Title

A systematic review of active case finding strategies for tuberculosis in homeless populations

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Running head

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KH conceived the systematic review, developed and executed the search, screened results, undertook quality appraisal, and the synthesis, and prepared the manuscript. RT undertook dual screening of 10% of results at all stages, and quality appraisal of all included studies. RT also aided in the synthesis and the preparation of the manuscript. JM aided in conceiving the review, and formed part of the team for discussion of any studies where inclusion or quality assessment was uncertain. JM also aided in the synthesis and the preparation of the manuscript.

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SUMMARY

Setting: Tuberculosis (TB) is prevalent in the homeless population, creating health inequalities and challenging eradication. Evidence-based approaches to active case finding (ACF) are needed.

Objectives: To determine the effectiveness of ACF for TB control, and identify strategies to improve uptake of screening and the diagnostic pathway, in homeless populations, in low and medium-burden settings. Secondary objectives included assessing yield of screening, and participant characteristics.

Design: A systematic search of electronic databases and grey literature sources identified ACF studies that reported population measures (prevalence or incidence) of TB control, and/or uptake and/or yield of screening for latent TB infection (LTBI) or active TB affecting any site. Studies are described using narrative synthesis.

Results: 20 studies met with the inclusion criteria. Studies were heterogeneous across multiple elements including programme design, which likely contributed to variability in outcomes. ACF was associated with reductions in TB rates in three time-trend analyses. The strongest evidence for improving uptake of screening is for incentives, with mixed evidence for peer educators. Observationally, professional support and mandatory screening may also improve uptake, and additional community support enhances completion of the diagnostic pathway. Those most likely to be diagnosed with TB appeared less likely to accept screening. Yield of screening was 1.5-57% (41,684 participants) for LTBI, and 0-3.1% (91,771 participants) for active TB.

Conclusion: Observational evidence suggests ACF is effective. Strategies to improve screening uptake are identified. Variability in uptake and yield necessitates programmes tailored to local populations, and areas for further research are identified.

INTRODUCTION

Diagnosis of TB is divided into passive and active case finding (ACF). ACF refers to strategies to identify people with TB, who would not otherwise have sought timely medical care.[1] "ACF" is used interchangeably with "screening" in the literature. Systematic screening of the homeless is recommended for active disease[2,3] and latent TB infection (LTBI), according to local epidemiology and resource availability.[4] In a review including multiple settings,[5] prevalence of TB amongst the homeless ranged from 0.2% to 7%, attributable to biomedical and social factors.[6] With declining global incidence,[7] TB in the homeless therefore creates health inequalities, and challenges effective control in the general population.[2]

Multiple approaches to screening for TB are recommended for underserved groups.[3] Varying definitions of homelessness complicate the assessment of screening interventions. TB risk is elevated in multiple homeless subpopulations,[6] and international policy has moved to adopt the broader ETHOS (European Typology of Homelessness and Housing Exclusion) typology.[3,8] ETHOS describes four categories of homelessness: roofless, houseless, insecure housing and inadequate housing. The evidence used in international guidelines frequently defines homelessness as those who are roofless or houseless,[9] and uses studies that include mixed high risk groups.[3] Although social risk factors can coincide, this approach assumes homogeneity of factors determining screening effectiveness, and of TB risk across groups. Other published reviews focus on the effectiveness of single screening modalities in ACF for the homeless.[10,11]

We completed a systematic review of ACF strategies for the broader homeless population. We aimed to assess effectiveness of ACF for population TB control through analysing changes in incidence or prevalence. Further, to identify interventions to improve uptake of screening and the diagnostic pathway. Secondary aims were to assess ACF yield, cost-effectiveness, the characteristics of participants accepting screening, and being diagnosed with TB, and identify unintended consequences.

