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published in
Annals of Epidemiology
2020

DOI (link to publisher)
10.1016/j.annepidem.2020.07.008

document version
Publisher's PDF, also known as Version of record

Annals of Epidemiology 49 (2020) 27–35

Contents lists available at ScienceDirect

Annals of Epidemiology

Commentary

Qualitative research in epidemiology: theoretical and methodological perspectives

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ARTICLE INFO

Article history:
Received 12 February 2020
Accepted 15 July 2020
Available online 22 July 2020

Keywords:
Qualitative research
Epidemiology
Causal inference
Public health
Methodology

ABSTRACT

Increasingly, modern epidemiology has adopted complex causal frameworks incorporating individual- and population-level determinants of health. Despite the growing use of qualitative methodologies in public health research generally, discussion of causal reasoning in epidemiology rarely considers evidence derived from qualitative research. This article argues for a coherent role of qualitative research within epidemiology through analysis of the principles of causal reasoning that underlie current debates about causal inference in epidemiology. It introduces two approaches to causal inference by Russo and Williamson (2009) and Reiss (2012) that emphasize the relevance of both the nature of causation and how knowledge is gained about causation in assessing evidence for a causal relation. Both theories have scope for incorporating multiple types of evidence to assess causal claims. We argue that these theories align with the empirical focus of epidemiology and allow for different types of evidence to evaluate causal claims, including evidence originating from qualitative research; such evidence can contribute to a mechanistic understanding of causal relations and to understanding the effects of context on health-related outcomes. Finally, we discuss this approach in light of previous literature on the role of qualitative research in epidemiology and implications for future epidemiologic research.

Introduction

It is now two decades since the "future" of modern epidemiology was decreed when epidemiologists were urged to develop approaches that could accommodate multilevel, complex causal models that acknowledge historical and societal influences on patterns of health and illness as much as individual characteristics [1–3]. Such debates aimed to take epidemiology beyond a "collection of methods to be applied to particular problems involving human diseases and health" by considering the theories of causation and the nature of causal inference [1]. Since then, epidemiologists have largely focused on the suitability of the potential outcomes framework, with arguments for [4] and against [5,6] its fitness in light of the expanded role of epidemiology.

Meanwhile, there has been increased adoption of complex causal frameworks in public health practice incorporating individual- and population-level determinants of health [7], and correspondingly, there are increasing calls for interdisciplinary and transdisciplinary research across the health sciences [8–10]. The need for diverse disciplinary perspectives resulted in increased acceptance and recognition of qualitative studies in health research [11–14]; however, the proportion of qualitative research articles published in medical journals is still low [15]. Despite previous calls for the inclusion of qualitative research in epidemiology [16–26], most applied qualitative research in public health is conducted as part of health systems research, behavioral science, evaluation studies, and clinical practice research [11,14].

Furthermore, there has been a minimal discussion about the role of different ontologies and epistemologies required within epidemiology to meet the challenge posed by the expanding scope of public health research [27,28]. For example, epidemiology has come under criticism for lack of engagement with theories of why inequalities in disease distribution arise and persist, which, in turn, affects which kinds of "causes" are considered and how they are studied [2,29,30].

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https://doi.org/10.1016/j.annepidem.2020.07.008
1047-2797/

In this article, we argue that there is a coherent role for qualitative research within epidemiology and demonstrate the validity of this argument through analysis of the principles of causal reasoning that underlie current debates about causal inference in epidemiology.

An overview of qualitative research in epidemiology

Broadly, qualitative research aims to investigate how different phenomena are related and interact within and across different units of analysis, from individuals to families to broader social groupings [31]; it seeks to elicit the perspectives, meanings, and experiences, frequently from the research participants' point of view, and explicitly engages with the role the researcher themselves plays in shaping the research findings [31]. One crucial problem for qualitative research is that it is often seen as "one method despite a diversity that includes anything from discourse analysis to ethnography, with data collected in personal interviews or focus groups (with samples of varying sizes), by participant observations or through documentary analysis" [32]. It is beyond the scope of this article to provide a comprehensive overview of qualitative research in general; readers are referred to introductory texts [33,34], and [Box 1] highlights a few methodologies for qualitative data collection and analysis that may be of interest for epidemiologists. However, an introductory example of qualitative research in epidemiology is a study of tuberculosis transmission in a township in South Africa [42]. Researchers aimed to understand tuberculosis transmission dynamics within a community by identifying local high-risk places while emphasizing the importance of understanding environmental, physical, and social conditions to design an appropriate public health response. Researchers held community meetings and conducted transect walks with local representatives, during which researchers recorded group discussions, observations, photographs, and informal open-ended conversations. Based on these data, a rough qualitative description of the community and its gathering places was produced. Data analysis included triangulating known tuberculosis risk factors (such as the size of an enclosed space, ventilation source, and duration of exposure) with observed characteristics of community gathering points to develop a locally specific tuberculosis transmission risk score. This risk score was overlaid with GIS data to locate potential transmission hotspots in the community.

