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Supplementary appendix

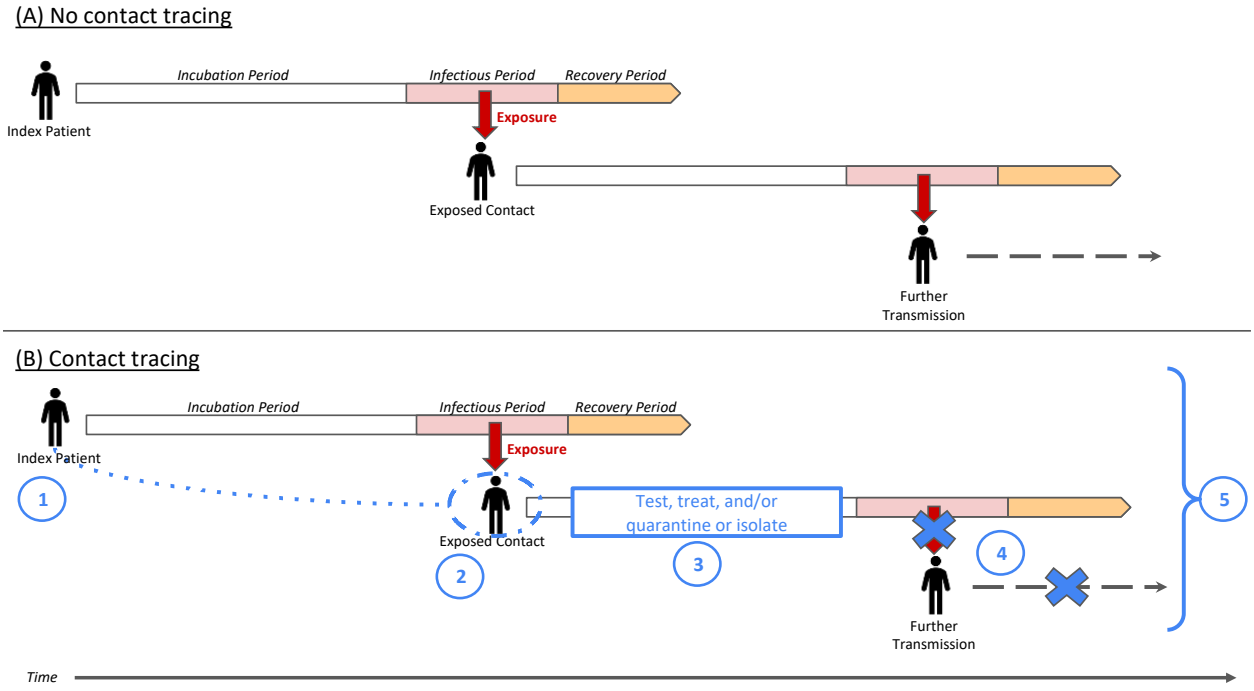
This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Hossain AD, Jarolimova J, Elnaiem A, Huang CX, Richterman A, Ivers LC. Effectiveness of contact tracing in the control of infectious diseases: a systematic review. *Lancet Public Health* 2022; published online Feb 15. https://doi.org/10.1016/S2468-2667(22)00001-9.

Supplementary Appendix

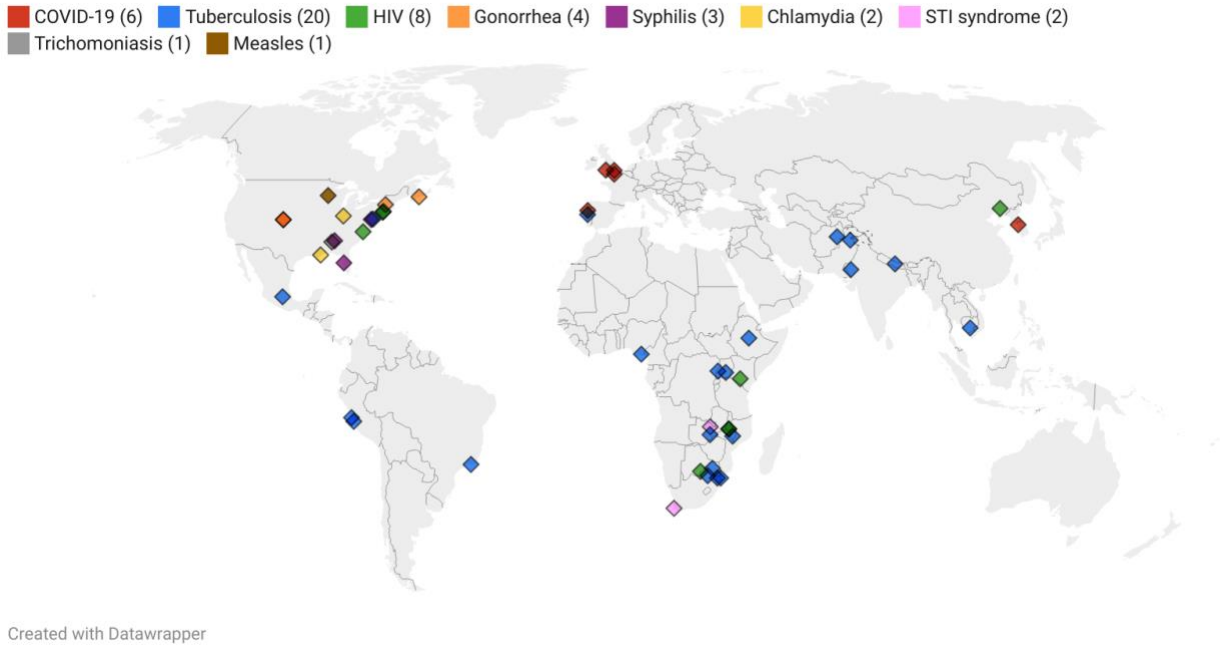
Contents:

Appendix Figure S1. Schematic illustrating processes and goals of contact tracing.



