# Factors influencing tuberculosis screening in healthcare workers in Portugal

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#### To the Editor:

Although the incidence of tuberculosis (TB) has increased in healthcare workers (HCWs) [1–3], several studies have shown that HCWs are not compliant with screening and/or preventive measures [4–7]. For example, a Portuguese study found that the estimated TB incidence was three- to seven-fold higher in HCWs than in the general population [8]. Latent TB infection (LTBI) diagnosis and treatment constitute the core of TB elimination, integrating the post-2015 strategies of the World Health Organization [9, 10].

To evaluate TB screening practices among HCWs and their reasons for nonadherence in Portugal, we developed a survey and distributed it to nurses and physicians from December 25, 2012 to January 31, 2013, closing when we received fewer than one response per day. The survey was anonymous, voluntary and digitally distributed through our network of contacts using a "snowball" distribution method where volunteers subsequently distribute the questionnaire to their contacts and so forth.

Continuous data are presented as mean±sD and compared using t-tests. Categorical data are presented as n (%) and compared using the Chi-squared or Fisher's test, as appropriate. Multiple logistic regression analysis was used to identify statistically significant determinants of TB infection, exposure and screening. Crude and adjusted odds ratios and 95% confidence intervals were determined. Goodness-of-fit of the models was evaluated; comparisons with the null model used the difference of deviances, as determined by Chi-squared tests, while comparisons with the saturated model used the difference of deviances, determined using the Chi-squared or Hosmer–Lemeshow test, as appropriate. The area under the receiver operating characteristic (ROC) curve was calculated for each model. All statistical analyses were performed using the R language and software, version 2.12.1 [11]. The level of significance was fixed at 0.05.

In Portugal, in 2008, there were 38 932 physicians and 56 859 nurses registered by their respective boards [12].

We obtained 2414 responses, of which 399 did not meet the inclusion criteria. Thus, responses from 2015 subjects were analysed; table 1 summarises the results. Of these subjects, 1540 (76.4%) were females and 1133 (56.2%) nurses. Subjects were aged 18–73 years (mean $\pm$ sD 39.02 $\pm$ 10.60 years). 44 (2.2%) subjects had a history of TB (20 before beginning professional activity).

Of the 2015 subjects, 784 (39.5%) were never screened; of these, 741 (94.5%) reported they were never offered screening. The remaining 43 (5.5%) subjects refused screening, five (11.6%) because they were unavailable for screening, 13 (30.2%) because they saw no benefits in screening, six (14.0%) because they would not be treated if positive and eight (18.6%) for other reasons; 12 (27.6%) did not state a reason. Among the 741 subjects who were not offered screening, 580 (78.2%) stated that they would be screened if offered, whereas 141 (19.0%) were either undecided or did not want to be screened; of the latter, 46 (32.6%) were concerned about the side-effects of possible treatment, 18 (12.8%) did not believe in the benefits of preventive treatment, 43 (30.5%) were not sufficiently informed to make a decision and 16 (11.6%) cited other reasons.

Of 1187 (58.9%) subjects screened, 139 (11.7%) were positive for LTBI (defined as the absence of disease but a positive tuberculin skin test (TST) or interferon- $\gamma$  assay); of these, 72 (51.8%) were treated, 47 (65.2%) after beginning professional activity. Of the 67 (48.2%) subjects who were not treated for LTBI, 12 (17.9%) refused treatment due to concerns about the side effects of treatment, five (7.5%) did not believe in the benefits of treatment, nine (13.4%) were not sufficiently informed to make a decision and 16 (23.9%) stated other reasons. LTBI was diagnosed on routine screening in 50 subjects (36.0%) and active post-exposure (any exposure, regardless of duration or place of exposure) in 45 (32.4%).

Logistic regression models disregarded survey responses from 53 subjects due to the absence of at least one of the explanatory variables. Thus, 1962 subjects were included in the model estimation. All variables, except for the variable representing the youngest individuals in the exposure model, were found to have a statistically significant effect on the response. All models were shown to have a goodness of fit that was significantly better than the null model (p<0.001) and not significantly different from that of the saturated model (p=0.560 for the screening model; p=1.000 for the infection and the exposure model). The area under the ROC curve was 62.1% for the screening model, 64.3% for the infection model and 59.7% for the exposure model.