Despite other similar examples of qualitative research applied in epidemiology, epidemiologists frequently consider qualitative and quantitative research not only as distinct methodologies but as separate disciplines, which answer different research questions [12,16,20,22–26,43]. Qualitative research typically plays a supportive role to "explain unexpected results, generate hypotheses to be tested by quantitative epidemiological research, and helping to develop measures of social phenomena" [26]. However, this purported "incompatibility" of quantitative and qualitative research has been frequently criticized [42], especially with further development of mixed-methods research frameworks [44]. Within epidemiology, qualitative and mixed-methods research are likely most familiar in social epidemiology. Social epidemiologists have had an important role in the appropriate inclusion of social theory in explanatory models of health and disease. A key example is the argument against the use of "race" as a purportedly explanatory variable while emphasizing the social origins of racial differences as "a result of economic and historical, not evolutionary, developments" [45]. The interaction of socioeconomic conditions (e.g., education, income, and race) has been used frequently to explain differences in health status; however, "although socioeconomic variables may provide a partial explanation of mechanisms, they do not resolve the issue of causality" [45]. Nonetheless, the inclusion of social determinants of health in epidemiologic studies has been criticized for reducing social context to a variable [46], and social epidemiology, in general, makes relatively little use of qualitative methods "despite its importance and arguable advantages in relation to other methods" [47].

Box 1
Selected methodologies for qualitative data collection and analysis that can be of interest for epidemiology

Observational approaches [31,35]

- It involves the systematic, detailed observation of people and events (i.e., watching and recording what people do and say) to find out about behaviors and interactions in natural settings. As such, these approaches are different from clinical observation of individual patients or observational study designs.
- It is important to distinguish between structured observation, which combines the flexibility of open-ended observation with the discipline of seeking certain types of structured data, and participant observation, which emphasizes the meanings that people give to their actions.
- The role of the researcher varies according to the nature of the setting and the research questions and includes complete participant, participant as observer, observer as participant, and complete observer.

Process tracing [36–38]

- It aims to establish chronological chains of connections between various states and events.
- Is an analytic tool for drawing descriptive and causal inferences from diagnostic pieces of evidence—often understood as part of a temporal sequence of events or phenomena.

Qualitative survey research [39]

- It aims to analyze the diversity of member characteristics within a population. The diversity of member characteristics may either be predefined or developed in open coding.
- Three levels of diversity analysis are defined: unidimensional description, multidimensional description, and explanatory analysis, which may develop either in a concept-oriented or in a unit-oriented fashion.

Qualitative comparative analysis [40,41]

- It aims to reveal the sets of conditions required for particular "causes" and "outcomes" to manifest.
- It is a case-oriented method that allows systematic comparison of cases as configurations of set memberships based on their attributes or combinations of factors that are referred to as "conditions" and the relationship of these to particular outcomes.
- The key question that QCA therefore seeks to address is which conditions (or combinations of) are "necessary" or "sufficient" to produce the outcome.

The lack of use of qualitative methods in social epidemiology (and epidemiology more widely) has been partly attributed to the lack of mutually compatible frameworks for causal inference [47]. Nonetheless, there are compelling examples in the literature that motivate the search for satisfactory frameworks for causal inference that can incorporate evidence generated through qualitative research. For example, a cohort study of mental morbidity in adolescents in Brazil demonstrates how meaning and experience shape health outcomes and how this understanding is integral to causal reasoning [48]. The researchers used a research design combining epidemiology and medical anthropology. They advocated for the integration of these two disciplines at the level of theory, not only methodology, producing an approach to epidemiology and anthropology that included cross-overs from each discipline. The study design included sampling procedures for qualitative ethnographic research that were analogous to a case–control study, which facilitated comparative analyses between subgroups with different exposure and outcome combinations. The researchers used ethnographic research to show that the observed statistical measures of association reflected multiple pathways. For example, the link between poverty and mental morbidity (observed statistically in the cohort population) manifested for many adolescents through the experiences of living with violence. For other adolescents, the link between poverty and mental morbidity was produced by the experience of being raised in highly controlled domestic environments, in which restricted social engagement was used as a parenting technique to reduce the threat of violence. This study demonstrates that a single exposure–outcome relationship observed using quantitative (i.e., statistical) approaches was revealed through qualitative research to have arisen through two distinct causal pathways.

Other authors have developed comprehensive frameworks for qualitative research in epidemiology, although we argue that none satisfactorily addresses how qualitative research could be integrated into contemporary approaches to causal inference in epidemiology.