Panel A illustrates the spread of a stylized infectious disease in the absence of contact tracing. Panel B shows how contact tracing mitigates disease transmission via several steps: (1) Exposed contacts are elicited (either directly from an index patient, through known exposure networks such as workplaces or neighborhoods, or through digital or other technologies); (2) Exposed or potentially exposed individuals (contacts), who may or may not be infected, are identified and contacted; (3) Exposed contacts are assessed and managed – which may include testing, treatment (including prophylactic treatment), and quarantine (or isolation) – ideally before they become infectious; (4) Further transmission from exposed contacts is prevented; (5) Data collected in the process helps to detect clusters of cases and improve overall understandings of pathogen dynamics and epidemiology.

Appendix Figure S2. Geographic locations of all included studies of contact tracing.



Number of included studies for each infection in parentheses.

Appendix Table S1. PubMed* database search.

("Contact tracing"[All Fields] OR "contact trace"[All Fields] OR "Contact tracer" [All Fields] OR "Contact investigation" [All Fields] OR "contact investigations" [All Fields] OR "contact investigator" [All Fields] OR "contact examination" [All Fields] OR "contact examiner" [All Fields] OR "Contact screen" [All Fields] OR "Contact screening" [All Fields] OR "contact screener" [All Fields] OR "partner notification" [All Fields] OR "partner notifier" [All Fields] OR "partner notice" [All Fields])

*Search strategy adapted for Embase and Cochrane Library. No language or date limits were utilized.

Appendix Table S2. Definitions of contact tracing interventions and control interventions.

Term	Definition
Intervention definitions	
Provider-initiated contact tracing	Contact tracing in which a trained provider confidentially directly notifies the index patient's contacts, with the index patient's consent, of infection exposure and need for additional evaluation or management; either immediately (provider referral[13,14]) or after a pre-determined time allowed for initial patient-initiated contact tracing (contract referral[13,14]). Alternate terms include partner services[15] and assisted partner notification services[14]
Household contact tracing	Provider-initiated contact tracing in which a health worker visits the home of an index patient to evaluate other household members for signs of infection
Control definitions	
Patient-initiated contact tracing	Contact tracing in which index patients are counseled by a trained provider to notify partners of exposure themselves. Alternate terms include passive referral,[14] self-referral,[13] patient referral,[13] and partner notification services[14]
Passive case finding	Routine health facility-based care in which patients are evaluated for signs of an infectious disease only if they present seeking care for symptoms which could be consistent with that disease[15]
Facility-based screening	Health facility-based care approach in which all patients presenting to a clinic are evaluated for signs of an infectious disease, regardless of their reason for attending clinic
Other definitions	
Digital contact tracing	Contact tracing implemented with the assistance of digital tools, such as proximity tracing tools, symptom tracking tools, or outbreak response tools[16]

Appendix Table S3. Definitions of high-burden and lower-burden settings for tuberculosis.

Definition	Criteria
High-burden settings for tuberculosis	Settings where the tuberculosis prevalence, incidence, or case notification rate (reported by the study) was greater than 100 per 100,000 people during the study period. This cutoff value was decided by following the example of a previous study by Baussano and colleagues.[a] Where these values were not specified, settings were considered 'high-burden' if located in countries appearing on the World Health Organization's list of high-burden countries for tuberculosis, multidrug-resistant tuberculosis, or tuberculosis-HIV coinfection during the study period[b]
Lower-burden settings for tuberculosis	Settings that did not meet either criteria to be defined as 'high-burden' settings for tuberculosis

[a]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3298382/
[b]https://www.who.int/tb/publications/global_report/high_tb_burdencountrylists2016-2020.pdf?ua=1

Appendix Table S4. Study risk of bias ratings.

