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REVIEW

Measuring trust in vaccination: A systematic review

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ABSTRACT

Vaccine acceptance depends on public trust and confidence in the safety and efficacy of vaccines and immunization, the health system, healthcare professionals and the wider vaccine research community. This systematic review analyses the current breadth and depth of vaccine research literature that explicitly refers to the concept of trust within their stated aims or research questions. After duplicates were removed, 19,643 articles were screened by title and abstract. Of these 2,779 were screened by full text, 35 of which were included in the final analysis. These studies examined a range of trust relationships as they pertain to vaccination, including trust in healthcare professionals, the health system, the government, and friends and family members. Three studies examined generalized trust. Findings indicated that trust is often referred to implicitly (19/35), rather than explicitly examined in the context of a formal definition or discussion of the existing literature on trust in a health context. Within the quantitative research analysed, trust was commonly measured with a single-item measure (9/25). Only two studies used validated multi-item measures of trust. Three studies examined changes in trust, either following an intervention or over the course of a pandemic. The findings of this review indicate a disconnect between the current vaccine hesitancy research and the wider health-related trust literature, a dearth in research on trust in low and middle-income settings, a need for studies on how trust levels change over time and investigations on how resilience to trust-eroding information can be built into a trustworthy health system.

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Introduction

Trust in the safety and efficacy of vaccines, trust in the individuals that administer vaccines or give advice about vaccination, and trust in the wider health system are all important factors which influence the vaccine decision-making process.[1-3] Trust is especially important in light of the increasing number of vaccines recommended or required, as well as the complex safety and efficacy data that form the basis of vaccine policies and recommendations, which means that the public depends on health experts' competence, judgement and ability to interpret these data correctly and in the best interests of the public.[4-9] Due to this complexity, vaccination decisions occur within the context of trust held in the various actors who interpret and make decisions based on the available evidence.[10]

Vaccine-related trust also exists within the additional context of deeper, underlying trust in society at large. The historical legacy of trust/mistrust due to past interactions with official institutions additionally influences generalized trust in society (see Figure 1). These varied histories and experiences mean that public trust in vaccines and immunization programs is highly variable and locally specific.[11] Recognizing trust as a complex web of vaccine-related factors, as well as these external trust factors, can provide valuable insights into levers of vaccine acceptance, hesitancy or refusal.

Definitions of trust

The word 'trust' has been given a multitude of definitions within the health literature. At its core, trust becomes important when there is an implicit imbalance of power due to a high level of information asymmetry, where trusting individuals accept a vulnerable position in relation to a trusted party. In the context of vaccine decisions, one chooses to trust another to help make a risk/benefit-based decision about which one has incomplete information.[12-14]

Trust relationships require an active choice on behalf of the trusting party. Within this choice, trust-based cooperation assumes the trusted party firstly has the trusting individuals' best interests at heart and, secondly, has the expertise and ability to perform at a level of competence that is expected of them.[15] As such, the process of trusting is sometimes described as a leap of faith.[15,16]

We define trust as a relationship that exists between individuals, as well as between individuals and a system, in which one party accepts a vulnerable position, assuming the best interests and competence of the other, in exchange for a reduction in decision complexity.

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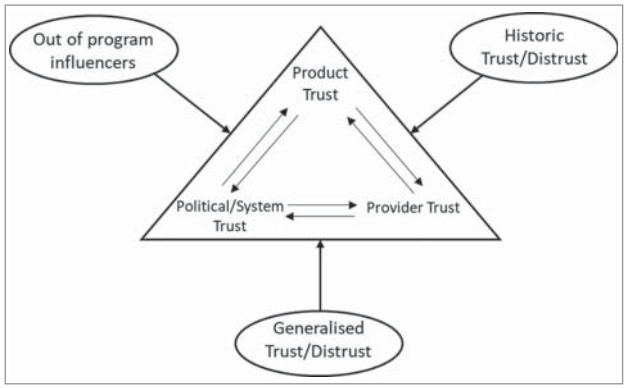

Figure 1. A visulisation of the trust relationship related to vaccination.