## TABLE 1 Summary of results and statistical analysis

No. Screened         Screened screened         screened public industriate analysis         No. industriate analysis         Infected industriate analysis $p - ulc$ No. No. industriate analysis         No. industriate analysis         No. industriate ind		Total	Screening					Inf	ection		Exposure				
Price     Normale     Mathemate     Normale     Mathemate       50     1501PA     1501PA     22172     2017     Ref     4017A     1017A     1017A     101PA			Not screened	Screened	p-value		Not infected	Infected	p-value		Not exposed	Exposed	p-value		
Sec.         D.82         D.840         D.847         D.847         D.847         D.841           Famme         550         76,14         212         253         122         0.007         480         70,11         180         70,11         180         70,11					Univariate analysis	Multivariate analysis			Univariate analysis	Multivariate analysis	·		Univariate analysis	Multivariate analysis	
Fermio         150 (7x.4)         474 (7x.8)         724 (7x.8)<	Sex				0.082				0.947				0.261		
Mape area stars 1930-1100201 (20.1)20.1 (20.2)40.1 (20.1)	Female	1540 (76.4)	616 (74.4)	924 (77.8)		Ref.	1400 (76.4)	140 (76.5)			189 (79.7)	1349 (76.2)			
Age vars       39,011 0.0	Male	475 (23.6)	212 (25.6)	263 (22.2)		0.024	432 (23.6)	43 (23.5)			48 (20.3)	421 (23.8)			
-3.4       67       64.0       672       133       168.0       472       134       124 <t< td=""><td>Age years</td><td>39.02±10.60</td><td></td><td></td><td>0.065</td><td></td><td></td><td></td><td>&lt; 0.001</td><td></td><td></td><td></td><td>0.007</td><td></td></t<>	Age years	39.02±10.60			0.065				< 0.001				0.007		
35-9       32       32       32       32       32       32       32       32       32       32       32       35       15       3       14       27       -0.001       47       32       64       17.4       64       17.4       64       17.4       67.0       46       17.4       17.4       0.074       0.074         Protection       357       32       52.6       35       15.6.5       9       15.4.2       0.01       17.4       17.4       0.021       17.4       17.4       0.021       17.4       0.021       17.4       17.4       0.021       17.4       17.4       0.021       17.4       17.4       17.4       17.4	≤34	877 (43.5)	385 (46.6)	492 (41.5)		Ref.	826 (45.1)	51 (27.9)		Ref.	124 (52.3)	748 (42.3)	748 (42.3)	Ref.	
short       short </td <td>35-49</td> <td>732 (36.3)</td> <td>280 (33.9)</td> <td>452 (38.1)</td> <td></td> <td>0.006</td> <td>651 (35.6)</td> <td>81 (44.3)</td> <td></td> <td>&lt; 0.001</td> <td>67 (28.3)</td> <td>664 (37.6)</td> <td>664 (37.6)</td> <td>0.001</td>	35-49	732 (36.3)	280 (33.9)	452 (38.1)		0.006	651 (35.6)	81 (44.3)		< 0.001	67 (28.3)	664 (37.6)	664 (37.6)	0.001	
Projection         0.6.83         0.75 (A)         0.780         0.780         0.780         0.780           Physician         133 (6.2)         37 (6.3)         62 (5.5)         0.01         103 (5.6)         98 (5.3)         133 (5.1)         97 (6.3)         0.21         0.33 (5.1)         97 (6.3)         0.21         0.31 (5.1)         97 (5.3)         0.21         0.31 (5.1)         0.42 (5.3)         0.21 </td <td>≥50</td> <td>404 (20.0)</td> <td>162 (19.6)</td> <td>242 (20.4)</td> <td></td> <td>0.008</td> <td>353 (19.3)</td> <td>51 (27.9)</td> <td></td> <td>&lt; 0.001</td> <td>46 (19.4)</td> <td>356 (20.1)</td> <td>356 (20.1)</td> <td>0.094</td>	≥50	404 (20.0)	162 (19.6)	242 (20.4)		0.008	353 (19.3)	51 (27.9)		< 0.001	46 (19.4)	356 (20.1)	356 (20.1)	0.094	
Physiciant       882 (42.8)       97 (43.7)       92 (42.8)       97 (43.7)       97 (43.5)       98 (54.6.4)       104 (43.9)       77 (43.7)       99 (54.6.3)       90	Profession				0.653				0.492				0.980		
Norse         133 [56,2]         947 [56,3]         1035 [56,5]         94 [53,4]         133 [56,1]         994 [56,3]           Methadd         15,2 ± 0.2         13,2 ± 0.3         0.01         14,9 ± 0.2         8,2 ± 7         <0.01         13,7 ± 0.9         15,4 ± 0.3         0.01         0.021           Set         34 ± 0.2         13,7 ± 0.9         15,4 ± 0.3         0.021         0.021           Set         34 ± 0.2         0.01         14,9 ± 0.2         0.001         0.01	Physician	882 (43.8)	357 (43.1)	525 (44.2)			797 (43.5)	85 (46.4)			104 (43.9)	774 (43.7)			