The first example is Popay's two models of inclusion of qualitative methodologies in epidemiology [19]. In the “enhancement model,” qualitative research is used to make sense of quantitative findings (i.e., to enhance or add something extra). Examples include using qualitative research as a “hypothesis-generating” approach before quantitative research or improving and validating score constructs in psychosocial questionnaires. More comprehensively, an “epistemological model” is proposed, wherein qualitative research has the same status and value as quantitative research but addresses different types of questions, strengthens the theoretical and conceptual depth of the research, and “shifts the balance between the researcher and the researched.” Examples include a comprehensive study of how sense-making processes shape responses to illness and future health trajectories and studies of how socioeconomic conditions influence decision-making processes relevant to health. Popay's framework does not address questions of causal inference, which potentially limits the scope for the desired “equal status” to be afforded to qualitative research within epidemiology. However, some of the examples presented are salient; for instance, although it is well established that smoking causes lung cancer, qualitative research is required to understand why certain population groups smoke at higher rates than others. In that regard, qualitative research has demonstrated that public health programs have missed opportunities to recognize and address the social and economic circumstances in which smoking can represent a logical choice with positive effects on psychosocial well-being [49,50]. Also, qualitative research has demonstrated that differences in smoking rates are related to peer group, family, neighborhood, and societal contexts [50,51].

A second example is the framework for qualitative epidemiology proposed by Agar [18], which adapted the host–agent–environment triad in an attempt to show the role of qualitative methodologies in causal inference in epidemiology. In this framework, the host was reconceptualized as a “person-in-context” and environment as “context,” whereas “agent” was not fully specified. Agar called for the examination of the immediate person-in-context as a “movie” rather than a snapshot with different types of contexts that can be described as “above” (i.e., hierarchical structures), “around” (i.e., contemporaneous contexts), and “behind” (i.e., how historical social and economic contexts influence current contexts). Agar recommended ethnography as the principal methodology to orient epidemiology toward greater attention to the effects of context. However, limitations of this approach include reliance on the outdated host–agent–environment model for representing causal relationships, which has long been supplanted by more sophisticated models of complex causation. Agar recognized limits of an adapted host–agent–environment triad as a causal framework but then abandoned discussion of causality as being a concept too complex to be workable.

A third approach was proposed by Faltermaier [21], who argued that qualitative research should be used to investigate societal structures and stressors and individual psychosocial traits as determinants of health outcomes in complex causal models. It was further argued that qualitative research has a particular role in life-course epidemiology, as “causal factors often show their pathogenic effects only after long periods; therefore, biographical processes have to be included in aetiological research” [21]. Faltermaier argued that progress in epidemiology depends more on the development of comprehensive causal theories than on the proliferation of quantitative risk factor studies investigating a restricted set of prespecified variables. Though arguing for the methodological plurality to develop complex causal models, Faltermaier does not further develop frameworks to achieve this aim.

In the rest of the article, we develop a theoretical basis for the contribution of qualitative research to causal inference in epidemiology. First, we build our argument to show that qualitative research is consistent with the philosophical roots of epidemiology. Second, we show that qualitative research can contribute to causal reasoning in epidemiology based on modern theories of causal inference that separate a causal claim from the evidence used to assess it. Finally, we discuss our approach with reference to previous efforts to integrate qualitative research in epidemiology and other implications.

The philosophical roots of epidemiology

Broadly conceived, epidemiology is “the study of the occurrence and distribution of health-related states or events in specified populations, including the study of the determinants influencing such states and the application of this knowledge to control health problems” [52]. Epidemiologic research on the “occurrence and frequency of phenomena of public health, clinical, social, or biological relevance, in addition to the occurrence and causal assessments related to the determinants of such phenomena” can be corroborated using “acceptable scientific methods of observation, inference, and/or experiment” (our emphasis) [52].

In general, the choice to use a research methodology is influenced by the researcher's view of ontology and epistemology (Fig. 1). Ontology reflects the assumptions and beliefs about the nature of reality. Epistemology refers to the assumptions and beliefs about the nature of knowing, which provides a “philosophical background for deciding what kinds of knowledge are legitimate and adequate” [31]. In other words, ontology is about