Trust relationships related to vaccination

Vaccine acceptance involves multiple levels of trust: trust in the **product** (the vaccine), the **provider** (the specific healthcare professionals or administrative staff that are involved in providing and administering vaccination), and trust in the **policy-maker** (the health system, government, and public health researchers involved in approving and recommending the vaccine).[17]

Trust in information needs to be considered at multiple levels – i.e. trust in the information itself[13,18,19] as well as trust in those who produce and propagate the information.[20,21] In this review, we consider trust in information as nested within the trust held in the source of that information.[18] Each source of information also possesses attributes that inform one's assessment of its trustworthiness and reliability.[22] Finally, perceptions of trustworthiness are subjective, since the same person or institution may be ascribed different levels of trustworthiness by different individuals, depending on those individuals' personal experiences and biases.[23]

External levers of trust

In addition to influences on trust in the context of immunization, there are a number of external factors that influence trust.

Generalized trust

Generalized trust refers to the characteristic trait that differs between individuals with regard to their willingness to trust other members of society in general.[24] When community-mindedness and civic participation are widespread in a society with high average levels of trust, the concept of *generalized trust* forms part of the wider concept of *social capital.* Historically, generalized trust has been said to play an important role in the flow of information from official sources to individuals in a community.[25,26]

Historical influences on trust

How a health system has performed in the past, and the perceived values that it holds, play a substantial role in the process of building trust. Earle & Siegrist[27] describe the dual concepts of *social trust* and *confidence* within their TCC Model of Trust, Confidence and Cooperation.[27-29] *Social trust*, closely relates to the similar concepts of benevolence, fidelity and morality in that its main requirement is a perceived set of shared values between individuals and a trusted party. *Confidence,* conversely, is described as the performance-based aspect of trust in which the competence and ability of the trusted party is assessed. If, therefore, a system is seen to discriminate against a particular population over a sustained period of time, it is likely that that population will lose trust in the system, which has implications for trusting and accepting the health information and interventions it provides in the future.

Religious and ethnic minorities are frequently cited in the healthcare trust literature as holding lower levels of trust in the health system and healthcare professionals (HCPs).[30-32] This distrust can be traced back to historical mistreatment and systematic neglect or abuse of these populations by health and governmental systems.[33,34]

External influencers

Non-official sources of health information also influence decision making.[35,36] Trust in these sources depends on perceived

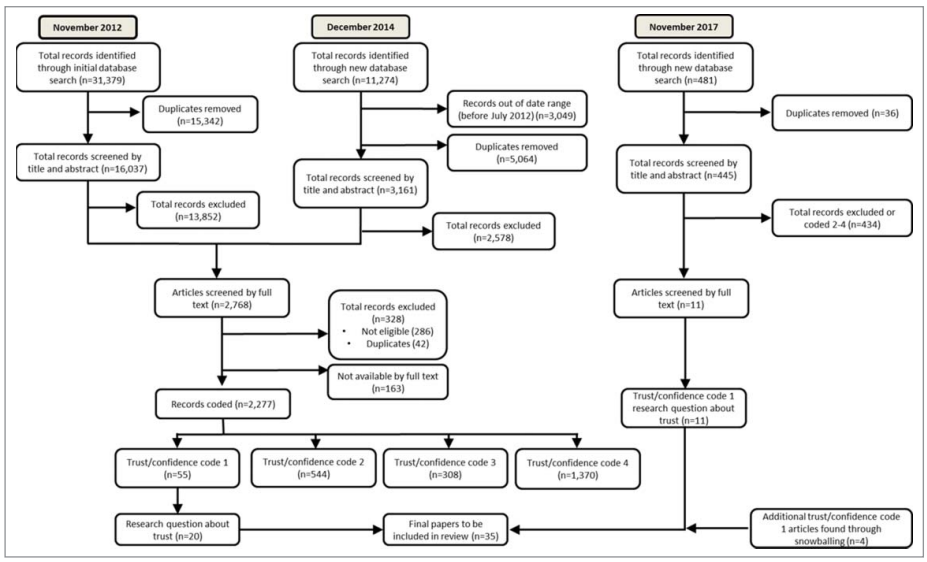

Figure 2. Search flow diagram for systematic review.

motive (*Do the sources have my interests at heart?*) and ability (*Have they been competent and reliable in the past?*). These external influencers can include an individual's own friends and family members, and non-official medical advice from religious organizations, alternative health networks, politicians and celebrities.

Mechanisms by which trust-based cooperation is built or eroded

Vaccination-related trust is considered in this review as a complex interaction between the core elements of trust in the product, provider and policy-maker and the external levers of trust – generalized trust, historical trust and other influences outside of the health system (see Figure 1). Trust related to vaccination is strengthened when external levers align with the vaccine-related trust factors, and it is weakened when these are misaligned. If trust is lost in the vaccine-related players, then trust is more likely to be placed in other influencers, who may be indifferent to vaccination or may actively oppose it.