METHODS

Consistent with ETHOS,[8] this review used a broad definition of homelessness. Active TB and LTBI diagnoses were defined as per the study diagnostic pathway. Interventions included all strategies to improve uptake of screening and the diagnostic pathway. All screening modalities were included, although yields of Miniature Mobile Radiography (MMR) were excluded from the analysis due to limitations of MMR.[12] Comparators within studies were reviewed, but were not obligatory. Regarding outcomes, tuberculin skin testing (TST) uptake figures represent proportions offered a test who returned for TST reading. Other outcomes chosen by authors were also considered. All study types were considered, and no publication date limit was applied. Only full-text articles available in English were included. The PICOS and inclusion and exclusion criteria are shown in Tables 1 and 2, respectively.

Table 1. PICOS elements

Table 2. Inclusion and Exclusion Criteria

We developed a search strategy relating to concepts of “ACF”, “tuberculosis” and “homeless person”, (see online appendix). It was adapted for six electronic databases; EMBASE, CINAHL Plus, ASSIA, ProQuest Dissertations and Theses, Scopus, and the Cochrane Library. All were searched on 30/06/2017. Grey literature sources included Grey Literature Report, Open Grey, WHO iris, ECDC, NHS evidence, NICE guidance and evidence. We also attempted to contact corresponding authors, and searched reference lists of included studies for additional studies. Titles, abstracts and full text were screened by KH. A random sample of 10% were screened independently at each stage by RT with calculation of an inter-rater reliability score using Cohen’s κ. All authors discussed studies where inclusion was uncertain, to achieve consensus.

Data extraction forms were developed and piloted on three studies. All studies meeting inclusion criteria were appraised independently by two reviewers (KH and

RT) for risk of bias with modified critical appraisal checklists, relevant to the study type.[13,14,15] Studies were then given a grading of A-C; A (low risk of bias), B (potential bias but findings likely to remain valid) and C (high risk of bias), corresponding to the Cochrane assessment of bias.[16] Any disagreement was resolved by discussion. Studies graded C were excluded.

Due to significant heterogeneity of studies identified at the scoping stage of the review, with regard to populations, interventions, settings and outcomes, a narrative synthesis was planned. Ethical approval was not required. The protocol is registered in PROSPERO, CRD42017071375. PRISMA checklist available in the online appendix.

RESULTS

The database search returned 5,266 results, including 471 duplicates. Additional sources revealed a further three studies. Screening titles and abstracts identified 42 studies for full text review, of which 22 studies met the inclusion and exclusion criteria. 20 of the included studies met the quality criteria. Five studies[17-21] were graded A, 15[22-36] were graded B. See online appendix for studies rejected from the shortlist. Cohen's K for agreement between the authors was 0.96 at title screening, 1.0 at abstract screening and 1.0 at full text review stage. Figure 1 shows the selection process.

Figure 1: Study selection flowchart

Study Characteristics

Tables 3 and 4 describe the studies and outcomes. All were conducted in urban centres in Europe (12 studies), USA (7 studies), or Australia (1 study). Two[17,18] were randomised-controlled trials, four[22-25] were observational time series, and the other 14 were descriptive studies, many with quasi-experimental designs. Studies had a diverse range of objectives; five[17,18,24,26,27] aimed to assess interventions to improve screening uptake, and the remaining 15[19-23,25,28-36] aimed to assess overall programme effectiveness. In four studies[18,27-29] "homeless" was not defined, and could not be clarified by attempting to contact authors. Only three studies[26,30,31] applied a broad definition of homelessness, the remainder focussed on shelter users, explicitly or by nature of the study design. Screening was mostly carried out onsite at homelessness service venues. Screening modalities were diverse, most commonly chest x-ray (CXR) and TST were used. Five of the 10 CXR studies[17,21,22,26,29] used mobile CXR.

Table 3. Included study characteristics and evidence grading.

Table 4. Study and screening details, and outcomes.

Effectiveness of ACF – population measures

Three time series[22,23,25] showed that incidence or prevalence of active TB declined in the screened homeless population following implementation of screening programmes. The observational nature of these studies challenges attribution of causality. Two of these studies[22,23] however also demonstrated a reduction in clustering of cases in the screened population. Bernard *et al*.[22] reported that clustered cases declined during screening from 14.3/year to 2.7/year in the screened homeless population (p<0.01), whereas clustering of cases in homeless people not undergoing screening remained stable. One study[25] also reported reduced LTBI rates, following ACF for both active and LTBI.

