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Research and evidence based environmental health

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Introduction

Environmental health (EH) professionals have often spoken of the need to become more research active [1, 2] and make their work more evidence based, but to date little has been written about how to achieve this in practice. It can also be argued that having a research base is needed in order to advocate effectively for action to improve environmental health. This chapter is therefore written as an introductory guide to research for EH professionals, students, and policy makers. By developing knowledge it is hoped the practitioner will feel more confident navigating the world of research; motivated towards making their own work more evidence based; and enthused about contributing to the evidence base from which others can learn. This chapter is not a research methods textbook, a step by step guide to research or evidence based environmental health, nor does it seek to make definitive statements about these complex areas. However it highlights the most important issues regarding research in environmental health, considers the importance of research to the environmental health profession and provides useful signposts towards further resources.

The chapter is divided into three sections. The first defines evidence based environmental health and why it remains a priority for EH professionals. The second section explores the key stages of environmental health research and provides guidance on the development of your reading skills. The final section suggests ways to become more research active and evidence based, acknowledging the many challenges EH professionals face and concluding with a vision for evidence based environmental health. The chapter ends with an annex including a glossary of environmental health research terms, a list of references and suggested further reading.

SECTION 1: INTRODUCING EVIDENCE BASED ENVIRONMENTAL HEALTH

What is evidence based environmental health?

Environmental health is a relatively new term [3] and does not have a simple definition [4, 5]. Definition is problematic for many reasons, not least because ‘environment’ and ‘health’ are themselves difficult to define and then combine [6]. However, definitions can provide a useful starting point, and this chapter is based around the wording developed during a series of World Health Organisation (WHO) conferences:

“Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling and preventing those factors in the environment that can potentially affect adversely the health of present and future generations” [7 - page unknown]

Reflecting on this definition, perhaps the greatest challenge facing potential researchers is grappling with the interdisciplinary nature of environmental health. The WHO definition and the historical development of the role of EH professionals suggests that environment-health relations and their management have always been shaped by many disciplines including biology, chemistry, physics, psychology, law, politics, philosophy, economics, sociology and history. It can therefore be useful to view environmental health as a complex subject shaped by many disciplines.

The interdisciplinary skills of EH professionals are, arguably, one of their greatest strengths, but simultaneously this lack of a single disciplinary ‘home’ or body of knowledge presents many challenges. Recognising and managing this complexity is critical for all EH professionals, students and policy makers, and highlights how much could be gained by collaborating with researchers and others with greater knowledge of the many disciplines underpinning environmental health.

Organisations and individuals have long sought to influence environmental health policy and practice using evidence. In his 1842 *Report on the Sanitary Conditions of the Labouring Population of Great Britain* Edwin Chadwick described environmental health conditions and inequalities across industrialising Britain and argued that these could be addressed by his ‘great preventives’ (e.g. household water supplies, toilets and sewerage) delivered by a cadre of EH professionals [8]. Many factors continue to influence the use of evidence in policy and practice including greater pressures towards productivity and competitiveness, an increasingly knowledgeable and well informed public,

declining trust in the expertise of professionals, and greater scrutiny and accountability of governments [9]. As in Chadwick's day ideology remains a powerful driver of environmental health policy [10, 11] and politicians can always be heard jousting over 'the evidence' that supports their arguments or undermines their opponents.

An exploration of the origins and development of the 'evidence based' movement in clinical medicine is beyond the scope of this chapter (see [12]), but its main principles have been incorporated into our definition of 'evidence based environmental health' as:

“...environmental health policy and practice supported by the best available evidence, taking into account the preferences of citizens and the wider public and our own professional judgment” [13 – page 6]

Implicit in this definition is the ability of EH professionals to provide a clear and up-to-date rationale for their work that goes beyond default responses such as 'it's what the law says' or 'that's how we've always done it here' and enables them to challenge engrained attitudes. Policy is included because in the form of legislation and guidance it remains an important driver of environmental health practice. This definition also recognises that evidence is often uncertain, changing, vulnerable to politics and can be difficult to access (hence 'best available'), but EH professionals should have the confidence to embrace its uncertainties and use them to improve public health.