Objectives

The objectives of this systematic review are to:

(1) Investigate how studies conceptualize and measure the concept of trust as a prominent factor in vaccine intention or uptake;
(2) Discuss how the research compares to the wider literature on trust in the context of health decisions; and
(3) Investigate the different dimensions of trust and their relationships as they influence vaccine uptake.

Methods

Search strategy

Ten different medical and social science literature databases were searched for peer-reviewed articles on trust in vaccines or vaccination programs. These databases were Medline, Embase, PsychInfo, Cochrane, CINAHL Plus, Web of Science, LILACS, Africa-Wide Information, IBSS and IMEMR. Other than the time periods covered by each database, no additional time limitations were set.

A set of keywords was created to reflect the core concepts: vaccination and public perceptions, decision-making, and vaccination behaviour. Using Medline as a foundation database, these keywords were first refined and then systematically adapted (e.g. alternative truncations) and applied to the remaining databases. Adaptations were extended to subject headings and descriptors where appropriate.

In Medline, the keyword search terms were: vaccin$, immunis$ and immuniz$ (Concept 1) and anxiety, attitude$, awareness, behavio?r, belief$, criticis$, doubt$, distrust$, dropout$, exemption$, fear$, hesitanc$, trust, mistrust, perception$, refusal$, rejection, rumo?r, intent$, controvers$, misconception$, misinformation, opposition, delay, dilemma$, objector$, uptake, barrier$, choice$, mandatory, compulsory, concern$, accepta$, knowledge, parent$ con$, confidence, decision making, anti-vaccin$, antivaccin$.

The following MeSH terms were also included in the search: Vaccination, Vaccines, Mass Vaccination, Immunization and Immunization Programs and Public Opinion, Attitude to Health, Attitude, 'Health Knowledge, Attitudes, Practice', Patient acceptance of health care, Treatment Refusal, Parental Consent, Decision Making, Prejudice and Internet.

The search was run across all databases during the period 12–19 November 2012 and again on 15 December 2014 (see Figure 2). We conducted a final update to this review on 17 November 2017 for which we used a reduced version of the previous search terms, including only (vaccin$ or immunis$ or immuniz$) and (distrust$ or trust or mistrust or rumo?r) and narrowed the year range to 2015–2017.

Study selection

Studies were included if they met the following criteria: (i) they included research on trust/distrust, perceptions, concerns, confidence, attitudes, beliefs about vaccines and vaccination programs; (ii) they were published in a peer-reviewed journal; (iii) they were written in English.

Literature was excluded if it was: (i) about non-human vaccines or vaccines not currently available; (ii) related to research and development of vaccines (unless explicitly about public trust, confidence, concern or hesitancy); (iii) non-peer-reviewed or non-research papers.

The screening of titles and abstracts was shared between at least two authors and a sample of studies was independently coded to ensure consistency.

Data extraction

The included papers were assigned a numerical trust code based on the following criteria:

- Code 1: Primary research question about trust.
- Code 2: Trust referred to as a dimension, factor or variable (i.e. trust is identified in the results or named as a determinant related to vaccine acceptance, although not explicitly investigated in the research question).
- Code 3: Trust is mentioned in a peripheral way (e.g. in discussion section, but not in methods or results).
- Code 4: No reference to trust.

The papers coded as trust code 1 were then screened by full text, and only papers with research questions specifically about trust were included in our analysis. A data extraction form was developed by the authors. Information extracted included details about the study country, vaccine, population of focus, study methodology and trust factor (e.g. the health system, health care professional, the government etc.).

[**references in order of table**[37-64]]
[**references in order of table**[65-71]]

Results

After duplicates were removed, 19,643 articles were screened by title and abstract and 2,779 articles were screened by full text. Thirty-five articles were included in the analysis.

Characteristics of studies

Of the 35 included studies, over half (21/35) were conducted in the USA. Two studies were conducted in Taiwan, one study was in India, and one in Japan. The remaining nine studies were conducted in either Western Europe or Australia. The target vaccine/vaccination program varied between studies with 11 studies focusing on childhood vaccinations (standard vaccine schedule or specifically MMR, rotavirus, or influenza vaccine), 14 studies focusing on adult vaccinations (HPV, seasonal influenza, pandemic influenza, postpartum pertussis, smallpox, or anthrax vaccine) and three studies focusing on the adolescent HPV vaccination. Investigated trust factors predominantly included the information from and/or the trust placed in the health system, healthcare professionals, the government, science or trusted others (e.g. friends, family, alternative healthcare professionals, non-official internet sources, celebrities). Three studies investigated the concept of *generalized trust*.