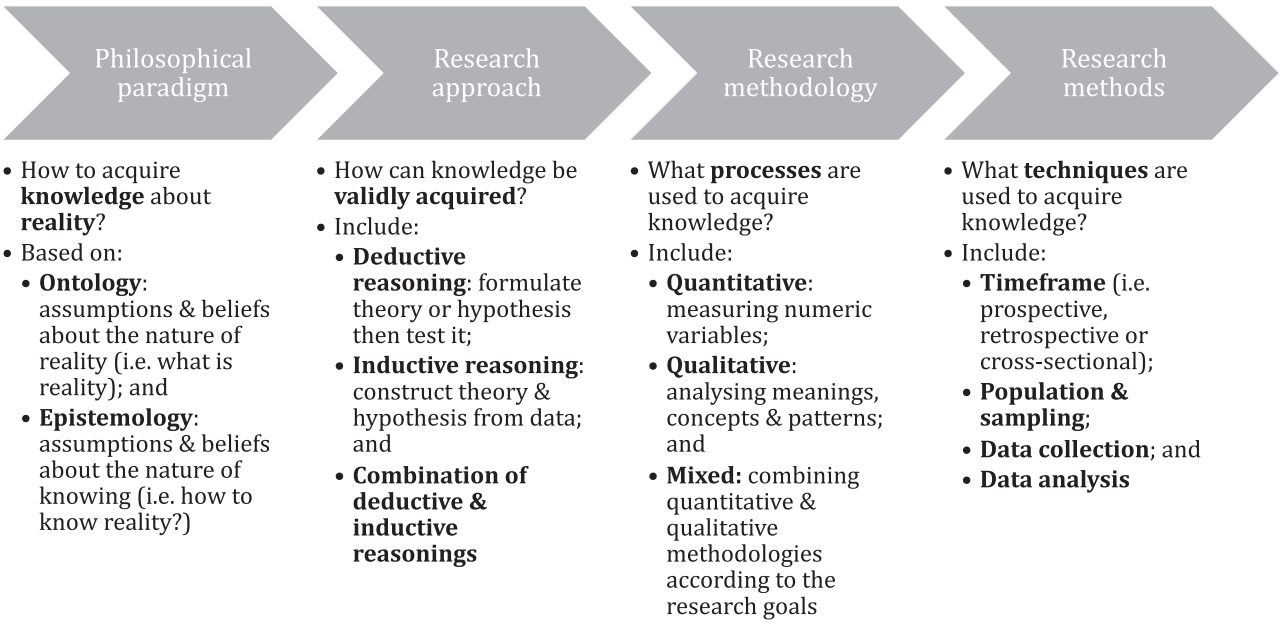

Fig. 1. Relationships between philosophy, methodology, and research methods.

understanding "what is reality," whereas epistemology concentrates on understanding "what it means to know or how to know reality."

Although philosophical theories underpinning epidemiologic research and practice are rarely made explicit [27], the alignment of epidemiology with biomedical sciences and its near-exclusive adoption of quantitative methodologies reflect the influence of positivism. Positivism posited the existence of a single, objective, and independent reality; the ensuing epistemological view is that research is time- and context-independent, and that the researcher is an outsider who uses deductive reasoning to measure and observe objective reality with reliable and valid tools [12,31]. Statements such as "epidemiology seeks to be precise and quantitative" [5] align with this view. On the other hand, most qualitative research is framed within interpretivism and constructionism, whose ontological view assumes that there are multiple realities created by people's social interactions, and the epistemological view that research is value bound makes use of inductive reasoning, and the researcher cannot be external to the research [53] (Table 1). Within this ontology, the search for singular "causes" and "effects" can be considered an almost trivial task [54]. As a result of these antagonistic perspectives, there is a partitioning of many disciplines along ontological (hence methodological) lines, including the alignment of epidemiology with quantitative methodologies.

However, the positivist and interpretivist/constructivist paradigms have been frequently criticized [53]. Furthermore, we are more interested in what epidemiologists do, rather than how their theoretical standpoints are characterized (and dare we say, stereotyped) [16]. Research and practice in public health use a mix of ontological and epistemological perspectives [27,55]. This mixing can be rationalized through more tenable philosophies, including pragmatism and critical realism. Broadly conceived, pragmatism takes an ontological view of a constantly renegotiated, debated, and interpreted reality, and an epistemological view that the validity of an ontological position is determined based on whether it suits a purpose is capable of creating action and works satisfactorily in practice [29,56–58]. Pragmatism has been widely used to justify mixed-methods research [31]. Alternatively, critical realism has also gained traction in public health, particularly in the evaluation of complex interventions [59]. Critical realism accepts the positivist perspective of the existence of an independent reality but also accepts that actors' interpretations of reality influence the nature of social change.