Interventions to improve uptake

The uptake of screening was reported in the two RCTs,[17,18] and 8 studies using non-RCT designs.[19-21,23,26,27,31,32] Uptake ranged from 26-90%, varying regardless of whether studies used outreach or centralised screening facilities (see Table 4).

One RCT assessed peer eductors,[17] the other, peer support and incentives.[18] Monetary incentives improved attendance for completion of screening from 53% to 84%, (p<0.001).[18] Regarding peer support and/or education, results are conflicting, although the studies did differ by screening modality and setting. One showed no improvement in uptake of mobile CXR,[17] adjusted relative risk 0.98 (CI 0.78-1.22). The other[18] reported completion of screening following a TST improved from 53% to 74% with peer support (p=0.004). The best evidence is therefore for incentives, with uncertainty around peer support.

In total, nine studies[17-19,21,26-28,31,32] included incentives. In addition to the RCT reported above,[18] two before and after comparison studies, also reported an improvement in uptake; from 25% to 62%,[26] and from 12% to 47%.[27] The remaining studies[19,21,31,32] reported uptake with incentives ranging from 26% to 90%, or did not report the impact of incentives.[17,28]

Professional support for ACF was provided in three observational studies by community health workers,[20,26] and primary care physicians.[24] Education for

participants was also described.[19] Before and after comparisons of professional education and support increased screening uptake from 25% to 45%[26] in one study, and by an undefined amount in another.[24] Uptake varied widely from 18% to 87% amongst studies using professional support,[19,20,26] and there were other differences between studies, including incentives.

Three observational studies from the USA,[33] Switzerland[19] and Poland[30] explicitly described free screening. Of these, only one[19] reported uptake, high at 87%, but notably screening was combined with education and incentives. Additionally, many studies were in countries with universal or targeted free healthcare. One screening programme was mandatory to access temporary housing.[23] In the four years after implementation, uptake increased, and incidence declined from 510 to 121 per 100,000 per year.

The diagnostic pathway

Diagnostic pathways required assessment in secondary care, or public health departments. The RCT[18] assessing completion of screening provides evidence that peer support and incentives are of benefit. A further six observational studies reported uptake of diagnostic pathways. In three studies[19,26,31] where arrangements were made for same day assessment, or participants were escorted, supported or incentivised to attend, uptake was 70% to 92%. The other three studies[21,26,35] reported following usual referral pathways, and uptake of the diagnostic pathway was lower at 44% to 57%. Thus, observational evidence supports the experimental findings.

Secondary outcomes

Across four observational studies[23,25,29,31] a total of 41,684 participants were screened for LTBI, with reported diagnostic yields ranging from 1.5% to 57%. Three studies[23,25,31] reported completion of treatment rates, ranging from 6% to 84%. Across 12 studies[18,19,22,23,25,26,29-31,33,34,36] a total of 91,771 participants were screened for active TB with reported diagnostic yields ranging from 0 to 3.1%. Six

studies[20,26,27,31,34,36] reported completion of treatment rates, ranging from 35% to 100%.

Two studies compared those who accepted and refused screening. Bock *et al.*[33] reported uptake of screening was more likely if participants knew someone with TB (Odds Ratio (OR) 1.4 (95% Confidence Interval (CI) 1.15-1.7)), had completed high school (OR 1.25 (CI 1.01-1.29)), were not currently abusing drugs or alcohol (OR 1.31 (CI 1.16-1.48)), were not of African-American origin (OR 0.79 (CI 0.68-0.91)) and had previously had screening (OR 1.31 (CI 1.17-1.46)). Janssens *et al.*[19] reported uptake of screening was associated with being male (p=0.002), younger than 25 years (p=0.001), homeless for less than a year (p=0.005) and staying in a shelter for fewer than seven nights (p=0.036). Meanwhile, multiple studies[20,26,27,31,34,36] reported that immigrants and older males with a history of alcohol abuse were more likely to screen positive, and be diagnosed with TB. Lau *et al.*[35] and Capewell *et al.*[32] reported that those diagnosed through screening were more likely to be sputum negative (57% vs 19%, p<0.01), and have less advanced disease, than those diagnosed through passive case finding.