HCW time       15.2±10.2       10.3±10.1       14.3±10.3       0.001       14.9±10.2       18.5±9.7       <0.001       13.7±10.9       15.4±10.1       0.021         vsars       -55       344 119.4       -55       54       -55       54       55       55       55       55       55       55       55       55       55       55       55       55       56       100       590 16.3.1       590 16.3.1       500 17       6001       1103 26.51       54 (29.5)       129 (56.5)       129 (56.5)       54 (29.5)       129 (56.5)       129 (56.5)       56 (29.5)       100 (40.0)       590 (33.3)       -       -       0.007       0.001       0001       103 (46.7)       131 (20.1)       0.002       139 (41.5)       1179 (47.8)       0.067       0.001       0.002       139 (41.5)       1179 (47.8)       0.067       -       0.001       0.002       139 (41.5)       137 (20.0)       Rei       0.002       59 (32.3)       1179 (47.8)       0.067       -       0.001       0.002       139 (41.5)       141 (41.0)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)       140 (40.1)<	Nurse	1133 (56.2)	471 (56.9)	662 (55.8)			1035 (56.5)	98 (53.6)			133 (56.1)	996 (56.3)			
orsin         set         set </td <td>HCW time</td> <td>15.2±10.2</td> <td>10.3±10.1</td> <td>14.3±10.3</td> <td>0.001</td> <td></td> <td>14.9±10.2</td> <td>18.5±9.7</td> <td>&lt;0.001</td> <td></td> <td>13.7±10.9</td> <td>15.4±10.1</td> <td>0.021</td> <td></td>	HCW time	15.2±10.2	10.3±10.1	14.3±10.3	0.001		14.9±10.2	18.5±9.7	<0.001		13.7±10.9	15.4±10.1	0.021		
-5-5       364 (19.4)         6-10       452 (28.4)         11-15       287 (14.5)         11-15       287 (14.5)         -20       271 (14.5)         511 (26.1)       531 (64.1)         700 (24.7)       277 (15.9)         010re       704 (24.7)         010re       600 (35.0)         011 (15.2)       850 (13.0)         011 (15.2)       850 (13.0)         011 (15.2)       861 (30.0)         011 (15.2)       861 (30.0)         011 (15.2)       870 (33.1)         011 (15.2)       870 (33.1)         011 (15.2)       871 (35.1)         011 (15.2)       871 (35.1)         011 (15.2)       861 (30.0)         011 (15.2)       861 (30.0) <td>years</td> <td></td>	years														
6-10       827       12.8       542       12.9       542       12.9       542       543       559       543       543       559       <	<5	384 (19.4)													
11-15       287 [14,5]         14-20       271       581 [29.3]         Region       0.019       -20         North       1311 [65,1]       531 [64,1]       700 [65,7]       1182 [64,5]       129 [70,5]       129 [54,0]       1190 [66,7]         Other       704 [34,9]       297 [35,9]       407 [34,3]       650 [35,6]       54 [29,5]       107       128 [54,0]       1190 [66,7]         Workplace       0.007       704 [34,7]       74 [56,7]       80 [73,0]       <0.011	6-10	452 (22.8)													
16-20       527       16.40       527       16.40       54       55       55       55       107       67       0.007       0003       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.007       0.001	11–15	287 (14.5)													
>21       581 (2?.3)       581 (2?.3)       0.493       591 (6.2)       0.125 $\cdot$ 0.01         North       1311 (6.1)       531 (6.1)       780 (6.7)       182 (6.4)       129 (7.5)       129 (6.4)       180 (6.7)       0.01         Other       704 (3.4)       277 (3.5)       407 (3.4)       650 (3.2)       129 (7.5)       109 (4.6)       590 (3.3)       0.07         Workplac $\cdot$ 0.01       0.021       139 (6.1)       1170 (6.7)       0.001       0.001         Outpatient       1324 (7.2)       474 (5.8)       850 (7.3)       0.001       191 (6.3)       51 (2.8)       718 (5.8)       559 (3.2)       Ref.         Surgical       317 (15.7)       141 (17.0)       176 (14.8)       0.001       101 (4.1)       16 (8.7)       0.009       0.01       0.01         Nonsurgical       157 (15.8)       151 (8.1)       150 (8.5)	16-20	277 (14.0)													
Region       0.473       1182 (46.1)       704 (34.9)       297 (35.9)       407 (34.3)       1182 (46.1)       129 (70.5)       129 (70.5)       128 (54.0)       129 (70.5)       128 (54.0)       129 (70.5)       128 (54.0)       129 (70.5)       128 (54.0)       129 (70.5)       128 (54.0)       129 (70.5)       120 (70.5)	>21	581 (29.3)													
