the program was $5474 per case detected and treated with one client lost to follow-up. If all detected cases were treated, the cost of the program would be $5250 per case detected and treated. The cost of the program per person tested was $36.

Based on the widely referenced standard of $50,000 per QALY threshold being indicative of acceptable cost-effectiveness in Australia, the ED screening program was not cost-effective in the discounted base-case analysis compared with no screening with an ICER of $134,802 per QALY gained. The ICER per case detected and treated was $28,913, considering a syphilis prevalence of 0.68%. In comparison, the undiscounted cost analysis revealed an ICER of $16,521 per QALY gained, and $19,846 per case detected and treated.

Deterministic sensitivity analysis

Table 2 summarises the costs, effects, and ICERs comparing the ED screening program versus no screening, based on prevalence rates ranging from 0.1 to 3%. The effects are presented as QALYs gained and the number of syphilis cases detected and treated per 1000 Aboriginal and Torres Strait Islander peoples.

Threshold analysis indicated that at a syphilis prevalence of 1.55%, the ED screening program strategy becomes cost-effective with the ICER (A$ per QALY gained) equal to the willingness to pay of $50,000. At a prevalence rate of 6.1%, the program becomes cost saving and absolutely dominates the comparator of no screening.

The ICER was most sensitive to syphilis prevalence; specificity, sensitivity and cost of the enzyme immunoassay (EIA) screening test; and probability of a true positive test being treated as early syphilis in the screening program (Table 3). The ICER was also sensitive to the following probabilities with paucity of data: probability of remaining alive and still infected after 30 years of acquisition; probability the infection is detected outside of a screening program; and probability that syphilis remains latent in those still infected after 30 years (Table 3). The utility weight to which

Table 2. Total costs, syphilis cases detected and treated, quality-adjusted life years (QALYs) gained and incremental cost-effectiveness ratio (ICER) per 1000 Aboriginal and Torres Strait Islander peoples aged 15–40 years screened through an ED screening program vs no screening according to syphilis prevalence in Australian dollars ($AUD, 2024 currency conversion rate).

Syphilis prevalence (%)	Strategy	Total cost (A$)	Syphilis cases detected and treated	QALY gained	ICER (A$ per case detected and treated)	ICER (A$ per QALY gained)
0.100	ED screening program	33,498	0.953	18.017038	212,484	1,023,208
	No screening	988	0.800	18.017006		
0.390	ED screening program	34,791	3.718	18.017031	51,736	249,673
	No screening	3853	3.120	18.016907		
0.680	ED screening program	36,083	6.482	18.017023	28,182	135,918
	No screening	6717	5.440	18.016807		
0.970	ED screening program	37,376	9.248	18.017016	18,679	90,182
	No screening	9582	7.760	18.016708		
1.260	ED screening program	38,669	12.013	18.017009	13,565	65,499
	No screening	12,447	10.080	18.016608		
1.550	ED screening program	39,961	14.777	18.017001	10,370	50,052
	No screening	15,312	12.400	18.016509		
1.840	ED screening program	41,254	17.542	18.016994	8178	39,474
	No screening	18,176	14.720	18.016409		
2.130	ED screening program	42,547	20.307	18.016987	6583	31,776
	No screening	21,041	17.040	18.016310		
2.420	ED screening program	43,839	23.071	18.016979	5371	25,924
	No screening	23,906	19.360	18.016201		
2.710	ED screening program	45,132	25.836	18.016972	4418	21,324
	No screening	26,771	21.680	18.016111		
3	ED screening program	46,424	28.601	18.016965	3649	17,613
	No screening	29,636	24.000	18.016011		

the ICER was most sensitive was that of remaining lifetime following tertiary and late neurosyphilis after treatment (Table 3).

Probabilistic sensitivity analysis

Fig. 1*a* shows 5000 Monte Carlo simulation runs with randomly varied probabilities, costs, and durations, with green dots representing simulations where the ICER is less than $50,000, and red dots representing simulations where the ICER exceeds this threshold. The ICER remains less than $50,000 in 6.4% of 5000 Monte Carlo simulation runs (Fig. 1*b*). In the undiscounted analysis, the ICER remains cost-effective in 72% of the Monte Carlo iterations.

Discussion

To our knowledge, this study represents the first health economic analysis evaluating a syphilis screening program in an ED setting. At the observed local syphilis prevalence of 0.68%, the screening program for Aboriginal and Torres Strait Islander peoples aged 15–40 years presenting to a regional ED was not cost-effective compared with no screening. Cost-effectiveness was achieved when prevalence exceeded 1.55%, indicating that the value of this approach is contingent on epidemiological context and may be limited in lower-prevalence settings.