No unintended consequences of ACF were reported. Only three studies[21,29,34] reported cost-effectiveness; these evaluations were limited by their age and methodological issues. We did not identify evidence that uptake was superior for any specific screening modality. Exploring concerns that TST uptake is limited by low return rates; five studies[18,25,28,31,33] reported proportions of participants with a TST injected, who subsequently returned for TST reading. These ranged from 60% to 89%.

DISCUSSION

The review provides observational evidence[22,23,25,30] that ACF is associated with reduced TB transmission and incidence. Causality is unproven however, as multiple other interventions were implemented for homeless and general populations over these periods. Screening yields support the hypothesis that ACF will reduce morbidity and mortality, through earlier diagnosis of disease.[35] Screen-detected cases are also less likely to be smear positive,[32,37] reducing the potential for onwards transmission.[38] Consistent with existing literature,[5] reported prevalence of TB varied. Those in practice should therefore use this evidence alongside WHO recommendations[4,39] that programme developers consider local factors, including the target group risk profile, costs, availability, feasibility, and objectives of screening.

The strongest evidence on improving screening and diagnostic pathway uptake was for material incentives, with conflicting evidence on peer support.[17,18] This may reflect the context-specific nature of peer support, or, other differences in study design. Further benefits of peer support include improved social support, and reduced drug and alcohol use.[41] Therefore, practitioners and policy-makers should consider wider benefits, alongside acceptability.

The observational evidence supports modifying usual referral pathways for this population. There was weak evidence for professional support and/or education improving uptake, consistent with findings for mixed underserved groups.[42] Additionally, mandatory screening to access shelter accommodation also appeared effective.[23] However, concerns exist around adverse consequences, including increasing stigma.[40] Most studies used mobile screening, and evidence for comparison to centralised screening was limited.

Our findings are consistent with previous reviews showing that ACF using CXR screening improves diagnosis and reduces transmission,[9,10,11] and that incentives improve uptake and completion of screening.[9] We report the low quality of evidence and heterogeneity of studies, limitations similar to previous reviews.[9,10,11] However, our review is directly applicable to the target population, whereas in reviews considering mixed groups, most evidence relates to screening migrants.[9]

The review highlights challenges to developing screening programmes. Individuals most at risk appear less likely to accept screening, an issue that extends beyond TB.[43] Homeless individuals do believe healthcare is important, but biomedical screening must incorporate a biopsychosocial response, sensitive to the populations' values.[44] Screening programmes also need supported linkage to diagnostic and treatment pathways, as progression beyond initial screening was often poor. Some TB programmes adopt this holistic approach,[45] combining ACF and case management. Finally, successful screening must target the correct population. In contrast to international policy,[3] the studies generally focussed on adult shelter users. Homelessness is not a static entity and TB risk is elevated across the spectrum of homelessness,[6] thus ACF and the research field should reflect the evidence and policy context.

Mobile, poorly quantified populations, with co-existent drug, alcohol and other health issues, present difficulties for experimental studies, and for effective TB control. However, evidence from studies at lower risk of bias is required and has proven possible. Currently, we must interpret existing evidence pragmatically.[46] Building rigorous evaluation into ACF programme planning would add to the available evidence. Accurately assessing incidence is difficult, therefore investigators should specifically consider reporting outcomes such as uptake and yield. Improved understanding of why programmes are more or less effective at engaging the intended population requires qualitative studies, seeking perspectives of service providers and service users. Such studies were outside the scope of this review. Areas particularly requiring improved evidence include mobile screening, uptake of different screening modalities, linking screening with diagnosis and treatment, and cost effectiveness.

Strengths and limitations

We developed a comprehensive search, and adhered to good-practice methodology. Further, the diverse range of settings increases generalisability. The heterogeneity of study types, and designs of screening or treatment programmes made the synthesis challenging.