Quantitative studies

Context of trust

Of the 28 quantitative studies reviewed, ten studies examined trust in the context of vaccine uptake, six studies examined trust in the context of intention to vaccinate, ten studies examined factors associated with vaccine trust and two studies examined HCPs trust in the health system and their likelihood to give a strong recommendation to vaccinate (see Table 1). Findings from these studies indicated that combined trust in the health system, trust in science and trust in government have an indirect effect on the likelihood of HCPs recommending vaccination.[56]

All studies measured some aspect of vaccination trust (see Figure 1). Factors outside of the specific vaccine or vaccination program were measured less frequently, with three studies examining generalized trust,[40,45,57] three studies examining out-of-program influences[44,54,61] and one study examining changes in trust over time.[62] Wada and Smith[61] was the only study to have referenced the concept of trustworthiness and its findings indicated that respondents who did not trust a vaccination recommendation were more likely to consider other non-medical sources as being trustworthy.

Definition and measurement overview

Eighteen of the quantitative studies did not contain a definition of trust or a discussion of the concepts present within the trust literature, despite explicitly mentioning trust within their aim or research question.[37,39,41-44,46,48,49,51-54,56,58,60,61,64] By leaving the definition of trust implicit, these papers created ambiguity around this core concept. Four studies[38,47,50,63] included some brief mentions of relevant trust concepts (e.g. a distinction between social trust and confidence). Only six studies defined trust through extensive reference to previously published peer-reviewed trust literature.[40,55,57,59,62,72]

Among the 25 studies that reported their measures, only three used previously validated or widely used measures of trust.[49,57,60] Five studies constructed measures of trust explicitly informed by published trust literature.[40,50,59,62,72] A further five studies, while not explicitly mentioning the trust literature, used metrics that reflected aspects of confidence and social trust as they are conceptualized in the literature.[38,52,58,63,64] The remaining studies (10 of 25) measured trust with a single-item measure that either asked the respondents to indicate their level of trust in the trust subject (e.g. individual services, or the system) or in the information provided.[39,41,43,44,46,48,54-56,61]

[***Footnote:*** A full reporting of measures used can be found in the supplemental materials]

Studies focused on vaccination uptake

Within the quantitative studies that examined the relationship between trust and vaccine uptake 7/10 studies reported measuring trust in the health system, 5/10 reported measuring trust in primary HCPs, 4/10 reported measuring trust in government and 1/10 reported measuring *generalized trust*. No studies focusing on vaccine uptake examined other subjects of trust such as trust in science, trust in the media or trust in influential individuals outside the immunization system (such as friends and family, religious or community leaders, celebrities, alternative healthcare professionals).

Trust in the health system was reliably found to predict vaccine uptake in regression analyses[47,51] or was found to be significantly associated with retrospective reports of a vaccine uptake.[38,39,43,49] A positive association was also identified between trust in HCPs and vaccine uptake in 4/6 studies measuring this factor.[38,46,50,51]

Three out of the four studies that examined trust in government found a significant positive association between trust and vaccine uptake.[38,46,50] The one study[57] investigating *generalized trust* found a significant positive association between generalized trust and vaccine uptake.

One study used a validated trust measure[49] – the Group-Based Medical Mistrust Scale.[73] Ronnerstand[57] and Lee et al.[50] used the standard *generalized trust* question[24] and use an adapted version of the Trust in Physician Scale[74] respectively.

Studies focused on 'intention to vaccinate'

Among the six studies that investigated intention to vaccinate, trust in the health system was the most-measured trust factor (4/6 studies).[52,59,60] Two studies measured trust in governments,[40,62] one study measured trust in HCPs[52] and one study measured generalized trust.[40] All trust factors measured were found to be positively associated with an increased intention to vaccinate.

Three of the studies made a distinction between *social trust* and *confidence*,[59,60,62] one of which mentions the TCC Model of Trust, Confidence and Cooperation specifically.[62] One study used a validated trust measure[60] in the form of the Health Care System Distrust Scale.[75]

Additionally, an experimental study by Scherer et al.[58] indicated that showing individuals a summary of the vaccine adverse effect data slightly increased trust in the health system, however showing detailed reports greatly reduced trust.