North       1311 (45.1)       531 (46.1)       780 (45.7)       150 (45.6)       127 (70.5)       128 (54.0)       1180 (46.7)         Workplace       -0.01       0.172       0.02       139 (45.1)       1179 (47.8)       0.001         Outpatient       647 (32.8)       331.3       31 (427.0)       Ref.       556 (32.2)       Ref.       87 (38.5)       555 (32.2)       Ref.       569 (32.3)       0.001         Surgical       121 (15.7)       141 117.0)       Ref.       556 (32.2)       Ref.       557 (32.2)       Ref.       650 (30.0)       0.001         Surgical       157 (15.7)       141 117.0)       Ref.       531 (83.6)       167 (17.3)       0.002       50 (21.1)       656 (15.0)       <0.001	Region				0.493				0.125				<0.001		
Other       79 (36.9)       29 (35.9)       40 (34.3)       65 (35.5)       54 (29.5)       109 (4.0)       590 (33.3)         Workplace       -       -       -       0.001       1393 (67.7)       131 (72.0)       0.002       139 (61.5)       1179 (67.8)       0.001         Outpatient       647 (32.8)       33 (41.3)       314 (27.0)       Ref.       956 (33.3)       51 (28.0)       Ref.       97 (38.3)       55 (32.2)       Ref.       0.001         Surgical       317 (15.7)       141 (17.0)       176 (14.8)       -0.001       301 (16.4)       16 (8.7)       0.002       50 (21.1)       255 (15.0)       -0.001         Surgical       317 (15.7)       141 (17.0)       176 (14.8)       -0.001       301 (16.4)       16 (8.7)       0.002       50 (21.1)       255 (15.0)       <0.001         Surgical       317 (15.7)       141 (17.0)       176 (14.8)       -0.001       E0.053       E1.053       E3.05	North	1311 (65.1)	531 (64.1)	780 (65.7)			1182 (64.5)	129 (70.5)			128 (54.0)	1180 (66.7)			
Workplace       0.017       0.021       0.022       0.921 (61.2)       0.067         In-patient       1647 (32.8)       333 (41.3)       314 (27.0)       Ref.       596 (33.3)       51 (28.0)       Ref.       87 (38.5)       559 (32.2)       Ref.       0.001         Surgical       317 (15.7)       10.76 (14.8)       0.001       301 (16.4)       16 (79.13)       Ref.       87 (38.5)       559 (32.2)       Ref.       0.001         Nonsurgical <sup>W</sup> 1698 (84.3)       667 (83.0)       1011 (85.2)       Ref.       1531 (83.6)       167 (91.3)       Ref.       187 (78.9)       1505 (85.0)       Ref.       0.001         Yes       1699 (84.3)       656 (79.3)       104 (87.9)       1535 (83.9)       164 (89.6)       157 (73.8)       1517 (85.7)       4.001         Yes       1699 (84.3)       656 (97.3)       104 (87.9)       1535 (83.9)       164 (89.6)       157 (73.8)       1517 (85.7)       52 (14.2)         Yes       1699 (84.3)       171 (20.7)       143 (12.1)       255 (15.1)       191 (10.4)       62 (26.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       252 (14.2)       2	Other	704 (34.9)	297 (35.9)	407 (34.3)			650 (35.5)	54 (29.5)			109 (46.0)	590 (33.3)			
In-patient       1324 (87.2)       474 (58.7)       850 (73.0)       <0.001       1173 (66.7)       131 (72.0)       0.002       139 (61.5)       1179 (67.8)       0.001         Outpatient       647 (32.8)       333 (41.3)       314 (27.0)       Ref.       596 (33.3)       51 (28.0)       Ref.       87 (38.5)       55 (32.2)       Ref.         Service       0.009       0.002       50 (21.1)       265 (15.0)       0.001       867.       87 (38.5)       55 (58.2)       Ref.         Nonsurgical <sup>10</sup> 1698 (84.3)       687 (84.3)       616 (17.3)       1041 (17.0)       176 (14.8)       <0.001       801 (16.4)       16 (8.7)       0.002       50 (21.1)       265 (15.0)       <0.001         Nonsurgical <sup>10</sup> 1698 (84.3)       656 (77.3)       1043 (87.9)       Ref.       1531 (83.6)       164 (89.6)       157 (73.8)       1517 (85.8)          Yes       1699 (84.3)       656 (79.3)       1043 (87.9)       20.001       295 (16.1)       19 (10.4)       62 (26.2)       252 (14.2)       252 (14.2)         No       314 (15.6)       1080 (91.4)       <0.001       1599 (87.6)       171 (94.5)       0.002       Ref.       0.001         Yes       170 (88.2)       690 (83.6)       1080	Workplace				<0.001				0.172				0.067		
Outpatient       647 (32.8)       333 (41.3)       314 (27.0)       Ref.       596 (33.3)       51 (28.0)       Ref.       87 (38.5)       55 (32.2)       Ref.         Service       0.009       0.009       0.009       0.009       0.019         Surgical       317 (15.7)       141 (17.0)       176 (14.8)       <0.001       301 (16.4)       16 (8.7)       0.002       50 (21.1)       265 (15.0)       <0.001         Nonsurgical <sup>W</sup> 1698 (84.3)       687 (83.0)       1011 (85.2)       Ref.       1531 (83.6)       167 (91.3)       Ref.       187 (78.9)       1505 (85.0)       Ref.         