Cost-effectiveness of interferon-gamma release assay for systematic tuberculosis screening of healthcare workers in low-incidence countries

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SUMMARY

Background: Tuberculosis (TB) is one of the important occupationally acquired infectious diseases in low-incidence countries. Delays in TB diagnosis and treatment among healthcare workers (HCWs) result in costly large-scale TB contact screening among patients and other HCWs.

Aim: To assess the cost-effectiveness of TB screening for HCWs using interferon-gamma release assays (IGRAs) compared with tuberculin skin test (TST) and chest x ray (CXR).

Methods: Markov models were constructed using a hospital payer perspective. The target populations were a hypothetical cohort of 30-year-old HCWs at the time of employment, and a hypothetical cohort of HCWs working on a high-risk ward until 60 years of age. Six strategies were modelled: TST, QuantiFERON-TB Gold In-Tube (QFT), T-SPOT.TB (T-SPOT), TST followed by QFT, TST followed by T-SPOT, and CXR. The main outcome measure of effectiveness was quality-adjusted life-years (QALYs). Costs and QALYs gained per person screened were calculated.

Findings: QFT was the most cost-effective strategy at the 'willingness to pay' level of US$ 50,000/QALYs gained (at the time of employment: US$ 334.91, 21.071 QALYs; on a high-risk ward: US$ 1050.32, 20.968 QALYs; values for 2012). Cost-effectiveness was sensitive to latent TB infection (LTBI) rate and bacillus Calmette-Guérin vaccination rate. TST followed by QFT was more cost-effective than QFT when the LTBI rate was <0.026 at the time of employment and <0.08 on a high-risk ward.

Conclusion: Systematic TB screening using QFT is cost-effective for screening HCWs, and is recommended in low-incidence countries.

Introduction

Tuberculosis (TB) is one of the important occupationally acquired infectious diseases in low-incidence countries.[1,2] Healthcare workers (HCWs), especially those working in pneumology departments, emergency rooms, laboratory departments, radiology departments and pathology departments,

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Table I
Baseline estimates for selected model variables of healthcare workers (HCWs)

	Baseline value	One-way sensitivity analysis range	References
HCWs at the time of employment			
Probability of having LTBI	0.032	0.001—0.101	Estimate 8
Incidence of TB	0	0—0.001	
Annual probability of having LTBI	0.01	0—0.1	
Annual probability of having TB	0	0—0.001	
HCWs on a high-risk ward			
Probability of having LTBI	0.14	0.01—0.51	Estimate 8
Incidence of TB	0.001	0—0.01	
Annual probability of having LTBI	0.01	0.001—0.1	
Annual probability of having TB	0.001	0—0.01	
Probability of developing active TB from LTBI			
Age 30—35 years	0.0048		11
Age 36—55 years	0.0036		
Age 56—60 years	0.0015		
Age-specific all-cause mortality rates			
Age 20 years	0.00041		14
Age 30 years	0.00056		
Age 40 years	0.00110		
Age 50 years	0.00268		
Age 60 years	0.00630		
Probability of successful TB treatment	0.39	0.1—0.6	12
Probability of recurrence of active TB after treatment	0.035	0.02—0.05	13
Efficacy of standard six-month INH chemoprophylaxis protocol	0.8	0.6—0.9	16
Adherence rate of standard six-month INH chemoprophylaxis protocol for IGRA	0.8	0—1	14
Adherence rate of standard six-month INH chemoprophylaxis protocol for TST	0.5	0—1	
Probability of INH-induced hepatitis by INH prophylaxis	0.003	0.001—0.02	15
Sensitivity of TST for LTBI	0.77	0.71—0.82[a]	9
Specificity of TST for LTBI in BCG-vaccinated HCWs	0.59	0.46—0.73[a]	
Specificity of TST for LTBI in non-BCG-vaccinated HCWs	0.97	0.95—0.99[a]	
Sensitivity of QFT for LTBI	0.84	0.81—0.87[a]	10
Specificity of QFT for LTBI	0.99	0.98—1.00[a]	
Sensitivity of T-SPOT for LTBI	0.89	0.86—0.91[a]	
Specificity of T-SPOT for LTBI	0.98	0.94—0.99[a]	
Sensitivity of CXR for active TB	0.70	0.59—0.82	17
Specificity of CXR for active TB	0.60	0.52—0.63	
Cost (US$; 1 US$ = ¥ 103.9)			
QFT	60.6	30.3—120.2	18
T-SPOT	60.6	30.3—120.2	
TST	15.4	7.7—30.8	
CXR	36.3	18.2—61.6	
Smears and cultures of sputum examination	69.9	35.0—139.8	
INH chemoprophylaxis for six months	515.7	257.9—1035.4	14
Treatment of INH-induced hepatitis by chemoprophylaxis	11,903	5951.5—23,806	
Treatment of TB for six months	14,879	7440—29,758	
Utility			
Non-LTBI	1		20
LTBI taking no chemoprophylaxis	1		
LTBI taking chemoprophylaxis without complications	0.99		
LTBI taking chemoprophylaxis with liver dysfunction	0.85		
Active TB during treatment and before	0.80		
Dead	0		

BCG, bacillus Calmette-Guérin; LTBI, latent tuberculosis infection; TB, tuberculosis; CXR, chest x-ray examination; INH, isonicotinyl hydrazide; TST, tuberculin skin test; QFT, QuantiFERON-TB Gold In-Tube; T-SPOT, T-SPOT.TB; IGRA, interferon-gamma release assay.
[a] 95% confidence interval.