Studies that measured factors associated with vaccine trust

In ten studies, multiple trust factors were identified[37,41,48,54,64] and formed the primary focus of the study.[44,55,61,63,72]

Table 1. Characteristics of quantitative studies.

	Year data collected	Location	Vaccine(s) of focus	Study methodology	Number of participants	Cohort or comparison	Demographic of focus	Type of trust studied. Trust in…
Berry, Gold, Ryan, Duszynski & Braynack-Mayer (2012)[37]	2011	Australia	Childhood, General	Questionnaire/ survey	2002	Cohort	Parents, Urban and rural	- Health System (Data management)
Casiday, Cresswell, Wilson & Panter-brick (2006)[38]	2004	United Kingdom	Childhood, MMR	Questionnaire/ Survey	996	Comparison	Parents	- Health System (Trust in factor) - HCP (Trust in factor)
Cheng, Huang, Shaw, Kao & Chueh (2010)[39]	2009	Taiwan	Postpartum, Pertussis	Questionnaire/ Survey	1207	Comparison	Mothers, Postpartum	- Health System (Information)
Chuang, Huang, Tseng, Yen & Yang (2015)[40]	2014	Taiwan	Adult, Pandemic influenza	Questionnaire/ Survey	1745	Cohort	Adults	- Generalized trust - Government (Trust in factor)
Cooper, Hernandez, Rollins, Akintobi & Mcallister (2017)[41]	2014	USA	Adult, HPV	Questionnaire/ Survey	1203	Comparison	Adults, Males	- Health System (Information)
Das & Das (2003)[42]	1998	India	Childhood, General	Questionnaire/ Survey	146	Cohort	Parents	- HCP (Trust in factor)
Fowler, Baggs, Weintraub, Martin, McNeil & Gust (2006)[43]	2002-2004	USA	Adult, Anthrax	Questionnaire/ Survey	404	Comparison	Laboratory workers	- Health System (Information)
Freed, Clark, Butchart, Singer, & Davis (2011)[44]	2009	USA	Childhood, General	Questionnaire/ Survey	1552	Cohort	Parents	- Health System (Information) - Government (Information) - Media (Information) - Friends and family, non-expert celebrities (Information)
Freimuth, Jamison, An, Hancocj & Quinn (2017)[45]	2015	USA	Adult, Influenza	Questionnaire/ Survey	1630	Comparison	Adults, African American and White	- Generalized trust - Health System (Trust in factor) - HCP (Trust in factor) - Government (Trust in factor) - Vaccination (Trust in concept)
Fu, Zimet, Latkin & Joseph (2017)[46]	2012-2014	USA	Adolescent, HPV	Questionnaire/ Survey	400	Comparison	Parents, African American	- Health System (Trust in factor) - HCP (Trust in factor)
Gilles et al (2011)[47]	2009	Switzerland	Adult, Pandemic Influenza	Questionnaire/ Survey	601	Comparison	Adults	- Health System (Trust in factor) - Government (Trust in factor)
Grabenstein, Guess, Hartzema, Koch & Konrad (2002)[48]	1998	USA	Adult, Influenza	Questionnaire/ Survey	2090	Cohort	Adults, 65+ yrs	- Health System (Comparison between traditional sites and non-traditional sites for vaccination)
Kolar, Wheldon, Hernandez, Young, Romero-Daza & Daley (2015)[49]	2011	USA	Adult, HPV	Questionnaire/ Survey	711	Comparison	Adults, racial/ethnic minority students	- Health System (Trust in factor)
Lee, Whetten, Omer, Pan & Salmon (2016)[50]	2002-2003	USA	Childhood, General	Questionnaire/ Survey	2445	Comparison	Parents	- Government (Trust in factor) - HCP (Trust in factor)
Manika, Ball, Stout & Stout (2014)[51]	Does not state	USA	Adult, HPV	Questionnaire/ Survey	117	Comparison	Adults, Females, University students	- Health System (Information) - HCP (Information)
Marlow, Waller & Wardle (2007)[52]	2006	United Kingdom	Adolescent, HPV	Questionnaire/ Survey	684	Comparison	Parents, Mothers	- HCP (Trust in factor)

(*Continued on next page*)

Table 1. (*Continued*)