Table 1
Overview of ontologies and epistemologies relevant to epidemiology and public health

Philosophy	Ontology	Epistemology	Approach to causal inference	Methodology
Positivism	The existence of a single, objective, and independent reality	Research is time- and context-independent	Mainly deductive proof	Mainly quantitative
Interpretivism/constructionism	The existence of multiple realities created by people's social interactions	Research is value bound	Mainly inductive discovery	Mainly qualitative
Pragmatism	The existence of a constantly renegotiated, debated, and interpreted reality	Research is validated based on whether it suits a purpose, is capable of creating action, and works satisfactorily in practice	Deductive and inductive approaches	Quantitative Qualitative Mixed
Critical realism	The existence of an independent reality, but actors' interpretations of reality influence the nature of social change	Research seeks understanding of a range of mechanisms mediating between cause and effect while adopting a stand that cause and effect mechanisms do not hold across context and times	Deductive and inductive approaches	Quantitative Qualitative Mixed

The resulting epistemology seeks an understanding of a range of mechanisms mediating between cause and effect while adopting a stand that cause and effect mechanisms do not hold across contexts and times [54]. Indeed, some epidemiologists explicitly define their ontological positions as aligning with pragmatism [5,60] or critical realism [56–58].

Causal reasoning in epidemiology

What is a cause?

Epidemiology has no single standard for what constitutes a cause [5,61,62]. Generally, there are five distinct meanings of a cause—production, necessary, sufficient component, probabilistic, and counterfactual [61,63] (Table 2 provides a brief overview of each type of cause). At the same time, causal reasoning is at the heart of epidemiology not only as a cognitive goal but also as an opportunity for action; causal inferences are used to inform policy, guide diagnosis or treatment, and identify intervention targets [64,65].

The most widely used approach to causal inference in epidemiology is the probabilistic interpretation of the counterfactual framework, which considers the causal effect of a condition as the difference in probability of an outcome that would occur if the condition were present compared with if the condition were not present, all else being constant [5,61]. However, there are several shortcomings of this framework, including that it does not formalize a role for investigating mechanisms mediating causal effects [5,6], despite evidence that amassing numerous sources of coherent findings is the foundation of applied causal reasoning [64]. Few epidemiologists would disagree that "the central challenge of epidemiology (is) using different kinds of evidence to arrive at one overall verdict. One time-honored strategy, both within and outside epidemiology, is triangulation: one's confidence in a finding increases if different data, investigators, theoretical approaches, and methods all converge on that finding" [5].

As such, some advocate for "causal pluralism," which holds that "there are different coexisting types of a cause" [5,6]. However, this pluralistic account also has problems in conflating different types of evidence with different kinds of causes [66] and has been criticized as being too vague to advance research and practice about causal reasoning [66].

These debates about causal inference approaches in epidemiology show that a "cause" has frequently been defined in terms of the type of evidence required to demonstrate it; for example, the criticisms of the probabilistic counterfactual framework are that it excludes the possibility of identifying a cause using (partly) mechanistic evidence or (partly) findings from nonrandomized studies.

However, to adjudicate evidence for a causal relation, both the nature of causation (an ontological concern) and how knowledge is gained about causation (an epistemological concern) are of relevance [55]. Conflating the nature of causation with a particular type of evidence fails to explain why there have been other ways to verify causal claims, including the canonical example that the causal effect of smoking on lung cancer was verified through a series of observational and mechanistic studies [65], as well as frequent use of meta-analysis and critical narrative reviews [28].

Modern theories of causal inference

To address the inconsistencies between the nature of causation and type of evidence, philosophers of science have put forward models of causal inference wherein the nature of causal relation is separated from the evidence used to assess it. Here, we will briefly highlight two approaches to causal inference by Russo and Williamson in 2009 [64] and by Reiss in 2012 [65], which can harmonize the debate around causal inference in epidemiology.

The framework proposed by Russo and Williamson [64] commences with a rejection of a pluralist approach to causal inference, arguing that the statement "X causes Y" implies a singular causal relation of interest and that there are not different types of causes indicated by different types of evidence. Instead of linking the definition of a causal relation to a type of evidence, they propose an "epistemic" model in which the meaning of "cause" stems from the epistemology of causal reasoning itself; in other words, causal relations have no meaning independent of the rational agent(s) who assess(es) the evidence for causal claims. This rational agent is entitled to hold causal beliefs if those beliefs "account for all known dependencies that are not already accounted for by known noncausal relationships" and are "compatible with other knowledge (including knowledge of mechanisms)." Also, agents "should not have any causal beliefs that are not warranted by evidence." The ideal agent should be both omniscient as well as rational to hold causal beliefs, although in practice, "the more we know, the closer our rational causal beliefs will correspond to the causal facts." Then, they argue that the singular causal claim "X causes Y" implies two types of evidence: probabilistic reasoning (X causes Y implies that variation in X makes a difference to the probability that Y occurs) and mechanistic reasoning (explaining how X causes Y). Thus, a rational agent requires probabilistic as well as mechanistic evidence to make a causal claim, which accords well with how the relationship between smoking and lung cancer was established [64].