Yes       1699 (84.3)       656 (79.3)       1043 (87.9)       1535 (83.9)       164 (89.6)       175 (73.8)       1517 (85.8)         No       314 (15.6)       171 (20.7)       143 (12.1)       20.001       259 (16.1)       19 (10.4)       62 (26.2)       252 (14.2)          Yes       1707 (88.2)       690 (83.6)       1080 (91.4)       <0.001       1599 (87.6)       171 (94.5)       0.032         0.001         Yes       1770 (88.2)       690 (83.6)       1080 (91.4)       <0.001       159 (87.6)       171 (95.5)       0.032        0.001         Yes <td>In-patient</td> <td>1324 (67.2)</td> <td>474 (58.7)</td> <td>850 (73.0)</td> <td></td> <td>&lt;0.001</td> <td>1193 (66.7)</td> <td>131 (72.0)</td> <td></td> <td>0.002</td> <td>139 (61.5)</td> <td>1179 (67.8)</td> <td></td> <td>0.001</td>	In-patient	1324 (67.2)	474 (58.7)	850 (73.0)		<0.001	1193 (66.7)	131 (72.0)		0.002	139 (61.5)	1179 (67.8)		0.001	
Service         0.003         0.009         0.009         0.001         0.001           Surgical         317 (15.7)         141 (17.0)         176 (14.8)         0.001         301 (16.4)         16 (8.7)         0.002         50 (21.1)         256 (50.9)         Ref.         1531 (83.6)         167 (91.3)         Ref.         187 (78.9)         1505 (85.0)         Ref.         0.001           Training in           0.003         Ref.         187 (78.9)         1505 (85.0)         Ref.         0.001           Yes         1699 (84.3)         656 (79.3)         1043 (87.9)         1535 (83.9)         164 (89.6)         175 (73.8)         1517 (85.8)              0.001         759 (87.6)         171 (94.5)         0.032	Outpatient	647 (32.8)	333 (41.3)	314 (27.0)		Ref.	596 (33.3)	51 (28.0)		Ref.	87 (38.5)	559 (32.2)		Ref.	
Surgical       317 [15,7]       141 [17,0]       176 [14,8]       <0.001	Service				0.203				0.009				0.019		
Nonsurgical"       1698 [84.3]       687 [83.0]       1011 [85.2]       Ref.       1531 [83.6]       167/[91.3]       Ref.       187 [78.9]       1505 [85.0]       Ref.         Training in       -       -       0.053       -       -0.001         TB       -       -       0.053       1517 [85.8]       -0.001         No       314 [15.0]       1517 [03.8]       1517 [85.8]       1517 [85.8]       252 [14.2]         No       314 [15.0]       170 [88.2]       690 [83.6]       1080 [91.4]       <0.001	Surgical	317 (15.7)	141 (17.0)	176 (14.8)		< 0.001	301 (16.4)	16 (8.7)		0.002	50 (21.1)	265 (15.0)		< 0.001	
Training in       <	Nonsurgical*	1698 (84.3)	687 (83.0)	1011 (85.2)		Ref.	1531 (83.6)	167(91.3)		Ref.	187 (78.9)	1505 (85.0)		Ref.	
TB	Training in				<0.001				0.053				<0.001		
Yes       1699 [84,3]       656 [79,3]       1043 [87,9]       1535 [83,9]       164 [89,6]       175 [73,8]       1517 [85,8]         No       314 [15.6]       171 [20,7]       143 [12.1]       295 [16.1]       19 [10.4]       62 [26.2]       252 [14.2]         TB exposure       -       0.009       NA       NA       NA         Yes       1770 [88.2]       690 [83.6]       1080 [91.4]       <0.011       1599 [87.6]       171 [94.5]       0.032         No       237 [11.8]       135 [16.4]       102 [78.6]       Ref.       227 [12.4]       10 [5.5]       Ref.       0.001         Yes       1325 [86.4]       102 [78.6]       Ref.       227 [12.4]       10 [5.5]       Ref.       0.001         Yes       1325 [86.4]       392 [54.4]       690 (62.4]       982 [59.5]       100 [57.1]       15 [28.8]       1061 [60.0]         Yes       1082 [59.3]       392 [54.4]       690 (62.4]       982 [59.5]       100 [57.1]       15 [28.8]       1061 [60.0]         Reason for       0.001       669 [40.5]       75 [42.9]       37 [71.2]       707 [40.0]       200 [10.0]       200 [10.0]       200 [10.0]       200 [10.0]       200 [10.0]       200 [10.0]       200 [10.0]       200 [10.0]	тв														
No       314 [15.6]       171 [20.7]       143 [12.1]       295 [16.1]       19 [10.4]       62 [26.2]       252 [14.2]         TB exposure       <0.001       0.009       NA       NA       NA         Yes       1770 [88.2]       690 [83.6]       1080 [91.4]       <0.001       1599 [87.6]       171 [94.5]       0.032         No       237 [11.8]       135 [16.4]       102 [78.6]       Ref.       227 [12.4]       10 [5.5]       Ref.         Protection       0.001       0.99 [87.6]       101 [5.5]       Ref.       0.001       0.001         Yes       1082 [59.3]       392 [54.4]       690 [62.4]       982 [59.5]       100 [57.1]       15 [28.8]       1061 [60.0]         Yes       1082 [59.3]       392 [44.07]       329 [45.6]       415 [37.6]       669 [40.5]       75 [42.9]       37 (71.2]       707 [40.0]         Reason for       105 [81.0]	Yes	1699 (84.3)	656 (79.3)	1043 (87.9)			1535 (83.9)	164 (89.6)			175 [73.8]	1517 (85.8)			