Notably, there was a substantial difference between the discounted and undiscounted ICERs. This discrepancy reflects the nature of preventive health interventions, where most costs are incurred upfront, while the benefits (e.g. avoided complications and onward transmissions) accrue over time. As a result, discounting of future QALYs significantly reduces their present value, inflating the ICER.

Unlike HIV, a similarly high morbidity disease, there are currently no Australian or international recommendations for opt-out syphilis screening based on a population prevalence threshold. The Centres for Disease Control recommend routine opt-out universal screening in all healthcare settings for HIV, at ≥0.1% prevalence of undiagnosed infection.[42] Modelling studies have demonstrated HIV screening is cost-effective even at this low prevalence,[43–45] particularly when

Table 3. Univariate sensitivity analysis per 1000 Aboriginal and/or Torres Strait Islander peoples, aged 15–40 years, screened through an ED screening program vs no screening in Australian dollars (AUD, 2024 currency conversion rate).

Variable	Base-case values	Sensitivity analysis values	ICER (A$ per QALY gained)
Most sensitive to			
Syphilis prevalence	0.00685	0.001	1,023,208
		0.030	17,613
Specificity of EIA screening test	0.946	0.670	229,647
		1	116,311
Current cost of EIA screening test	29	20.300	97,237
		37.700	172,367
Probability of true positive treated as early syphilis, in the screening program	0.778	0.545	185,163
		0.815	128,963
Sensitivity of EIA screening test	0.990	0.820	166,260
		1	133,285
Parameters with paucity of data			
Probability of remaining alive and still infected after 30 years after acquisition, among those with undetected syphilis with no screening program	0.897	0.033	4,433,813
		1	119,616
Probability that infection is detected with no screening program	0.800	0.500	49,313
		0.950	558,381
Probability syphilis remains latent in those still infected after 30 years	0.680	0.480	78,157
		0.880	382,234

considering the benefit of partner notification.[45] For the Aboriginal and Torres Strait Islander population, the threshold for cost-effective screening in an ED setting is 1.55% prevalence of undiagnosed infection. This finding could likely be generalised to similar Australian towns with a concentrated syphilis outbreak in Aboriginal and Torres Strait Islander peoples. It may be beneficial to conduct cross-sectional analyses to establish local prevalence rates before broader generalisation of these results to different sub-populations and metropolitan areas.

The cost-effectiveness of ED-based STI screening programs may be improved by narrowing the target population based on risk factors. Studies on HIV ED screening programs have demonstrated targeted screening of high-risk populations (men who have sex with men, diagnosis of another STI, intravenous drug use, among others) are cost-effective compared to no screening. Non-targeted (universal) approaches were often not cost-effective.[14–16] However, both targeted and universal ED screening approaches for chlamydia and gonorrhoea have been found to be cost-effective, with universal screening identifying and treating a higher proportion of patients with these STIs.[17,18]

This study employed targeted screening of the Aboriginal and Torres Strait Islander population; however, no further risk factors such as sexual preference or current/previous STIs were considered. Economic evaluations should be applied to more ED syphilis screening programs to determine optimal methods. Previous ED syphilis screening studies in the United States have identified high rates of undiagnosed syphilis.[8–10] Larios Venegas *et al.*[8] used targeted screening of all patients presenting with STI symptoms identifying a prevalence of 1.2%. Whereas, Stanford *et al.*[9] and Sweitzer *et al.*[10] universally screened patients, finding a prevalence of 1.1 and 3%, respectively. While both targeted and universal syphilis screening approaches have the potential to be cost-effective, reducing the screening population by targeting further risk factors is likely to reduce costs. However, universal screening has the advantage of identifying more asymptomatic latent infections in outbreak settings.[7] Universal screening is also more suited to an ED setting where competing priorities and inadequate time make it difficult to identify patient risk factors.[46,47]

Results of the economic analysis were most sensitive to probabilities of disease progression in the comparator of no screening. The probability those infected are detected without a screening program and remain infected 30 years after acquisition were based on unsubstantiated assumptions in an Australian context. A wide range of values were used in the sensitivity analyses to account for these uncertainties. For instance, the 80% assumption that syphilis is detected is based on a probability of syphilis being reported as a case was derived from a 1999 incidence study in the United States, which likely represents a best guess estimate.[29] It is possible that this assumption is too high for the Aboriginal and Torres Strait Islander population, who face significant barriers to accessing healthcare. Compared to non-Indigenous people,