Alternatively, Reiss offers an account of causation based on inferentialism, a semantic theory that "regards the meaning of a sentence as constituted by their inferential connections" [65]. This account implies there can be no isolable and singular meaning of the sentence "X causes Y." Instead, a sentence describing a causal claim can only be understood if we recognize that it comprises two elements—an inferential base, which is the set of evidence supporting the causal claim, and the inferential target, which is the purpose of the causal claim. For example, "smoking causes lung

Table 2
Overview of concepts of "cause"

Type of cause	Brief definition
Production	A cause is that which produces an effect
Necessary	A cause is a condition without which the effect cannot occur
Sufficient-component	A set of conditions, which when present together, results in an effect
Probabilistic	A cause is a condition that increases the probability of an effect occurring
Counterfactual	A causal effect of a condition is the difference in outcome that would occur if the condition is present compared to if the condition was not present, all else being constant

Adapted from (Parascandola & Weed, 2001 [61]; Holland et al.; 1985 [63]).

Table 3
Summary of two approaches to causal inference by Russo and Williamson (2009) [64] and Reiss (2012) [65]

Element	Russo and Williamson's epistemic model	Reiss' inferentialist framework
What?	Causal claim • There is a single causal relation of interest "X causes Y," which is equivalent to a causal belief. Causal beliefs are justified if they "account for all known dependencies that are not already accounted for by known non-causal relationships" and are "compatible with other knowledge (including knowledge of mechanisms)." Also, agents "should not have any causal beliefs that are not warranted by evidence."	Inferential target The purpose of the causal claim "X causes Y" may have multiple inferences: • X raises the probability of Y; • An individual can reduce their risk of Y if they are not exposed to X; and • Increased prevalence of X explains the increased incidence of Y.

How?	Two types of evidence are needed to make a causal claim:
	• Probabilistic reasoning: variation in X makes a difference to the probability that Y occurs; and
	• Mechanistic reasoning: explaining how X causes Y.
		Inferential base
		The set of evidence supporting the causal claim could include:
		• Probabilistic reasoning; or
		• Mechanistic reasoning: this may include:
		  • Biological mechanisms; and
		  • Social mechanisms (e.g., social, economic, commercial, political, and ecological determinants of health).

Who?	Rational agent(s) who assess(es) the evidence for causal claims.	Acceptance by the "epistemic community" based on contextualism, which allows standards for epistemic justification of causal claims to vary between domains, periods, and specific queries while always respecting and coherent with "local empirical facts, background knowledge and the goals and purposes of the query."

cancer" can have many inferences such as "smoking raises the probability of lung cancer," "an individual can reduce their risk of lung cancer if they quit smoking," or "smoking rates explained increases in lung cancer incidence in the 20th century"; each of these inferential targets may require different components in their inferential base. In Reiss' inferentialist framework, justification of causal claims depends on (1) coherence with "local empirical facts, background knowledge, and the goals and purposes of the query"; and (2) acceptance by the "epistemic community" (i.e., those generating, critiquing and applying—in our case—epidemiological knowledge). However, Reiss avoids the traditional epistemic justifications of external epistemic standards (e.g., randomized controlled trials are the gold standard of evidence for causal claims) or descriptivist epistemic approaches (i.e., causal claims are justified according to whichever standards are upheld by the epistemic community). Instead, Reiss proposes contextualism as the preferred mode of epistemic justification, "allowing standards to vary between domains, periods, and specific queries" but always respecting and coherent with "local empirical facts, background knowledge, and the goals and purposes of the query." For example, standards for establishing whether a particular agent is a carcinogen must weigh the risk of any alternative explanations against harms caused by not making a causal claim given the inferential base at hand. Reiss offers an empirical formulation that aligns well with pragmatism; "causal claims are objective to the extent that predictions and interventions made on their basis are successful and to the extent that success at predicting and intervening can be established objectively. Both these factors are domain specific" [65].

To briefly summarize (Table 3), both of these frameworks for causal reasoning relate the meaning of "cause" to the agent(s) or epistemic communities who endeavor to make a causal claim, which is separate from the evidence used to assess the claim. Both frameworks have scope for multiple types of evidence to assess causal claims. Reiss' inferentialist framework departs from Russo and Williamson's epistemic model in relaxing the assumption that mechanistic evidence must be available to support causal claims, as the evidence required depends on the inferential target. For example, some causal claims are widely accepted in the absence of mechanistic evidence, although only if there were no competing causal claims with equal probabilistic evidence (according to the available evidence at the time the causal claims were made). Finally, both frameworks highlight that rational and informed agents or epistemic communities of informed agents can only make causal claims as long as the available evidence is sufficient to rule out alternative explanations; this is a stricter criterion than "inference to best explanation" [66] and recognizes the conditionality of causal claims on the state of knowledge at any given time. Unlike Russo and Williamson, who argue that there is only one "type" of a cause, it would appear in Reiss' framework that there can be a variety of types of causes according to the inferential target. However, Reiss emphasizes the role of the epistemic community, in our case epidemiologists, who in practice share a sufficiently similar understanding of a "cause" across contexts to be able to make coherent assessments of the available evidence for specific causal claims.