Study	Country	Design	Bias Tool Used*	Average Newcastle-Ottawa Scale Score (if applicable)	Overall Risk of Bias†
COVID-19					
Fetzer and Graeber (2021)[20]	United Kingdom	Quasi-experimental design, with difference-in-differences regression	Newcastle-Ottawa Scale	8·5	Low
Kendall et al. (2020)[21]	United Kingdom	Retrospective cohort study	Newcastle-Ottawa Scale	7·5	Low
Liu et al. (2021)[22]	130 countries	Country-level cohort study	Newcastle-Ottawa Scale	7·5	Low
Malheiro et al. (2020)[23]	Portugal	Retrospective cohort study	Newcastle-Ottawa Scale	5	Some
Park et al. (2020)[24]	South Korea	Pre-post design	Newcastle-Ottawa Scale	5	Some
Wymant et al. (2021)[25]	United Kingdom	Retrospective cohort study	Newcastle-Ottawa Scale	8·5	Low
Tuberculosis					
Ayles et al. (2013)[26]	Zambia, South Africa	Cluster randomized controlled trial (2x2 factorial design)	Cochrane Risk of Bias Tool		Low
Becerra et al. (2005)[27]	Peru	Prospective cohort study	Newcastle-Ottawa Scale	6·5	Some
Cavalcante et al. (2010)[28]	Brazil	Cluster randomized controlled trial	Cochrane Risk of Bias Tool		Low
Davis et al. (2019)[29]	Uganda	Cluster randomized controlled trial	Cochrane Risk of Bias Tool		Low
Dongo et al. (2021)[30]	Uganda	Pre-post design	Newcastle-Ottawa Scale	5·5	Some
Duarte et al. (2012)[31]	Portugal	Pre-post design	Newcastle-Ottawa Scale	5	Some
Eyo et al. (2021)[32]	Nigeria	Prospective cohort study with historical comparison	Newcastle-Ottawa Scale	5·5	Some
Fatima et al. (2016)[33]	Pakistan	Pre-post design	Newcastle-Ottawa Scale	5·5	Some
Gashu et al. (2016)[34]	Ethiopia	Cross-sectional study	Newcastle-Ottawa Scale	7	Low
Gurung et al. (2021)[35]	Nepal	Prospective cohort study	Newcastle-Ottawa Scale	6	Some
Hanrahan et al. (2019)[36]	South Africa	Cluster randomized controlled trial	Cochrane Risk of Bias Tool		Low
Hernández-Garduño et al. (2015)[37]	Mexico	Longitudinal population-based study	Newcastle-Ottawa Scale	5·5	Some
Khatana et al. (2019)[38]	India	Quasi-randomized controlled trial	Cochrane Risk of Bias Tool		Some
Kliner et al. (2013)[39]	Eswatini	Pre-post design, with sequential implementation of interventions	Newcastle-Ottawa Scale	7·5	Low
Mandalakas et al. (2017)[40]	Eswatini	Prospective cohort study	Newcastle-Ottawa Scale	8	Low
Morishita et al. (2016)[41]	Cambodia	Cluster randomized controlled trial (quasi-experimental)	Cochrane Risk of Bias Tool		Low
Sanaie et al. (2016)[42]	Afghanistan	Prospective cohort study	Newcastle-Ottawa Scale	5·5	Some
Shah et al. (2020)[43]	Peru	Cluster randomized control trial (stepped wedge design)	Cochrane Risk of Bias Tool		Some
Young et al. (2016)[44]	United States	Observational, with hypothetical control	Newcastle-Ottawa Scale	6	Some
Zachariah et al. (2003)[45]	Malawi	Pre-post design	Newcastle-Ottawa Scale	5·5	Some
HIV					
Brown et al. (2011)[46]	Malawi	Randomized controlled trial	Cochrane Risk of Bias Tool		Low
Chen et al. (2021)[47]	Malawi	Randomized controlled trial	Cochrane Risk of Bias Tool		Low

Cherutich et al. (2017)[48]	Kenya	Cluster randomized controlled trial	Cochrane Risk of Bias Tool		Low
Grande et al. (2021)[49]	Botswana	Pre-post design	Newcastle-Ottawa Scale	6	Some
Hu et al. (2021)[50]	China	Randomized controlled trial	Cochrane Risk of Bias Tool		Low
Landis et al. (1992)[51]	United States	Randomized controlled trial	Cochrane Risk of Bias Tool		Some
Malave et al. (2008)[52]	United States	Retrospective cohort study	Newcastle-Ottawa Scale	5·5	Some
Udeagu et al. (2014)[53]	United States	Prospective cohort study	Newcastle-Ottawa Scale	4	Some
Curable sexually transmitted infections					
CDC MMWR (1992)[55]	United States	Pre-post design	Newcastle-Ottawa Scale	5	Some
Du et al. (2007)[57]	United States	Longitudinal population-based study	Newcastle-Ottawa Scale	8·5	Low
Ehlman et al. (2010)[54]	United States	Prospective cohort study	Newcastle-Ottawa Scale	4·5	Some
Faxelid et al. (1996)[64]	Zambia	Randomized controlled trial	Cochrane Risk of Bias Tool		Low
Jones et al. (2021)[62]	United States	Pre-post design	Newcastle-Ottawa Scale	6·5	Some
Katz et al. (1988)[63]	United States	Randomized controlled trial	Cochrane Risk of Bias Tool		High
Mathews et al. (2021)[65]	South Africa	Randomized controlled trial	Cochrane Risk of Bias Tool		Low
Peterman et al. (1997)[56]	United States	Randomized controlled trial	Cochrane Risk of Bias Tool		High
Potterat and Rothenberg (1977)[58]	United States	Quasi-randomized controlled trial	Cochrane Risk of Bias Tool		Some
Schleihauf et al. (2019)[59]	Canada	Pre-post design	Newcastle-Ottawa Scale	7	Low
Schwebke and Desmond (2010)[61]	United States	Randomized controlled trial	Cochrane Risk of Bias Tool		Low
Woodhouse et al. (1985)[60]	United States	Pre-post design	Newcastle-Ottawa Scale	7·5	Low
Measles					
Banerjee et al. (2021)[66]	United States	Outbreak investigation	Newcastle-Ottawa Scale	8·5	Low

Study citations follow the order of references in the main article. *The Cochrane Collaboration Risk of Bias Tool was used to assess risk of bias in randomized studies,[17] and the Newcastle-Ottawa Scale was used to assess risk of bias in nonrandomized studies.[18]

†Two reviewers independently assessed risk of bias for each included study. When the Cochrane Collaboration Risk of Bias Tool was used, the overall risk of bias was determined by following the tool's standardized instructions: studies assessed to have 'low' risk of bias in all tool domains were considered to have 'low' overall risk, studies assessed to have 'some' risk of bias in at least one tool domain were considered to have 'some' overall risk, and studies assessed to have 'high' risk of bias in at least one domain OR assessed to have 'some' risk of bias in two or more domains in a way that "substantially lowers confidence in the result" were considered to have 'high' overall risk.[17] Any conflicts in the overall risk of bias assessment were adjudicated by a third reviewer or by consensus. When the Newcastle-Ottawa Scale was used, the overall risk of bias was determined by the average score of the two reviewers: greater than or equal to 7 was considered 'low' overall risk, greater than or equal to 4 but less than 7 was considered 'some' overall risk, and less than 4 was considered 'high' overall risk.