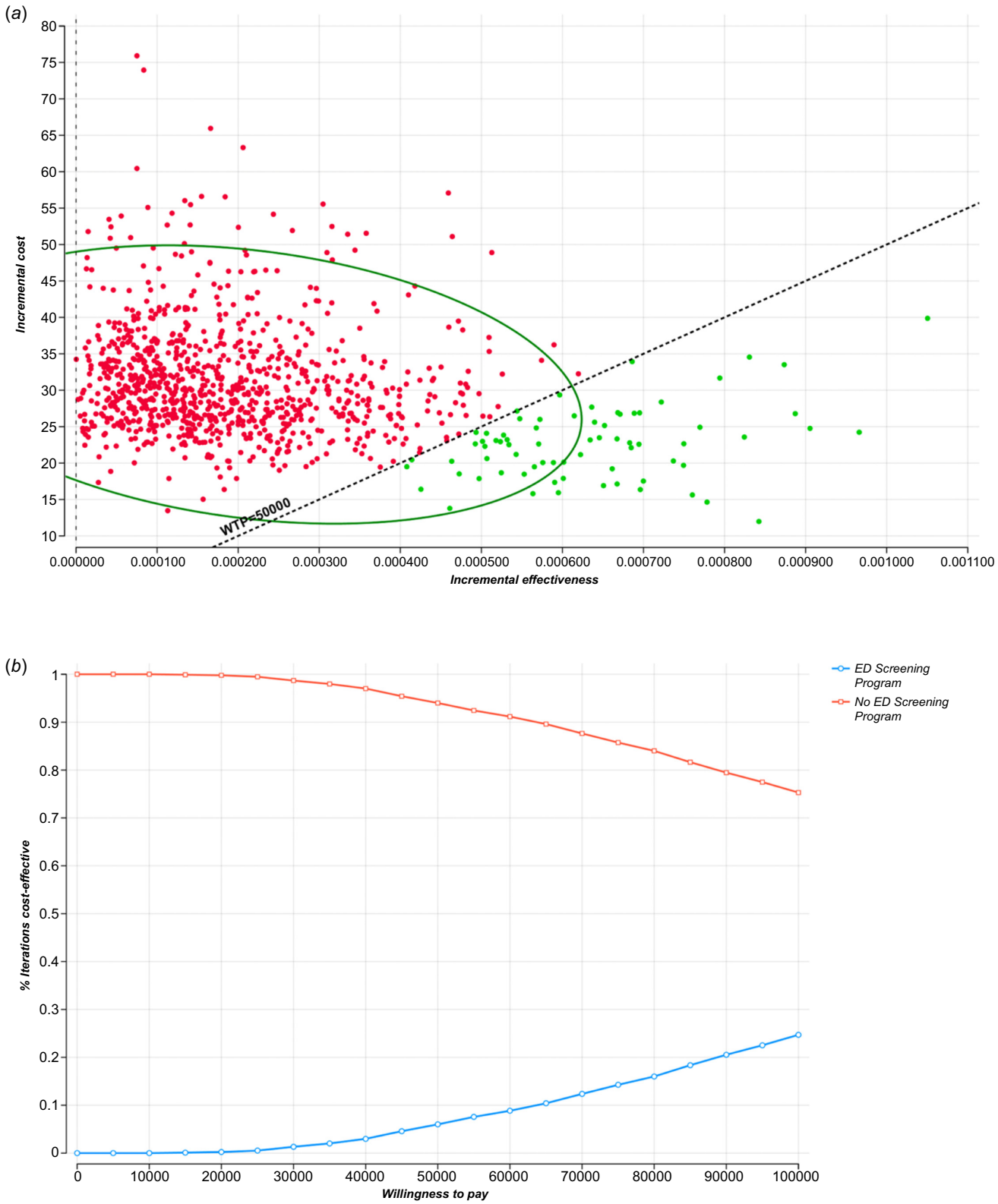

Fig. 1. (*a*) Scatterplot of 5000 Monte Carlo simulation runs with randomly varied probabilities, costs, and duration of symptoms of late syphilis complications (willingness to pay (WTP) = $50,000). (*b*) Cost-effectiveness acceptability curve.