	Year data collected	Location	Vaccine(s) of focus	Study methodology	Number of participants	Cohort or comparison	Demographic of focus	Type of trust studied. Trust in…
McPhillips, Davis, Marcuse & Taylor (2016)[53]	2000	USA	Childhood, Rotavirus	Questionnaire/ Survey	558	Cohort	HCPs, Physicians	- Health System (Trust in factor) - Government (Trust in factor) - HCS (Trust in factor)
Moran, Frank, Chatterjee, Murphy & Baezconde-Garbanati (2016)[54]	Does not state	USA	Childhood, General	Questionnaire/ Survey	761	Cohort	Parents, ethnic minority and white	- Friends and family (Trust in factor)
Quinn, Jamison, Freimuth, An, Hancock & Musa (2016)[55]	2016	USA	Adult, Influenza	Questionnaire/ Survey	1643	Comparison	Adults, African American and White	- HCP (Trust in factor) - Vaccination (Trust in concept)
Raude, Fressard, Gautier, Pulcini & Peretti (2016)[56]	2013-14	France	Childhood, General	Questionnaire/ Survey	1582	Cohort	HCPs, GPs	- Health System (Trust in factor) - HCP (Trust in factor) - Government (Trust in factor) - Health System (Trust in factor)
Ronnerstrand (2013)[57]	2009-2010	USA	Adult, Pandemic influenza	Questionnaire/ Survey	28 798	Comparison	Adults	- Government (Trust in factor) - Science (Trust in factor) - Generalized trust
Scherer, Shaffer, Patel & Zikmund-Fisher (2016)[58]	2014	USA	Adolescent, HPV	Experimental	1259	Experimental, comparison	Adults	- HCS (Trust in factor)
Taylor-Clark, Blendon, Zaslavsky & Benson (2005)[59]	2002	USA	Adult, Smallpox	Questionnaire/ Survey	1006	Comparison	Adults	- Health System (Trust in factor)
Tucker-Edmonds, Coleman, Armstrong & Shea (2011)[60]	2009	USA	Adult, Pandemic influenza	Questionnaire/ Survey	173	Comparison	Adults, Pregnant women	- Health System (Trust in factor)
Wada & Smith (2015)[61]	2014	Japan	Undefined	Questionnaire/ Survey	3140	Cohort	Adult	- Government (Trust in factor) - Media (Information) - Friends and family (Information)
Weerd, Timmermans, Beaujean, & Oudhoff (2011)[62]	2009	The Netherlands	Adult, Pandemic influenza	Questionnaire/ Survey	8060	Comparison	Adults	- Government (Information and trust factor)
Won, Middleman, Auslander & Short (2015)[63]	2012-2013	USA	Childhood, General	Experimental	1608 / 844	Experimental, intervention	Parents	- HCS (Trust in factor)
Wu et al (2008)[64]	2003	USA	Childhood, General	Questionnaire/ Survey	228	Cohort	Parents, Mothers, Postpartum	- HCS (Trust in factor)

Table 2. Characteristics of qualitative studies.

	Year data collected	Location	Vaccine(s) of focus	Study methodology	Number of participants	Demographic of focus	Data analysis process
Brownlie & Howson (2006)[65]	1998 and 2001	UK	Childhood, MMR	Focus groups and in-depth interviews	58	HCPs,	Thematic analysis
Bunton & Gilding (2013)[66]	2011	Australia	Adult, HPV	Exploratory workshops	46	Adults, Women	Content analysis based partially on a grounded theory approach
Harris, Chin, Fiscella, Humiston & York (2006)[67]	2004-2005	USA	Adult, Influenza	In-depth interviews	20	Adults, 65+ yrs	Content analysis based partially on a grounded theory approach
Hilton, Petticrew, & Hunt (2007)[68]	2002-2003	UK	Childhood, MMR	Focus groups	72	Parents	Thematic analysis
King & Leask (2017)[69]	2010-2011	Australia	Childhood, Influenza	In-depth interviews	25	Parents	Content analysis based partially on a grounded theory approach
Senier & Senier (2016)[70]	2004	USA	Childhood, general	In-depth interviews	20	Parents	Thematic analysis
Quinn, Jamison, Musa, Hilyard & Freimuth (2016)[71]	2016	USA	Childhood, general	Focus groups	118	Adults, African American and White	Thematic analysis

Table 3. Definitions of trust across reviewed literature.