Reporting was generally poor on recruitment methods, sampling frames and whether individuals were screened multiple times. Therefore, some figures for uptake were estimates, and opportunities arose for selection bias. There was insufficient evidence for some outcomes, few studies screened for LTBI, and no studies used newer tests such as Interferon Gamma Release Assays. Finally, restriction to the English language limited the selection base.

CONCLUSION

ACF appears effective observationally, yet high quality evidence is limited for strategies to optimise programmes. The strongest evidence for improving screening uptake and completion is for incentives, with mixed evidence for peer support. Descriptive evidence shows professional support and mandatory screening may also improve uptake, and highlights factors that could limit ACF effectiveness, particularly poor linkage to diagnostic and treatment pathways. Considering the variability in outcomes, and limitations of existing evidence, programmes should be locally tailored, and areas for further research are identified.

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Table 1. PICOS elements

PICOS element	Description
Population	Homeless populations, using the broad ETHOS typology
Intervention	Community-based ACF strategies (including targeted ACF programmes for homeless populations, and additional ACF interventions to improve uptake of screening and/or the diagnostic pathway)
Comparison	Comparators within studies, including RCTs, and time-series. Where possible, comparisons between studies will be made. Comparators are not a pre-requisite for study inclusion
Outcomes	Changes in homeless or general population incidence or prevalence Uptake of screening (both initial uptake and completion of the diagnostic pathway) Secondary outcomes: yield of ACF, study definitions of homelessness, cost-effectiveness, characteristics of individuals recruited to ACF studies, unintended consequences
Study Types	Studies reporting quantitative outcomes Experimental and observational studies will be assessed against the inclusion criteria

ETHOS: European Typology of Homelessness and Housing Exclusion, ACF: Active Case Finding.

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria
Study is set in medium or low burden country, as per WHO definitions[7]
Study participants are homeless (as per ETHOS, including those with no accommodation or unsuitable or temporary accommodation)
Study reports quantitative outcomes of effectiveness, including uptake and yield of screening, and of diagnostic pathways, cost-effectiveness and changes in general and homeless population TB rates.
Study reports on screening for any kind of TB (LTBI and/or active, and affecting any site)
Screening is based in the community (but may include referral to secondary care)
Exclusion criteria
Study includes other populations, or mixed populations where the data for homeless individuals cannot be extracted independently
Study includes only a narrow subgroup of homeless, for example those with HIV
Study reports only qualitative outcomes
Screening is to control an outbreak
Prevalence studies not connected to an ACF study or programme, and not reporting on other measures of effectiveness such as uptake of screening

WHO: World Health Organization, ETHOS: European Typology of Homelessness and Housing Exclusion, TB: Tuberculosis, LTBI: Latent TB Infection, HIV: Human Immunodeficiency Virus, ACF: Active Case Finding.

Table 3. Included study characteristics and evidence grading.