the Aboriginal and Torres Strait Islander population has worse access to primary care relative to need, increasing with remoteness.[6] A 2019 survey found that 30% of Aboriginal and Torres Strait Islander peoples reported a need to, but did not see, a healthcare provider in the prior year.[48] The high rate of undiagnosed syphilis identified by the ED screening program supports the potential gap in primary care access. Additionally, in Australia, inadvertent treatment for syphilis is unlikely, as benzathine penicillin G is not used for other conditions at the required dose, particularly not the three doses required for late latent syphilis.[28]

Strengths and limitations

The strength of this study lies in its use of real-world data derived from an ED screening program in Townsville, Queensland.[7] The prevalence of syphilis in the Aboriginal and Torres Strait Islander population presenting to a regional ED is accurate, reflecting the ongoing outbreak of syphilis in North Queensland and the heightened risk of undiagnosed infection in this population.[1]

The primary limitation of this study is that it did not capture the benefits of earlier syphilis detection to prevent onward transmission, as well as contact tracing or congenital syphilis. At least 25 additional individuals were tested as contacts of syphilis cases identified through the program, resulting in diagnosis of at least 13 additional infections.[7] The model likely underestimates the entire public health benefit of an ED-based screening program. Future research using transmission dynamic modelling is warranted to fully capture the broader impacts of the intervention and to determine whether their inclusion would materially alter the primary findings regarding cost-effectiveness.

The model excluded congenital syphilis as only one pregnant woman was diagnosed with early syphilis during the program.[7] A UK decision model by Huntington *et al.* reports the hospital cost of treating congenital syphilis as GBP5856.18 (2018 currency conversion rate), or approximately $12,448 (2024 currency conversion rate).[49–51] This cost could fund 429 initial EIA screening tests through the program (Item 69,387 MBS),[22] without considering the additional lifetime cost of congenital syphilis. Targeted interventions to increase antenatal syphilis screening are particularly important for the Aboriginal and Torres Strait Islander population, given their lower likelihood of attending antenatal care compared to non-Indigenous counterparts.[52,53] The ED screening program can complement these interventions by preventing cases of congenital syphilis and facilitating linkage to appropriate antenatal care.

Re-screening was excluded in the model due to insufficient data to make a reliable assumption about re-screening frequencies over the 40-year time horizon. Over 3.5 years of the program, an additional 1529 initial screening tests were conducted as re-screening, with a minimum interval of 6 months between tests.[7] These tests incurred an additional cost of $44,341, not included in the analysis, which would further reduce cost-effectiveness. Extending this interval could enhance the program's cost-effectiveness, though the magnitude of this effect is likely to be modest. Although no individual tested positive for a new syphilis infection more than once during the program, re-infection is likely over a 40-year period. Future analyses using transmission dynamic or Markov models can evaluate the impact of both re-screening and re-infections.

The model assumed a 100% penicillin cure rate and did not account for penicillin allergy, variation in treatment adherence, or loss to follow-up. In practice, these factors may increase the need for retreatment or additional utilisation of health care, increasing downstream costs and reducing cost-effectiveness. This is particularly relevant for Aboriginal and Torres Strait Islander populations, who are more likely to experience barriers to continuity of care, including missed follow-up appointments and disengagement from services due to structural and cultural barriers.[54]

The probabilities of developing each of the late syphilis complications provided by Chesson and Peterman[22] are consistent with the original model by Schmid,[30] which utilised data from the Oslo study as interpreted by Gjestland in 1955.[55] This data is all that is available given the ethical and clinical challenges associated with studying the natural progression of untreated syphilis. Relying on historical data may lead to an overestimation of complication rates in contemporary settings. This would bias the model in favour of screening and may therefore overstate cost-effectiveness, further supporting the robustness of the finding that the program was not cost-effective at the observed prevalence.

Conclusion

The ED syphilis screening program for Aboriginal and/or Torres Strait Islander peoples, aged 15–40 years, presenting to a regional ED was not cost-effective compared to no screening, using a discounted model. The program becomes cost-effective at a syphilis prevalence of 1.55%. Similar screening programs in settings with a higher burden of syphilis may be cost-effective, and further refining the target population based on additional risk factors could help reduce costs. Future economic evaluations of ED-based syphilis screening should consider using models that capture reductions in onward transmission and adopt a societal perspective to provide a more accurate reflection of the intervention's overall public health value. While the program is not cost-effective, cost alone should not be the sole determinant of value. The potential to reduce community transmission, prevent congenital syphilis infections and address the growing epidemic highlights the importance of continued screening efforts.

Supplementary material

Supplementary material can be accessed from the article page online.

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