IB exposure       c0.001       1599 (87.6)       171 (94.5)       0.032         Yes       1730 (88.2)       690 (83.6)       1080 (91.4)       <0.001       1599 (87.6)       171 (94.5)       0.032         Protection       0.001       0.001       1599 (87.6)       171 (94.5)       Ref.       0.001         Yes       1082 (59.3)       392 (54.4)       690 (62.4)       982 (59.5)       100 (57.1)       15 (28.8)       1061 (60.0)         Not always       744 (40.7)       329 (45.6)       415 (37.6)       669 (40.5)       75 (42.9)       37 (71.2)       707 (40.0)         Reason for mot using protection measures       0.010 (57.1)       15 (28.8)       1061 (60.0)       100 (57.1) </td <td>No</td> <td>314 [15.6]</td> <td>171 (20.7)</td> <td>143 (12.1)</td> <td>0.004</td> <td></td> <td>295 [16.1]</td> <td>19 (10.4)</td> <td>0.000</td> <td></td> <td>62 (26.2)</td> <td>252 (14.2)</td> <td></td> <td></td>	No	314 [15.6]	171 (20.7)	143 (12.1)	0.004		295 [16.1]	19 (10.4)	0.000		62 (26.2)	252 (14.2)			
Yes       1770 (88.2)       690 (83.6)       1080 (91.4)       <0.001       1599 (87.6)       171 (94.5)       0.032         No       237 (11.8)       135 (16.4)       102 (78.6)       Ref.       227 (12.4)       10 (5.5)       Ref.         Protection       0.001       0.605       0.0001         Yes       1082 (59.3)       392 (54.4)       690 (62.4)       982 (59.5)       100 (57.1)       15 (28.8)       1061 (60.0)         Not always       744 (40.7)       329 (45.6)       415 (37.6)       669 (40.5)       75 (42.9)       37 (71.2)       707 (40.0)         Reason for       mot using       protection	IB exposure	4550 (00.0)	(00 (00 ()	1000 (01 ()	<0.001	0.004			0.009	0.000	NA	NA	NA		
No       237 (11.8)       135 (16.4)       102 (78.6)       Ref.       227 (12.4)       10 (5.5)       Ref.         Protection       0.001       0.605       0.001         Yes       1082 (59.3)       392 (54.4)       690 (62.4)       982 (59.5)       100 (57.1)       15 (28.8)       1061 (60.0)         Not always       744 (40.7)       329 (45.6)       415 (37.6)       669 (40.5)       75 (42.9)       37 (71.2)       707 (40.0)         Reason for       not using       protection	Yes	1770 (88.2)	690 (83.6)	1080 (91.4)		<0.001	1599 (87.6)	171 (94.5)		0.032					
Protection     0.001     0.005     0.001       Yes     1082 (59.3)     392 (54.4)     690 (62.4)     982 (59.5)     100 (57.1)     15 (28.8)     1061 (60.0)       Not always     744 (40.7)     329 (45.6)     415 (37.6)     669 (40.5)     75 (42.9)     37 (71.2)     707 (40.0)       Reason for     0.001 (0.001)     0.001 (0.001)     0.001 (0.001)     0.001 (0.001)     0.001 (0.001)       protection     not using	No	237 [11.8]	135 [16.4]	102 (78.6)	0.001	Ref.	227 [12.4]	10 (5.5)	0 (05	Ref.			0.0001		
Yes     1082 (57.3)     392 (54.4)     670 (62.4)     982 (59.3)     100 (57.1)     15 (28.8)     1061 (60.0)       Not always     744 (40.7)     329 (45.6)     415 (37.6)     669 (40.5)     75 (42.9)     37 (71.2)     707 (40.0)       Reason for	Protection	1000 (50.0)		(00 ((0 ()	0.001			100 (57.1)	0.605		15 (00.0)	10/1 (/0.0)	0.0001		
Not always     744 (40.7)     329 (43.6)     415 (37.6)     669 (40.5)     75 (42.9)     37 (71.2)     707 (40.0)       Reason for not using protection     measures     75 (42.9)     37 (71.2)     707 (40.0)       Only knew     1025 (81.0)     1025 (81.0)     1025 (81.0)     1025 (81.0)       about case     1025 (81.0)     1025 (81.0)     1025 (81.0)       178 [14.1]     1025 (81.1)     1025 (81.1)	res	1082 (59.3)	372 (54.4)	690 (62.4)			982 (59.5)				15 (28.8)				
not using       protection       measures       Only knew     1025 (81.0)       about case       after       exposure       178 [14.1]	Not always	/44 (40./)	329 (45.6)	415 (37.6)			669 (40.5)	/5 (42.9)			37 [71.2]	/0/ (40.0)			
not using protection measures Only knew 1025 (81.0) about case after exposure 178 [14.1]	Reason for														
measures Only knew 1025 (81.0) about case after exposure 178 [14.1]	not using														
Integrates Only knew 1025 (81.0) about case after exposure 178 (14.1)	protection														
about case after exposure 178 [14.1]		1025 (91 0)													
after exposure 178 (14.1)	about case	1023 (01.0)													
exposure 178 (14.1)	about Case														
178 [14.1]															
	cybogai e	178 (14 1)													