	Trust was not explicitly defined	Hints made towards trust concepts mentioned in the literature	Trust defined through extensive use of trust literature.
Vaccine uptake	Cheng et al (2010)[39] Das & Das (2003)[42] Fowler et al (2006)[43] Fu et al (2017)[46] Manika et al (2014)[51] Kolar et al (2015)[49]	Casiday et al (2006)[38] Gilles et al (2011)[47] Lee et al (2016)[50]	Ronnerstrand (2013)[57]
Intention to vaccinate	Marlow et al (2007)[52] Scherer et al (2016)[58] Tucker-Edmonds et al (2011)[60]		Taylor-Clark et al (2006)[59] Weerd et al (2011)[62] Chuang et al (2015)[40]
Predictors of trust in relation to vaccination	Berry et al (2012)[37] Cooper et al (2017)[41] Freed et al (2011)[44] Grabenstein et al (2002)[48] Wu et al (2008)[64] Moran et al (2015)[54] Wada & Smith (2015)[61]	Won et al (2015)[63]	Freimuth et al (2017)[45] Quinn, Jamison, Freimuth, An, Hancock & Musa (2016)[55]
HCP intention to recommend vaccine	McPhillips et al (2016)[53] Raude et al (2016)[56]		
Qualitative research	Harris et al (2006)[67]	Hilton, Petticrew & Hunt (2007)[68] King & Leask (2017)[69]	Brownlie & Howson (2006)[65] Bunton & Gilding (2013)[66] Senier & Senier (2016)[70] Quinn, Jamison, Musa, Hilyard & Freimuth (2016)[71]

Measurement of trust within this subset of studies did not utilize validated measures of trust or explicitly use the existing trust literature to inform their measurement items.

Factors associated with a lower level of trust in the health system or a HCP included being in a lower income bracket[63,64] and belonging to an ethnic minority.[41,55,63,72] While factors such as previous participation in a school-based immunization program,[63] perceived importance of the vaccine,[63] and the use of Medicaid (US) over private insurance[63] were associated with higher levels of trust in the health system or a HCP. Further findings indicated a range of subjects that were trusted to different degrees by the respondents.[44,54,61]

Studies focused on healthcare professionals

Two studies with a focus on trust from the perspective of HCPs met our inclusion criteria.[53,56] Of these, one focused primarily on trust[56] and the other explored a range of vaccine acceptance factors, including trust.[53] Neither of the two studies utilised validated measures of trust, nor did they explicitly use previous trust literature to inform the development of their measures.

Qualitative studies

The findings from the qualitative studies were generally more representative of the wider trust literature than those of the quantitative studies (see Table 2). Of the seven qualitative studies, four studies thoroughly defined the concept of trust with reference to peer-reviewed literature[65,66,70,71] and a further two studies referenced at least some of the healthcare-trust literature.[68,69] Only in one study was the definition of trust left implicit.[67]

One of the common themes reported was the interaction between trust, information and conflicts of interest due to

Table 4. The use of measurement across reviewed quantitative literature.

	Measures of trust not reported	Used implicitly defined measures of trust	Used literature-aligned measures of trust	Used literature-informed measures of trust	Used validated measures of trust
Vaccine uptake	Das & Das (2003)[42] Gilles et al (2011)[47] Manika et al (2014)[51]	Cheng et al (2010)[39] Fowler et al (2006)[43] Fu et al (2017)[46]	Casiday et al (2006)[38]	Lee et al (2016)[50]	Ronnerstrand (2013)[57] Kolar et al (2015)[49]
Intention to vaccinate			Marlow et al (2007)[52] Scherer et al (2016)[58]	Taylor-Clark et al (2006)[59] Weerd et al (2011)[62] Chuang et al (2015)[40]	Tucker-Edmonds et al (2011)[60]
Predictors of trust in relation to vaccination	Berry et al (2012)[37]	Cooper et al (2017)[41] Freed et al (2011)[44] Grabenstein et al (2002)[48] Moran et al (2015)[54] Wada & Smith (2015)[61] Quinn, Jamison, Freimuth, An, Hancock and Musa (2016)[55]	Won et al (2015)[63] Wu et al (2008)[64]	Freimuth et al (2017)[45]	
HCP intention to recommend vaccine		McPhillips et al (2016)[53] Raude et al (2016)[56]			

financial incentives. A perceived trust violation was said to occur when HCPs, the government or the wider health system were seen to financially profit from vaccination which, in turn, often led to a perception of bias in the information provided by these individuals or institutions. Perceived trust violations were reported in four of the seven studies,[65,66,68,70] one of which indicated that HCPs themselves cited financial incentives as possibly damaging the trust relationships with their patients.[65] Hilton, Petticrew & Hunt[68] suggest that when financial incentive-based mistrust occurs, trust may then be transferred to other trusted parties that are perceived to be free of any 'hidden agenda.'