Incorporating qualitative research in causal reasoning

So far, we have argued that coherent theories for causal inference in epidemiology do not require rigid adherence to particular methodologies or types of evidence. If we accept the need, or at least, the scope for, both mechanistic and other nonprobabilistic evidence for causal claims, then the question arises, what kinds of evidence are relevant to epidemiology? In general, the use of biological mechanistic evidence to support causal claims is widespread in epidemiology [64]; in contrast, the use of sociological evidence (quantitative let alone qualitative) remains the subject of debate [46,67–70]. And yet, social and biological processes are increasingly recognized as intertwined, with the biological embodiment of social roles, structures, and processes causing health disparities [71]. The effects of social roles, structures, and processes are explicitly allowed within the inferentialist framework, particularly as it allows causal claims to be context dependent. In other words, causal effects may only manifest in a particular set of circumstances that are (partially) known at the time a causal claim is made and that may vary across time and place. Furthermore, if causal claims are conditional rather than universal, then any change in the circumstances supporting the causal claim, whether changes in background knowledge or shifts in context, should lead to a re-evaluation of the causal claim. Thus, qualitative methodologies have a valid role in understanding the effects of context, including the effects of social roles, structures,

and processes on health-related outcomes, as shown in the earlier example of poverty and mental morbidity in adolescents [48], where qualitative research explained the mechanism by which poverty determinates mental morbidity by both exposure to and protection from violence.

Although we have made an argument for qualitative epidemiology through appeal to current debates about causal inference approaches in epidemiology, we must also briefly reflect on premises of qualitative causal inference developed within disciplines where qualitative research is more prominent. Maxwell presents the most comprehensive and rigorous justification of qualitative causal inference, grounded in realist philosophy [72]. The key premises of Maxwell's model are as follows:

- Some causal processes can be directly observed rather than inferred from measured covariation of the presumed causes and effects, which implies that case studies and small n studies can contribute to causal inference (according to the research question);
- Context is intrinsic to causal processes;
- Behaviors relevant to health outcomes can be caused by "mental events and processes," which are "real phenomena" that should be the topic of empirical research; and
- Causal inference does not rely only on pre-established comparisons (e.g., statistical comparison of prespecified intervention and control groups); there is a role for flexible and inductive qualitative methodologies.

We argue that these premises are compatible with the frameworks presented earlier, especially Reiss' inferentialist approach and presentation of contextualism as the preferred mode of epistemic justification (i.e., making a causal claim) [65]. Therefore, qualitative research methods, when grounded in pragmatist or critical realist philosophies, can be used in epidemiology to contribute evidence for causal claims, whether as a form of mechanistic evidence for tracing the processes from cause to effect in Russo and Williamson's epistemic model or as part of the inferential base in Reiss' framework according to the purpose of the causal inquiry.

Discussion

In this article, we have aimed to demonstrate that qualitative research can be used to address important questions of relevance to epidemiology and enrich our understanding of contingent causal processes that explain variation in the distribution of health-related outcomes; this includes research orientations, study designs, and analysis techniques derived from qualitative methodologies. By demonstrating that coherent frameworks for causal inference in epidemiology can accommodate qualitative methodologies, we have addressed a key limitation of previous attempts to integrate qualitative methodologies in epidemiology.

Beyond the apparent lack of compatible causal inference frameworks, there are several other reasons why qualitative research is largely absent from epidemiology, which we briefly reflect on here. Previous arguments for qualitative research in epidemiology have mostly been written by qualitative researchers, who considerably have not been acquainted with how debates about the importance of context, theories of social-ecological disease causation, and purposes of epidemiologic research have played out within epidemiology. For example, in 1996, some years before Agar [18] and Popay's [19] writings, McMichael published the now-classic "Prisoners of the Proximate" article [2] that critiqued modern epidemiology for its "preoccupation with proximate risk factors"." Similarly, to Agar, McMichael emphasized the importance of studying health using ecological approaches that explicitly engage with distal as well as proximate risk factors, life course rather than time-limited risk, and interactions between individual- and population-level determinants. Contemporaneously, Krieger challenged the biomedically oriented "web of causation" [1] and proposed an "ecosocial" model of disease causation [73]. It is instructive that only one of the articles we found describing the role of qualitative research in epidemiology cited any of Krieger's articles [48] and none cited McMichael, let alone numerous other epidemiologists arguing in a similar vein [3,74–76]. Collectively, these articles have been cited several thousand times and spawned significant developments within epidemiology, although mostly applied through quantitative methodologies. The mutual lack of engagement by qualitative researchers with epidemiologic literature and vice versa goes some way to explaining why arguments for qualitative epidemiology have been mostly overlooked in debates about the scope and goals of epidemiologic research.