Appendix Table S5. Country income levels and disease burdens for tuberculosis-focused studies.

Study	Country	Study Years	World Bank Income Level of Country during Study Period*	Setting	Tuberculosis Prevalence, Incidence or Case Notification Rate in Study Setting during Study Period	High- or Lower-Burden
Studies evaluating the impact of provider-initiated contact tracing						
Ayles et al. (2013)[26]	South Africa, Zambia	2010	Upper-middle income (South Africa) and lower-middle income (Zambia)	16 communities in Zambia and eight communities in South Africa (urban and rural)	Notification rate of at least 400/100,000 per year in all study communities	High
Becerra et al. (2005)[27]	Peru	1996-1997	Lower-middle income	Low-income neighborhood in Lima (urban)	Estimated incidence between 170-340/100,000 per year	High
Cavalcante et al. (2010)[28]	Brazil	2000-2004	Upper-middle income (2000-2001) and lower-middle income (2002-2004)	Eight neighborhoods in Rio de Janeiro City (urban)	Estimated incidence of 240/100,000 (presumably per year)	High
Dongo et al. (2021)[30]	Uganda	2014-2016	Low income	Two districts: Kabarole (rural) and Wakiso (peri-urban)	Estimated incidence for 2018 (two years after the study) of 200/100,000 (presumably per year)	High†
Eyo et al. (2021)[32]	Nigeria	2017-2019 (historical comparison 2015-2018)	Lower-middle income	Three states in southern Nigeria: Akwa Ibom State (intervention state), Cross River State (intervention state), and Rivers State (control state) (not specified if urban or rural)	Not specified	High†
Gashu et al. (2016)[34]	Ethiopia	2011-2014	Low income	Six zones in Oromia and Amhara regions (rural)	Case notification rate greater than 130/100,000 (presumably per year) in all study zones	High
Gurung et al. (2021)[35]	Nepal	2017-2018 (historical comparison 2014-2017)	Low income	Eight districts (not specified if urban or rural)	Estimated incidence of 245/100,000 per year around the time of the study period	High
Hanrahan et al. (2019)[36]	South Africa	2017-2019	Upper-middle income	Catchment area of 56 primary care clinics in Limpopo Province (rural)	Estimated prevalence of 300/100,000	High
Hernández-Garduño et al. (2015)[37]	Mexico	1990-2010§	Upper-middle income	Whole country (urban and rural)	Whole country incidence of 18·7/100,000 during years of interest (2007-2010)	Lower
Khatana et al. (2019)[38]	India	2014-2015	Lower-middle income	Two communities in Kashmir (rural)	Case notification rate (for the broader state) of 74/100,000 per year	Lower
Kliner et al. (2013)[39]	Eswatini	2011-2012	Lower-middle income	Catchment area of a regional hospital (rural)	Estimated incidence of 1317/100,000 (presumably per year)	High
Mandalakas et al. (2017)[40]	Eswatini	2013-2015	Lower-middle income	Seven basic management units (BMUs) in Eswatini (urban and rural)	Not specified	High†
Morishita et al. (2016)[41]	Cambodia	2012-2014	Low income	30 districts with high rates of poverty (not specified if urban or rural)	Case notification rate greater than 125/100,000 (presumably per year) in all study districts	High
Sanaie et al. (2016)[42]	Afghanistan	2011-2012	Low income	Six provinces (not specified if urban or rural)	Not specified	High†
Shah et al. (2020)[43]	Peru	2012-2014	Upper-middle income	Densely-populated district in Lima (urban)	Study district with "among the highest [tuberculosis] rates in the Western Hemisphere"; around 30% of health centers in study district reported notification rates "two to four times higher than the Peruvian national [tuberculosis] notification rate (99 cases/100,000)"	High
Young et al. (2016)[44]	United States	2012	High income	All 50 states and Puerto Rico (urban and rural)	Not specified	Lower‡

Zachariah et al. (2003)[45]	Malawi	2001-2002	Low income	One district (rural)	Not specified	High†
Studies comparing programmatic adaptations within provider-initiated contact tracing						
Davis et al. (2019)[29]	Uganda	2016 - 2017	Low income	Catchment area of seven primary care clinics in Kampala (urban)	Not specified	High†
Duarte et al. (2012)[31]	Portugal	2001-2006	High income	City of Vila Nova de Gaia (urban)	Estimated incidence of 34/100,000 (presumably per year)	Lower
Fatima et al. (2016)[33]	Pakistan	2011-2013	Lower-middle income	Four districts with high concentration of low-income neighborhoods (urban)	Not specified	High†

Study citations follow the order of references in the main article. *Country income classifications were obtained from the World Bank website (https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bankcountry-and-lending-groups).

†The study country appeared on the World Health Organization's list of high-burden countries for tuberculosis, multidrug-resistant tuberculosis, or tuberculosis-HIV coinfection (https://www.who.int/tb/publications/global_report/high_tb_burdencountrylists2016-2020.pdf?ua=1) during the study period.

‡The study country did not appear on the World Health Organization's list of high-burden countries for tuberculosis, multidrug-resistant tuberculosis, or tuberculosis-HIV coinfection (https://www.who.int/tb/publications/global_report/high_tb_burdencountrylists2016-2020.pdf?ua=1) during the study period.

§While Hernández-Garduño et al. (2015) collected data from 1990 to 2010, the outcome of interest to our review was measured from 2007-2010.[37]

Appendix Table S6. Summary of included studies of contact tracing for HIV.