Further findings form Harris et al.[67] and Quinn et al.[71] indicate that mistrust in the health system by African Americans may be a symptom of long-term experiences of racial prejudice. Historical medical injustices and medical malpractice were seen to negatively affect trust; however, trust was said to recover when medical care was good over time.[69]

Discussion

Measurements of trust

The absence of validated psychometric measures of trust

A 2013 systematic review by Ozawa & Sripad[76] on the measurement of health-related trust identified and evaluated 45 validated multi-item measures of health system related trust. Within our vaccine-specific review only three studies[49,50,60] used or adapted any of the trust measures included in the Ozawa & Sripad review, indicating a disconnect between vaccine-related trust research and the wider health-related trust literature (Tables 3 and 4).

This lack of underlying theory and validity with respect to the measurement of trust was also prevalent across many of the studies that constructed their own measures. For example, 10 out of the 25 studies that reported their measures cited the use of a single question to measure an aspect of trust, many of which dichotomized their Likert scale variable for later analysis further reducing the sensitivity of their findings.

Within the qualitative research, it was evident that distrust based on value misalignment was particularly likely when HCP financial incentives for vaccinating were identified.[65,66,68,70] This form of distrust is distinct from the distrust caused by perceptions of incompetence. Currently this distinction is left largely unexamined by much of the vaccine-related trust research. The inclusion of a validated psychometric scale or the custom design of two trust questions (one related to perceived performance/reliability and one related to perceived motives and morality/values of a trusted party), would allow for a far more nuanced exploration of these different trust dynamics.

Measurement focused on trust in the health system or healthcare professionals

While trust is shown to have a positive effect on vaccination intention and uptake in most of the studies reviewed, few explored trust factors or concepts beyond those of trust in the health system (21 studies), the government (10 studies) or HCPs (9 studies). Only two studies[42,52] specifically measured trust in the vaccine (e.g. '*Overall, how much do you trust the flu vaccine?*'[42]). Furthermore, factors outside of the vaccination program were also rarely measured.[40,44,54,57,61,62,72] Future research would benefit greatly from investigating further interactions between the various dimensions of trust related to vaccination.

Historic trust and under representation of low- and middle-income countries

The theme of historic neglect or abuse from a government or health system was often seen as an underlying reason for distrust in vaccines among marginalized groups.[67,69,71] Some of the quantitative studies examined these themes through the comparison of trust levels between different ethnic groups.[45,46,49,54,55] While this is without doubt an important topic to study, the equally important concept of trustworthiness of the systems themselves is noticeably absent. By shifting the burden of distrust onto the minority individual or community, and away from the trustworthiness of institutions, the genuine drivers of trust and distrust may actually be obscured.

The level of diversity within the studies that met our inclusion criteria reflects a narrow focus on high-income countries. Only one study was based in a middle-income country[42] and none of the studies focused on low-income countries. With trust playing such a key role in influencing vaccine acceptance, more research is needed in middle and low-income settings to truly understand whether findings in high-income countries have relevance in low and middle-income countries.

Limitations

This review was conducted over a five-year period with periodic updates. While this resulted in the inclusion of a greater number of relevant studies, it is possible that some relevant papers may have been missed between updated searches, even with the addition of snowball searching and peer-recommendations for additional papers.

For the purpose of this review, only those papers that mentioned trust within their research aim or question were included. This therefore does not cover the full extent of the relationships that exist between trust and vaccination but instead focuses on those studies that made trust the specific focus of their research. Conclusions drawn from this review should therefore be limited to the methodology and extent of measurement within these studies rather than be taken as a full overview of trust's influence on vaccination.

Conclusion

Even within vaccine studies that include the concept of trust within their primary research question, trust can often be an ill-defined and loosely measured concept. The prevalence of single-item measures, where the definition of trust was left as implicit, indicates that a thorough understanding of trust as it relates to vaccine acceptance is currently under-researched. Furthermore, a lack of experimental or longitudinal studies that investigate how trust can be eroded or built over time demonstrates that there is great potential for new contributions to our understanding of the temporal dynamics and levers of trust in relation to vaccination.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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