Author (year)	Study Aim	Study Design	Study Location	Study Grade
Aldridge (2015)[17]	Evaluate the effect of peer educators on screening uptake	Cluster RCT	London, UK	A
Bernard (2012)[22]	Evaluate the impact of an ACF programme on TB transmission among homeless	Observational time series	Paris, France	B
Bock (1999)[33]	Evaluate the effectiveness of a tuberculin screening and isoniazid preventative therapy programme for a high risk, inner city population	Descriptive	Atlanta, USA	B
Capewell (1986)[32]	Describe the experience of using mobile MMR unit for screening hostel dwellers and compare to those passively diagnosed, report uptake and outcome of screening.	Descriptive	Edinburgh, UK	B
Citron (1995)[26]	Evaluate how best to improve TB detection, treatment and prevention and determine prevalence in homeless group	Descriptive	London, UK	B
Forman (2003)[28]	Evaluate a TB screening questionnaire in addition to incentivised TST screening	Descriptive	Alaska, USA	B
Goetsch (2012)[20]	Evaluate feasibility and sustainability of a screening programme, coverage, case-finding rate and characteristics of cases for homeless and illicit drug users	Descriptive	Frankfurt, Germany	A
Janssens (2017)[19]	Assess screening program acceptability in homeless and TB prevalence	Descriptive	Geneva, Switzerland	A
Jimenez-Fuentes (2014)[36]	Evaluate the screening and treatment programme for high-risk groups in Barcelona	Descriptive	Barcelona, Spain	B
Kimerling (1999)[34]	To interrupt TB transmission and evaluate the feasibility and utility of spot sputum screening in shelters, and symptom screening among a general homeless population	Descriptive	Birmingham , USA	B
Kong (2002)[23]	Describe the implementation of the screening programme and evaluate its effect on incidence and transmission	Observational time series	Denver, USA	B
Lau (1997)[35]	Review retrospectively the effectiveness of hostel screening programme, with emphasis on screening follow up	Descriptive	Sydney, Australia	B
Mcadam (2009)[25]	Examine trends of latent and active TB across homeless persons at selected sites where screening is being employed	Observational time series	New York, USA	B
Miller (2006)[29]	Compare health impacts and costs of two TB programmes: state-law mandated screening in prison, and non-mandated homeless shelter outreach screening	Descriptive with economic analysis	Texas, USA	B
Patel (1985)[27]	To evaluate the impact of incentives (food or cigarette vouchers) on attendance at screening	Descriptive	Glasgow, UK	B
Pilote (1996)[18]	Evaluate interventions (incentives and peer health advisors) to aid adherence to full screening programme	RCT	San Francisco, USA	A

Romaszko (2016)[30]	Evaluate whether the active case finding programmes in Poland were associated with reductions in TB incidence in the general population in Poland	Descriptive with modelling	Poland	B
Shanks (1982)[24]	Evaluate methods to improve attendance at MMR screening at hostels	Observational time series	Manchester, UK	B
Southern (1999)[31]	Evaluate a screening programme for homeless and compare different screening modalities, studying feasibility, yield and completion of cases.	Descriptive	London, UK	A
Stevens (1992)[21]	Evaluate an MMR screening programme in hostels	Descriptive	London, UK	B

RCT: Randomised Controlled Trial, ACF: Active Case Finding, CXR: Chest x-ray, TST: Tuberculin skin test, MMR: Miniature Mobile Radiography.

Table 4. Study and screening details, and outcomes.

Author (year)	Study length	Type of TB		Definition of homelessness	Location		Intervention in addition to screening programme	Comparator	Initial Screening modality					Screening Outcomes			
		Latent	Active		On site	Central			MMR	CXR	TST	Qu**	Sputum	Offered	Uptake (%)	Latent TB yield	Active TB yield
Aldridge (2015)[17]	20m		✓	Currently in hostel	✓		Peer educators on the day of screening. 27-38% received incentives	Cluster RCT: randomised to peer educator or usual care (on site screening)		✓				Total: 2342 C: 1192 I: 1150	C: 503 (45%) I: 468 (40%)	NR	NA
Bernard (2012)[22]	14y		✓	Shelter user, or non-user (not defined)	✓		Nil	Non-shelter dwellers and time series		✓				4000-5000/yr	22,000 (NR)	NA	0.8%
Bock (1999)[33]	2y	✓	✓	In shelter or on streets for 1/+ nights in last year	✓	✓	Free screening and treatment	Nil		✓	✓			NR	2065 (NR)	NR	0%
Capewell (1986)[32]	7y		✓	Currently in hostel	✓		Incentives	Passively detected cases	✓					7832-18026	4687 (26% - 64%)	NA	896 per 100,000 Xrays (0.9%)
Citron (1995)[26]	5m		✓	Statutory, single or potentially homeless	✓		Incentives, education and CHW	PI: mobile screening PII: incentive PIII: education, incentive and CHW		✓			✓	PI: 2000 PII: 303 PIII: 779	PI: 595 (25%) PII: 187 (62%) PIII: 611 (45%)	NA	PI: 1.5% PII: 0% PIII: 2%
Forman (2003)[28]	1m		✓	NR	✓		Incentives	Nil			✓	✓		NR	61 (NR)	NR	NR
Goetsch (2012)[20]	5y		✓	Stayed for 2/+ nights in one of the shelters		✓	CHW education and facilitation of screening	Screening for drug users		✓				8876-12822	2308 (18-26%)	NR	NR