Study	Country	Study Years	Design	Setting	Sample	Intervention*	Control	Outcome Measured	Results†	Risk of Bias
Studies evaluating the impact of provider-initiated contact tracing										
Brown et al. (2011)[46]	Malawi	2008-2009	Randomized controlled trial	Sexually transmitted infection clinics (urban)	240 index patients; 302 partners	Provider-initiated contact tracing by: 1) Contract referral (7 days), 2) Provider referral	Patient-initiated contact tracing	Case detection among contacts	Provider and contract referral were associated with **higher detection of new HIV diagnoses** among locatable partners: provider referral 21/82 (25·6%, 95% CI 16-35%), contract referral 21/88 (23·9%, 95% CI 15-33%), and passive referral 12/82 (14·6%, 95% CI 7-22%)	Low
Chen et al. (2021)[47]	Malawi	2015-2019	Randomized controlled trial	2 sexually transmitted infection clinics in Lilongwe (urban)	1885 index patients, 335 partners, 81 social contacts, and 2 other contacts of unknown relation	Provider-initiated contact tracing by contract referral (7 days), as well as patient-initiated referral of social contacts and testing for acute HIV infection (for HIV-seronegative and HIV-serodiscordant participants)	Patient-initiated contact tracing	Case detection among contacts	Contract referral (with patient-initiated referral of social contacts and testing for acute HIV infection in seronegative and serodiscordant participants) was associated with a **higher detection rate of new HIV cases per index patient** (0·06, 95% CI 0·04-0·08), compared to	Low

									patient-initiated contact tracing (0·03, 95% CI 0·02-0·04) (RR 1·9, 95% CI 1·2-3·1)	
Cherutich et al. (2017)[48]	Kenya	2013-2015	Cluster randomized controlled trial	18 HIV testing clinics (rural and urban)	1119 index patients, 1872 partners	Provider-initiated contact tracing	Patient-initiated contact tracing	Case detection among contacts	Provider referral **significantly increased the rate of new HIV diagnoses overall** (23·2% vs 4·1%) **and per index patient** (0·247 vs 0·049; IRR 5·0, 95% CI 3·2-7·9) compared to passive referral.	Low
Grande et al. (2021)[49]	Botswana	2018-2020	Pre-post design	40 clinics run by the Ministry of Health (not specified if urban or rural)	6440 index patients, 6071 partners	Post-period (January-March 2020): Index patients (both newly and previously diagnosed) offered a variety of services, including provider-initiated contact tracing, patient-initiated contact tracing (including option for "dual referral" where patient and provider notify partner together), self-test kits to share with partners, and referrals for "community testing" (not fully described)	Pre-period (October 2018-June 2019): patient-initiated contact tracing (only for newly diagnosed index patients), including option for "dual referral"	Case detection among contacts	There was **no significant difference** in the number of partners diagnosed with HIV per index patient before (0·13) versus after (0·14) the expansion of contact tracing services (p=0·50).	Some

Hu et al. (2021)[50]	China	2017-2019	Randomized controlled trial	HIV testing clinic in Shenyang City (urban)	187 index patients, 663 partners	Index patients were allowed to choose between 1) provider-initiated contact tracing via text message or a message on social media (the message invited partners for HIV testing, but did not disclose their possible exposure nor the name of the index patient); or 2) receiving HIV self-test kits that they could deliver to partners	Patient-initiated contact tracing	Case detection among contacts	Giving index patients the option of choosing either provider-initiated contact tracing or HIV self-testing kits resulted in a **greater number of partners diagnosed with HIV** (10/97 partners testing positive), compared to patient-initiated contact tracing (3/90 partners testing positive).	Low
Landis et al. (1992)[51]	United States	1988-1990	Randomized controlled trial	3 public health departments in North Carolina (rural)	74 index patients, 310 partners	Provider-initiated contact tracing	Patient-initiated contact tracing	Case detection among contacts	Provider referral was associated **with higher case detection:** 9 new HIV diagnoses among 157 reported partners (5·7%), versus 1 new HIV diagnosis out of 153 reported partners with passive referral (0·65%)	Some
Studies comparing programmatic adaptations within provider-initiated contact tracing										
Malave et al. (2008)[52]	United States	2004	Retrospective cohort study	New York City STD clinics and non-STD clinics (urban)	3666 index patients, 925 partners	Provider-initiated contact tracing initiated by NYC public health STD clinics (partners notified by DIS)	Provider-initiated contact tracing initiated by non-STD	Case detection among contacts	**Rate of new HIV diagnoses** among partners with unknown HIV status **was similar among**	Some

							clinics (partners notified by community providers or elicited by community providers and notified by DIS)		**partners elicited and contacted by DIS** (20/74, or 27·0%) versus partners elicited by community providers and contacted by DIS (10/45, or 22·2%; p=0·56), however STD clinics elicited significantly more partners per index patient (0·87 vs 0·22, p<0·01)	
Udeagu et al. (2014)[53]	United States	2011-2012	Retrospective cohort study	New York City (urban)	1828 index patients, 3319 partners	Provider-initiated contact tracing by: 1) Email notification, 2) Text message notification	Traditional provider-initiated contact tracing (mail, telephone, field visits)	Case detection among contacts	**Fewer new diagnoses of HIV** were made among partners not previously known to have HIV by Internet (email) PS (3/267, 1·1%) and text PS (5/325, 1·5%) than by traditional PS (106/2009, 5·3%)	Some

Study citations follow the order of references in the main article. CI = confidence interval; IRR = incidence rate ratio; STD = sexually transmitted disease; DIS = disease intervention specialist; PS = partner services.