### TABLE 1 Continued

	Total	Screening					Infe	ection		Exposure				
		Not	Screened	p-value		Not	Infected	p-value		Not	Exposed	p-value		
		Scicencu		Univariate analysis	Multivariate analysis	meeteu		Univariate analysis	Multivariate analysis	exposed		Univariate analysis	Multivariate analysis	
Considered														
low risk														
Avoiding	31 (2.5)													
alarm/														
discrimination														
Discomfort/	15 (1.2)													
carelessness														
Mask not	16 (1.3)													
available														
Previous TB				< 0.001				< 0.001				0.203		
Yes	44 (2.2)	44 (5.3)	0			0	44 (24.0)			2 (0.8)	42 (2.4)			
No	1971 (97.8)	784 (94.7)	1187 (100)			1832 (100)	139(76.0)			235 (99.2)	1728 (97.6)			
Previous LTBI				< 0.001				< 0.001				0.035		
Yes	139 (6.9)	0	139 (11.7)			0	139 (76.0)			8 (3,4)	129 (7.3)			
No	1876 (93.1)	828 (100)	1048 (88.3)			1832 (100)	44 (24.0)			229 (96.6)	1641 (92.7)			
LTBI				< 0.001				< 0.001				0.146		
treatment														
Yes	72 (51.8)	0	72 (6.1)			0	72 (39.3)			4 (1.7)	67 (3.8)			
No	67 [48.2]	828 (100)	1115 (93.9)			1832 (100)	111 (60.7)			233 (98.3)	1703 (96.2)			
HCW when		,	,	0.333			,	NA			,	0.116		
treated														
Yes	72 (68.6)	22 [61.1]	50 (72.5)				72 (68.6)			3 (37.5)	69 (71.1)			
No	33 (31.4)	14 (38 9)	19 (27 5)				33 (31 4)			5 (62 5)	28 [28 9]			
HCW time	8 14+7 69	7 2+7 5	10 2+7 8	0 146		NA	8 1+7 7	NA		9 7+9 1	8 1+7 7	0 791		
when treated														
vears														
<5	37 (51 4)													
6-10	13 (18 1)													
11-15	13 (18.1)													
16-20	4 (5.6)													
>21	5 (6 9)													
Screened	0 (0.7)	NΔ	NΔ					<0.001				<0.001		
Vec	1187 (58.9)	NA	NA			10/8 (57.2)	139 (76 በ)	\$0.001		102 [/3 0]	1080 (61 0)	\$0.001		
No	828 (41.1)					784 (42.8)	44 (24 D)			135 (57 0)	490 (39 D)			
Type of	020 (41.1)			NA		704 (42.0)	44 (24.0)	0.003		100 (07.0)	070 (07.0)	<0.001		
screening				110				0.000				\$0.001		
Routine	672 [63 1]	672 (63 1)	Ω			619 (64 6)	53 (49 5)			12 (13 5)	590 (60 8)			
Post-exposure	202 (26 0)	303 (34 0)	0			330 (35 /.)	56 (50 5)			77 (84 5)	381 (39.2)			
r ost-exposure	373 (30.7)	373 (30.7)	U			557 (55.4)	54 (50.5)			// [00.0]	JOI (J7.2)			

Data are presented as n (%) or mean±sp,unless otherwise stated. Descriptive statistics stratified by tuberculosis (TB) screening, infection (TB or latent tuberculosis infection (LTBI)) and exposure, and crude and adjusted p-values of the variables' effects on each of the three responses. HCW: healthcare worker; NA: not applicable. #: medical or intensive care.