Author (year)	Study length	Type of TB		Definition of homelessness	Location		Intervention in addition to screening programme	Comparator	Initial Screening modality					Screening Outcomes			
		Latent	Active		On site	Central			MMR	CXR	TST	Qu**	Sputum	Offered	Uptake (%)	Latent TB yield	Active TB yield
Janssens (2017)[19]	6m		✓	Seeking shelter place or self-defining	✓	✓	Education, free care and incentives for diagnostics	Nil		✓		✓		832	726 (87%)	NA	0%
Jimenez-Fuentes (2014)[36]	3y		✓	Seeking shelter place or free meal services		✓	Nil	Screening for drug users and recent immigrants		✓		✓		NR	3,654 (NR)	NA	0.3%
Kimerling (1999)[34]	10m		✓	Currently in shelter	✓		Nil	Nil					✓	NR	127 (NR)	NA	3.1%
Kong (2002)[23]	4y	✓	✓	Requiring temporary housing	✓	✓	Mandatory screening for admission to shelter	Time series			✓	✓		NR	T: 10,027 1995: 893 (26%) 1998: 3,897 (~67%)	12.8%	T: 0.1% 1995: 0.6% 1998: 0.1%
Lau (1997)[35]	5y		✓	Currently in hostel	✓		Nil	Passively diagnosed cases	✓					NR	3,555 (NR)	NA	0.05%
Mcadam (2009)[25]	14y	✓	✓	Currently in hostel	✓		Nil	Time series			✓	✓		NR	28,835 (NR. Of city homeless: 1992: ~3%, 2005: ~14%	1992: 57% 2006: 30%	1992: 1.5% 2004: 0.2%
Miller (2006)[29]	1y	✓	✓	NR	✓		Nil	Prison screening programme		✓	✓	✓		NR	822 (NR)	22%	1%
Patel (1985)[27]	5y		✓	NR	✓		Incentives	Before and after and non-incentivised screening	✓					NR	C: NR (12%) I: 9,132 (47%)	NA	1.4%

Author (year)	Study length	Type of TB		Definition of homelessness	Location		Intervention in addition to screening programme	Comparator	Initial Screening modality					Screening Outcomes			
		Latent	Active		On site	Central			MMR	CXR	TST	Qu**	Sputum	Offered	Uptake (%)	Latent TB yield	Active TB yield
Pilote (1996)[18]	2y		✓	NR	✓		Travel vouchers, incentives and peer health advisers to complete screening	3 armed RCT: usual care (travel voucher), incentive and peer health adviser			✓			1,460 initial screening	Initial screening: 1,257 (78%) C: (53%) Inc: (85%) Peer: (74%)	NA	1.7%
Romaszko (2016)[30]	10y		✓	ETHOS cats 1-3: no address or extreme poverty		✓	Free screening	Other Polish Provinces and Poland as a whole		✓				NR	944 (NR)	NA	2.2%
Shanks (1982)[24]	5y		✓	Currently in shelter	✓		Primary care physician promoting and supervising screening	Before and after, and non-intervention shelters	✓					NR	Before: 230-260 C: 185 I: 682	NR	NR
Southern (1999)[31]	2y	✓	✓	Temporary or insecure housing, in a hostel or sleeping rough	✓		Incentives	Nil		✓	✓	✓		NR	2,000 (40-90%)	1.5%	0.5%
Stevens (1992)[21]	0.5m		✓	In a shelter	✓		Incentives	Nil	✓					1250	547 (44%)	NA	0%

M: months, y: years, Inc: Incentive, P: Phase, T: Total, I: Intervention, C: Control, RCT: randomised controlled trial, NR: not recorded, NA: not available, Qu: questionnaire, CHW: community health worker, ~: approximate. Central location: screening at a general healthcare or public health facility. Uptake %: % those offered screening who accepted. Yield %: % those screened who

were diagnosed, ETHOS: European Typology of Homelessness and Housing Exclusion. MMR: Miniature Mobile Radiography, CXR: Chest X-Ray, TST: Tuberculin Skin Test