*For contract referral, the pre-determined length of time within which patients agreed to notify partners themselves is indicated in parentheses, when available.

†Significance or lack of significance of result is not stated when it was not specified in the study.

Appendix Table S7. Summary of included studies of contact tracing for curable sexually transmitted infections.

Study	Country	Study Years	Design	Setting	Sample	Intervention*	Control	Outcome Measured	Results†	Risk of Bias
Studies evaluating the impact of provider-initiated contact tracing										
CDC MMWR (1992)[55]	United States	1990-1991	Pre-post design	Montgomery County, Alabama (urban)	Post-intervention period: 151 index patients with syphilis, pre-intervention: 78 index patients with syphilis	Early post-intervention period (June-July 1991): Enhanced provider-initiated contact tracing services: increased case finding and partner notification activity, cluster investigation, and public health staffing; expanded STD clinic hours	Pre-intervention period (May-June 1991): baseline contact tracing services (no increased activity or expanded STD clinic hours)	Forward transmission: partners receiving prophylactic treatment	The time period of the enhanced contact tracing campaign was associated with a **significant increase in mean number of persons prophylactically treated per index patient** (3·9 vs 2·5, p<0·01), a 63% **decrease in syphilis incidence (as measured by self-referral of primary and secondary syphilis cases),** and no difference in the number of new cases detected per index patient (0·48 vs 0·37, p=0·66)	Some
Du et al. (2007)[57]	United States	1992-2002	Longitudinal population-based study	15 urban counties, New York state (urban)	37,393 index patients with gonorrhea, 34,807 partners	10% increase in provider-initiated contact tracing measures	NA	Overall disease incidence	Annual **gonorrhea incidence was inversely correlated with every 10% increase** in partners brought to preventive treatment (RR 0·94, 95% CI 0·91-0·97, p<0·0001) and cases interviewed (RR 0·98, 95% CI 0·95-1·00, p>0·05)	Low
Faxelid et al. (1996)[64]	Zambia	1992-1993	Randomized controlled trial	Health center in Lusaka (urban)	396 index patients (94 women, 304 men) with STI syndromes, 730 contacts	Index patients allowed to choose between 1) provider-initiated contact tracing or 2) patient-initiated contact tracing via referral	Patient-initiated contact tracing with no contact slips	Forward transmission: partners receiving prophylactic treatment	Among men, **a significantly greater number of partners per index patient presented to the health center to receive treatment** in the intervention group (1·8) compared to the control group (1·2) (p<0.001). There was	Low

						slips, which included "a brief information on the importance of seeking health care"			no significant difference between the groups among women (0·7 for both). There was no report of how many index patients within the intervention group selected provider-initiated contact tracing versus patient-initiated contact tracing via referral slips.	
Jones et al. (2021)[62]	United States	2017-2020	Pre-post design	New Orleans parish, with recruitment specifically from "barbershops, job training programs, recreation centers, and colleges/ universities" (urban)	184 index patients with chlamydia, 314 partners	Post-period (July 2018-December 2019): Modified "Check It" intervention, which involved patient-initiated contact tracing (following coaching from Check It staff), increased options for expedited treatment for index patients and partners (via pharmacy pickup, mail, or patient-delivered partner therapy), and increased hours of services‡	Pre-period (May 2017-July 2018): Original "Check It" intervention, which involved provider-initiated contact tracing (partners notified by DIS), and expedited treatment for index patients and partners via pharmacy pickup only‡	Forward transmission: partners receiving prophylactic treatment	The modified intervention using **patient-initiated contact tracing resulted in a greater proportion of partners completing treatment** (57/140, 40·7%) compared to the original intervention using provider-initiated contact tracing (22/131, 16·8%) (RR 2·66, 95% CI 1·61-4·39, p<0·0001).	Some
Katz et al. (1988)[63]	United States	1985	Randomized controlled trial	Unspecified location in the United States (not specified if urban or rural)	678 index patients (all men) with nongonococcal urethritis (presumed chlamydia)	Patient-initiated contact tracing: either "nursing referral" (nurse provided index patient with	Provider-initiated contact tracing (partners notified by DIS)	Forward transmission: partners receiving prophylactic treatment	The **number of partners receiving treatment per index patient was significantly higher in the provider-initiated contact**	High

						counseling and referral cards, but did not collect identifying information about partners) or "interview only" (DIS officer provided index patient with counseling, but did not provide referral cards and did not collect identifying information about partners except names)			**tracing group** (0·72) than in either patient-initiated contact tracing group (0·22 for the "nursing referral" group and 0·18 for the "interview only" group) (p<0·001 for both comparisons).	
Mathews et al. (2021)[65]	South Africa	2014-2017	Randomized controlled trial	Clinic in Cape Town (urban)	1050 index patients with STIs, 2178 partners (study accepted no more than 5 partners per patient)	"Enhanced partner notification," involving an offer of provider-initiated contact tracing and patient-initiated contact tracing, as well as communication skills training and education on STIs	Either 1) "health education" (education on STIs provided) or 2) "risk reduction counseling" (education on STIs provided alongside development of a "risk reduction plan" and offer to "role-play negotiating condom use")	Forward transmission: reinfection rate	There was **no significant difference in incidence of reinfection** between enhanced partner notification and health education (IRR 1·0, 95% CI 0·7-1·3, p=0·8). The difference between enhanced partner notification and risk reduction counseling was not reported.	Low
Potterat and Rothenberg (1977)[58]	United States	1975	Quasi-randomized controlled trial§	El Paso County, Colorado (urban)	187 index patients with gonorrhea, 390 partners	Patient-initiated contact tracing via referral slips	Provider-initiated contact tracing by contract referral (10 days)	Case detection among contacts; forward transmission: partners receiving prophylactic treatment	There was **no difference** in the proportion of partners newly diagnosed with gonorrhea between the patient-initiated contact tracing (via referral slips) group (70/198, 35%) and the contract referral group (67/192, 35%). There	Some