Regional differences in the response rates were initially detected but failed to become statistically significant in the regression models. The results can be extrapolated to the working population.

The major reason for the absence of screening was it not being offered. Post-exposure screening revealed a higher incidence of LTBI than routine screening (p=0.003) and treatment compliance was higher post-exposure (OR 2.9327, 95% CI 1.7154–5.0137). The most frequently screened individuals were of intermediate age (OR 1.419, 95% CI 1.097–1.836), worked in a hospital (OR 2.264, 95% CI 1.833–2.798), were female (OR 1.284, 95% CI 1.033–1.597), worked in nonsurgical services (OR 1.553, 95% CI 1.195–2.020) and had been previously exposed to TB (OR 1.858, 95% CI 1.395–2.474). Exposure occurred most frequently in older subjects (OR 1.705, 95% CI 1.230–2.363), those who worked in nonsurgical services (OR 1.553, 95% CI 1.195–2.020) and hospital workers (OR 1.729, 95% CI 1.253–2.387). Infection rates were higher in middle-aged individuals (OR 2.628, 95% CI 1.713–4.031), hospital workers (OR 1.745, 95% CI 1.218–2.499), workers in nonsurgical services (OR 2.398, 95% CI 1.393–4.132) and those previously exposed to TB (OR 2.053, 95% CI 1.062–3.967).

Concern about the side-effects of treatment was the factor cited most by individuals who refused screening, as well as those who opted not to be treated for LTBI. Similar results were reported previously [7], in that only 48.9% of 235 exposed HCWs with negative or unknown pre-exposure TST status had post-exposure TST tested. Another study reported that compliance with TST screening was very low (12.3%), and that increased information about transmission and testing did not increase compliance [5].

One striking observation was that most unscreened professionals were not offered screening. This finding suggests that institutional measures are insufficient or incorrectly applied.

We also found that treatment compliance was low (51.8%). Although we do not have data about whether treatment was not started or not completed, the percentage of noncompliant individuals was higher than in a previous study [7], in which 46 (93.9%) out of 49 HCWs prescribed treatment actually started treatment but 82.6% of those failed to complete treatment. Similar results were observed in non-HCW individuals [13], in that treatment completion rates were higher after exposure to TB. We found that the percentage treated for LTBI was almost three-fold higher in HCWs diagnosed after exposure than after routine screening.

Taken together, these results indicate that physicians and nurses did not consider LTBI treatment as an important measure to avoid TB, with the side-effects of treatment being the most frequent reason for noncompliance. This behaviour was similar to that in a previous survey [6], in which compliance was even lower, with only about 25% of physicians who were indicated for LTBI treatment completing it.

It is surprising that some professionals stated they did not receive training in TB, suggesting that they may not regard graduate education as training or that curricula are insufficient. This factor may explain why HCWs are unaware of TB epidemiology and pathogenesis and did not recognise the consequences of latent TB. A study assessing LTBI treatment of immigrants [14] also found that providers lacked knowledge of TB, both in written tests and in practice.

We could not determine whether TB in these HCWs was mainly due to nosocomial exposure, since about 50% of affected individuals reported having TB before starting professional activity, as did one third of individuals with LTBI. This reflects the higher risk in community settings of countries with an intermediate incidence of TB [15]. Our findings indicate, however, that most affected HCWs were identified during their first years of professional activity.

The study had several limitations. The survey was electronically distributed, anonymous and self-reported; thus, the validity of the answers could not be confirmed. The survey did not differentiate among screening methods or ask about what was considered positive screening. Moreover, the survey did not differentiate individuals who did and did not adhere to treatment, nor did it evaluate treatment regimens. Although it would be interesting to follow individuals who had LTBI and find differences in their development of TB, the survey was anonymous, preventing such follow-up.

Finding the actual barriers to screening of HCW is paramount. Our study suggest that institutions should have more effective screening programmes and HCWs should receive proper training allowing them to make more informed decisions.

Wider studies throughout Europe should be developed to evaluate these issues.

#### @ERSpublications



## Institutions should have more effective TB screening and HCWs should receive training to make informed decisions http://ow.ly/BSitS

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