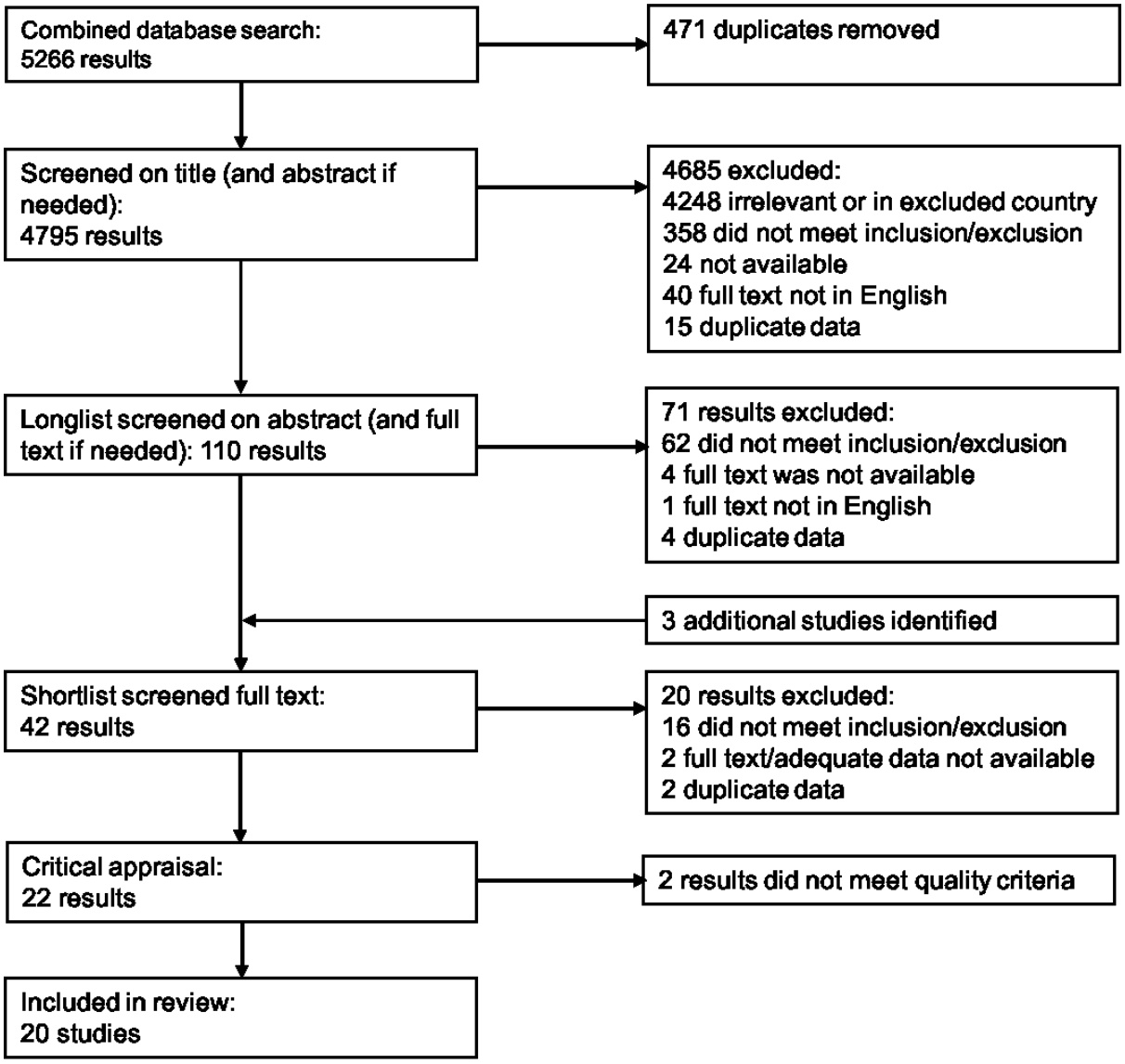

Figure 1: Study selection flow chart