									was also essentially no difference in the number of partners newly receiving treatment (49/198, or 25% vs 50/192, or 26%, respectively).	
Schleihauf et al. (2019)[59]	Canada	2014-2016	Pre-post design	Central Zone, Nova Scotia (urban)	343 index patients with gonorrhea	Post-period (May 2015 to December 2016): provider-initiated contact tracing by provider referral or contract referral led by public health nurse	Pre-period (January 2014 to May 2015): patient-initiated contact tracing (with assistance from public health nurse upon request)	Overall disease incidence	Enhanced contact tracing measures were associated with an **increase in mean reported gonorrhea cases/month** (pre: 7·7, post: 11·6, p=0·010) and an increase in laboratory testing percent positivity (pre: 0·27%, post: 0·43%, p<0·001)¶	Low
Schwebke & Desmond (2010)[61]	United States	2003-2008	Randomized controlled trial	Department of Health, Jefferson County, Alabama (urban)	484 index patients with trichomoniasis (all women)	1) Provider-initiated contact tracing by contract referral (2 days), 2) Patient-delivered partner therapy	Patient-initiated contact tracing	Forward transmission: reinfection rate	**There was no difference in trichomoniasis reinfection rates** at 1 month or 3 months between passive referral (9/92 [9·8%], 3/60 [5·0%]) and contract referral (15/100 [15·0%], 5/64 [7·8%]); RR at 1 month 1·24, 95% CI 0·88-1·74, at 3 months 1·23, 95% CI 0·70-2·16	Low
Woodhouse et al. (1985)[60]	United States	1977-1982	Pre-post design	Military base and civilian partnership, Colorado (urban)	7306 index patients with gonorrhea, 11,952 partners	Post-period (1980-1982): provider-initiated contact tracing	Pre-period (1977-1979): patient-initiated contact tracing	Overall disease incidence	**Gonorrhea incidence decreased** by 12·9% from the pre-intervention to post-intervention period (1653 vs 1440 cases) and **repeat infection rate decreased** significantly, from 10·4% to 8·1% (p<0·001)	Low
Studies comparing programmatic adaptations within provider-initiated contact tracing										
Ehlman et al. (2010)[54]	United States	2007-2008	Prospective cohort study	Washington DC (urban)	188 index patients with	Provider-initiated	Provider-initiated	Forward transmission:	**Fewer index patients had at least one**	Some

					syphilis, 888 partners	contact tracing via email	contact tracing via field visits and telephone calls	partners receiving prophylactic treatment	**partner treated for syphilis when email contact was used** (0·03) compared to phone/field (0·26), however the addition of email to traditional contact tracing **increased the total number of index patients with at least one partner treated** by 8%	
Peterman et al. (1997)[56]	United States	1990-1993	Randomized controlled trial	Departments of health in 3 counties in Florida and New Jersey (urban)	1966 index patients with syphilis, 11,272 partners	Provider-initiated contact tracing by 1) Immediate provider referral, 2) Immediate provider referral with option to draw blood for syphilis testing in the field	Provider-initiated contact tracing by contract referral (2 days)	Case detection among contacts	**Similar number tested positive for syphilis per index patient:** Contract referral: 0·20, Field notification: 0·18, Field blood: 0·18, and **prophylactically treated for syphilis per index patient**: Contract referral 0·67; Field notification: 0·61; Field blood: 0·62	High

Study citations follow the order of references in the main article. CDC = Centers for Disease Control and Prevention; MMWR = Morbidity and Mortality Weekly Report; STD = sexually transmitted disease; RR = relative risk; DIS = disease intervention specialist; STI = sexually transmitted infection; IRR = incidence rate ratio.

*For contract referral, the pre-determined length of time within which patients agreed to notify partners themselves is indicated in parentheses, when available.

†Significance or lack of significance of result is not stated when it was not specified in the study.

‡In the study by Jones et al., provider-initiated contact tracing was part of the control strategy, while patient-initiated contact tracing was part of the intervention strategy.[62]

§Index patients in the study by Potterat and Rothenberg were assigned to the intervention and control groups via alternate assignment.[58]

¶Schleihauf et al. noted a short-term increase in incidence during the intervention period attributed to increased case detection and testing percent positivity rate, so we considered this study to be one of the studies reporting a positive association with one of our hypothesized outcomes of interest.[59]

Appendix Table S8. Summary of included studies of contact tracing for measles.