Another fundamental limitation facing qualitative research is how it is perceived and valued by researchers and users of epidemiologic knowledge. A clear illustration for the frustration connected with this perception is a published letter by "a nonclinician clinical epidemiologist who conducts qualitative research in a health care environment" [77], describing how such researchers are viewed as "outsiders," not only because they "are not clinicians and their focus is not quantitative research" but also by qualitative researchers because they "are not sociologists with extensive formal training in theory." As a consequence, these researchers face challenges to "publish in medical journals and secure funding for [their] research projects." The devaluing and marginalization of qualitative research in health care partly relates to the lack of a shared epistemology that affords qualitative research a clear role as part of epidemiology, not only in a "complementary" (i.e., secondary) role. We have attempted to address this by drawing together debates about causal inference in epidemiology with arguments for the inclusion of qualitative research. However, more substantially, the lack of recognition of qualitative methodologies among epidemiologists reflects the priorities and worldviews of funding agencies and research users, besides concepts and structures of academic prestige [46]. Indeed, a mix of power, inertia, and habit, influenced by historical affiliations of epidemiology with positivism and unsatisfactory frameworks for causal inference, has led to the near-exclusion of qualitative research from epidemiology and suspicion of its rigor and validity; although as we have shown, there are no clear epistemological grounds for doing so. We see scope for this to change, given that the implicit influence of pragmatist philosophy is already evident in debates about causal inference. If one agrees that few epidemiologists would be stringent adherents to narrowly defined concepts of causation in practice [5], then it is also not unreasonable to attest that epidemiology (and epidemiologists) could embrace further methodological flexibility to include qualitative research.

The preceding considerations produce the final impediment to the inclusion of qualitative research in epidemiology—the lack of training in qualitative research as part of core epidemiology training. Generally, no courses on qualitative research are targeted to epidemiology students. In one exception, the University of Michigan offered a one credit hour summer course on "Qualitative Methods for Epidemiology" to "provide an overview of qualitative research methods that can complement and enhance epidemiologic studies," which was last offered in 2016 [78]. On the other hand, a recent survey on "Core Competencies of Epidemiologists" by the University of Zurich has recognized knowledge of qualitative health research methods and analysis [79]. However, qualitative research is not yet considered a core competency in epidemiology. We hope that training and expertise in qualitative research become

recognized as a specialization in its own right within epidemiology, analogous to competencies in spatial or molecular epidemiology. Such training would seek to equip epidemiologists with the tools and capacity to develop a reflexive orientation to the world and the ability to engage with individuals and communities in meaningful and ethical ways. It must also help epidemiologists to prioritize the translation of qualitative and quantitative epidemiologic research into opportunities for health promotion and equality.

As long as qualitative research is constrained to being part of interdisciplinary endeavors only, the full potential of qualitative research in epidemiology will not be realized. This may only change when we move from asking, "are qualitative methodologies applicable to answer epidemiological questions?" to "how and what types of qualitative research are applicable to answer a specific epidemiological question?"

Conclusion

Recent theories of causal inference offer frameworks that best align with the practice of epidemiology and its goals to contribute to public health. These frameworks explicitly allow for different types of evidence to evaluate causal claims, which we argue includes scope for expanding the bounds of epidemiology to embrace qualitative as well as quantitative methodologies. Causal reasoning based on evidence generated through qualitative or mixed methodologies can be justified through pragmatist and critical realist ontologies. We have highlighted topics of inquiry where qualitative research is likely to be useful in epidemiology, particularly in contributing evidence to a mechanistic understanding of causal pathways.

Fundamentally, the question of the role of qualitative research in epidemiology is less about methodology than it is about epistemology [18,19,21,48]. Qualitative researchers rightly warn against the portrayal of qualitative research methodologies as a toolkit from which quantitative researchers can select techniques perceived useful to their problem at hand, devoid of the rigorous approaches to design, analysis, and interpretation fostered in the disciplines that have made the most use of qualitative research [19,23,26]. Equally, however, qualitative epidemiologic research cannot be done well if it is not practiced, read, and used by researchers with core training in epidemiology. A methodologically pluralist epidemiology offers a "third way," as long as it is grounded in a shared epistemology and aims to contribute to expansive epidemiologic enquiry about the determinants of health and illness. It is through seeking to understand the effects of context(s) how the intersection of biological and social experiences and meanings shapes health outcomes and trajectories and the inherent heterogeneity of effects at individual and group levels [80] that more comprehensive explanations for patterns of health and illness will be attained.

Acknowledgment

The authors are grateful to Dr. Tine Verdonck and Associate Professor David Harley for their comments on an earlier draft of this article.

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