Study	Country	Study Years	Design	Setting	Sample	Intervention	Control	Outcome Measured	Results*	Risk of Bias
Studies evaluating the impact of provider-initiated contact tracing										
Banerjee et al. (2021)[66]	United States	2017	Outbreak investigation	US state of Minnesota (not specified if urban or rural)	All confirmed measles cases in the US state of Minnesota during a 2017 outbreak: 75 index patients	Contact tracing by Minnesota Department of Public Health Staff, where exposed contacts deemed susceptible to measles (did not have proof of vaccination or prior infection) were asked to participate in voluntary "exclusion" (avoid public settings, public transportation, and locations with at-risk populations for 21 days following exposure)	Contact tracing by Minnesota Department of Public Health Staff, where there was not "exclusion" of exposed contacts deemed susceptible to measles	Forward transmission: R(t), relative transmissibility	**R(t) values were lower among traced contacts who were excluded compared to those who were not excluded.** R(t) was calculated using three different methods: using direct epidemiological links (R(t)=0·38, 95% CI 0·20-0·73, versus 1·61, 95% CI 1·00-2·69, respectively), using the Wallinga-Teunis algorithm (R(t)=0·72, 95% CI 0·49-1·02, versus 1·28, 95% CI 0·94-1·68, respectively), and using a combined method (R(t)=0.42, 95% CI 0·22-0·76, versus 1·61, 95% CI 1·01-2·62, respectively). **Relative transmissibility was higher among contacts who were not excluded** (4·2 for the epidemiological method, 95% CI 1·9-9·6, p<0·001). **A negative association was also found between R(t) and the number of days since one began self-excluding or self-isolating** from others.	Low

Study citations follow the order of references in the main article. R(t) = time-varying reproduction number/effective reproduction number; CI = confidence interval.

*Significance or lack of significance of result is not stated when it was not specified in the study.

Systematic review protocol:
Effectiveness of contact tracing in the control of infectious diseases: A systematic review

Review question
What is the effectiveness of provider-initiated contact tracing in controlling the spread of infectious diseases, including COVID-19?

Searches
We will search PubMed, Embase, and the Cochrane Library for studies published ever through 21 April 2020*, with no date or language restrictions. We will manually review reference lists of related reviews and included articles for additional references.

Types of study to be included
Peer-reviewed articles reporting clinical trials and observational studies evaluating the impact of contact tracing interventions deployed by public health or healthcare workers (provider-initiated contact tracing)

Condition or domain being studied
All infectious diseases transmitted through human-to-human contact

Participants/population
Inclusion criteria:

- Studies evaluating the effects of provider-initiated contact tracing compared to the absence of contact tracing or to patient-initiated contact tracing on one of three outcomes of interest: case detection rates among contacts, overall forward transmission of disease, or overall disease incidence
- Studies evaluating an expansion or programmatic adaptation of pre-existing provider-initiated contact tracing services

Exclusion criteria:

- Studies not reporting at least one primary outcome of interest
- Studies without a control group
- Studies using mathematical modeling only
- Studies solely examining patient-initiated contact tracing, in which contacts are notified of exposure and the need for treatment, quarantine, or other measures by the index patient only

Intervention(s), exposure(s)
Provider-initiated contact tracing, in which a trained provider confidentially directly notifies the index patient's contacts, with the index patient's consent, of infection exposure and need for additional evaluation or management; or the expansion or programmatic adaptation of pre-existing provider-initiated contact tracing services

Comparator(s), control(s)
The absence of contact tracing; patient-initiated contact tracing only; or pre-existing provider-initiated contact tracing prior to expansion or programmatic adaptation

Context
All settings in which provider-initiated contact tracing takes place globally (healthcare settings and community settings)

Main outcome(s)
Case detection rates among contacts; overall forward transmission of disease; and overall disease incidence

Measures of effect
Number of identified cases among contacts; disease prevalence among contacts or in the community at large; reproduction number (R); disease incidence in the community at large; and any additional measures of effect assessing at least one of three primary outcomes of interest

Additional outcome(s)
None

Data extraction (selection and coding)
After elimination of duplicate records, we will screen abstracts of all records for full-text review. After screening, one reviewer will independently apply eligibility criteria to each full-text article, and then two reviewers will independently proceed to data extraction for eligible studies. Disagreements will be settled by discussion among all

authors. We will use Covidence systematic review software (www.covidence.org) for deduplication, screening, and data extraction. Two reviewers will independently extract the following data from eligible studies, using a standardized form created for the review: author, infection studied, years of study, location and setting, study design, study population, sample size, details of contact tracing intervention, effect measured, and effect size. Only data reported in published manuscripts or supplemental material will be extracted.

Risk of bias (quality) assessment
We will assess risk of bias within randomized studies using the Cochrane Collaboration Risk of Bias Tool (https://methods.cochrane.org/bias/resources/rob-2-revised-cochrane-risk-bias-tool-randomized-trials) and nonrandomized studies using the Newcastle–Ottawa Scale (http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp).

Strategy for data synthesis
We will report number of records and excluded duplicates, number of screened abstracts and full-text articles assessed for eligibility, and number of excluded articles and reasons for exclusion. We will categorize studies by disease and type of contact tracing intervention, summarizing number and type of studies for each disease, findings of each study, and risk of bias for each study. We expect that interventions and outcomes will be too heterogeneous for meta-analysis, but we may consider this if there are enough studies with similar outcomes and contexts.

Analysis of subgroups or subsets
As above

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Collaborators
Not applicable

Type and method of review
Systematic review

Anticipated or actual start date
21 April, 2020

Anticipated completion date
1 July, 2020*

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Conflicts of interest
None

Language
English

Country
United States of America

Stage of review
Review ongoing

Details of final report/publication(s) or preprints if available
Not applicable

Subject index terms status
Not applicable

Subject index terms
"contact tracing" OR "partner notification" OR "contact investigation" OR "contact examination" OR "contact screening", and their permutations

Date of registration in PROSPERO
Not applicable

Date of first submission
Not applicable

Details of any existing review of the same topic by the same authors
Not applicable

**To ensure our systematic review included the most up-to-date information (i.e., included studies published after 21 April 2020 otherwise meeting inclusion criteria), we exactly repeated this review protocol a second time to additionally capture all studies published between 22 April 2020 and 4 February 2021, and a third time to additionally capture all studies published between 5 February 2021 and 22 November 2021.*