However, the application of evidence works alongside professional judgement because of the limits of the available evidence and the unique and complex nature of environmental health cases. Critically, judgements should also consider the preferences of citizens and the wider public influenced by environmental health activities. The term 'citizens' is used to include all those EH professionals encounter during their daily work (e.g. business owners/operators, employees, the public) and recognises their legal rights and responsibilities. The terms 'client' and 'customer' are avoided because of their associations with market derived neoliberal ideologies that remain powerful but can exacerbate health inequalities causing avoidable morbidity and mortality [14]. This can be exemplified by EHPs themselves being uncertain as to who would be the client and customer in the context of a tenant complaining about their housing conditions and a notice served on the landlord, the owner of the property.

A word of warning is also needed here. The term 'evidence based' has become increasingly politicised and is often used to support the dominant opinion or those with the most powerful voices.

In response there has been something of a backlash towards the term, but its use is recommended provided you take the following course of action:

- Tune your ‘warning antennae’ to provide an alert every time terms like evidence or evidence based are seen in a publication or someone describes their work in this way;
- Examine the references or challenge the speaker about what they mean by evidence (e.g. what evidence has been used?).
- If there are no references, or the publication is poorly referenced, or the references are based on single studies or personal experiences or have been carried out by those with vested interests they might not have declared - treat the ‘evidence’ with extreme caution.

Why is evidence based environmental health needed?

Before grappling with this question it is important to consider the potential of environmental health research to contribute to a better understanding of some of the greatest and most persistent challenges faced by societies today such as poverty, inequality, climate change, urbanisation and the need for more sustainable economies. Research into the complex relationships between human health and the environment has a long history and is constantly being re-focused, for example in the UK there is now a greater emphasis on the impacts of environmental health on mental health and wellbeing [15, 16]. But for EH professionals probably the most powerful argument for research is its potential for better understanding how environment-health relationships are managed, particularly the effectiveness of environmental health interventions. Academics have been researching the work of EH professionals for years (e.g. [17 - 20]) but research by EH professionals themselves remains rare, as is their engagement with academic research.

Returning to why evidence based environmental health is needed, Greenhalgh [21] provides warnings of the alternative drivers of decision making by health professionals:

- *Decision-making by anecdote* – where decisions are based solely on personal experience;
- *Decision making by press cutting* – where decisions are based on single published studies without consideration given to the methods used or the results of alternative studies;
- *Decision making by GOBSAT* (Good Old Boys Sat Around Tables) – the product of biased, ‘expert opinion’ that in reality could simply consist of the bad habits and personal experiences of ageing professionals; and
- *Decision making by cost minimisation* – where the cheapest option is followed, regardless of its effectiveness.

In 2015, UK government economic policies could be characterised by austerity that has brought the cost minimisation driver to the fore. For example policy recommending the re-organisation of local government environmental health services has been advocated by powerful organisations like the Auditor General for Wales [22], but supported by little or no evidence that the recommended models of collaboration and outsourcing will ‘improve efficiency’ and ‘maintain performance’. Until EH professionals can better demonstrate the effectiveness of their work to those making funding decisions, they are likely to remain a highly vulnerable workforce [23].

Another justification for evidence based environmental health is to move beyond the traditions and rituals that continue to influence policy and practice. Richard North [24] is one of the few EH professionals to have subjected environmental health practice to critical review and provides many examples (e.g. the banning of bleach on safety grounds) of how easily poor science can become conventional wisdom and then absolute standards. In the UK the development of food hygiene risk rating systems and their powers to predict the epidemiological risk associated with food premises provides another example of how questionable science can become standard practice. Day [25] describes how the original systems on which scores were based were only designed to provide a ‘quick and dirty’ means of prioritising inspection resources. Two case control studies [26, 27] further question the effectiveness of food hygiene risk rating systems and the EH professionals applying them, but these systems remain largely unchanged and are being expanded by initiatives like *Scores on the Doors* and applied in new areas like the *Tattoo Hygiene Rating Scheme* in Wales and England.

EH professionals should be utilising evidence which is based on research and evaluation in their policy and practice. Aveyard and Sharp usefully categorise this evidence:

- Evidence for effectiveness;
- Direct evidence – from studies that relate directly to practice;
- Indirect evidence – from studies relevant but not directly related to practice;
- Evidence deduced from scientific knowledge – where scientific principles are applied to practice to explain how things work [28 - pages 40-45].

This evidence might be based on ideas constructed to explain phenomena, so called theoretical research, or on empirical research founded on observation or experience. In the category ‘evidence for effectiveness’ concerns about the effectiveness of medical interventions has led to the development of ‘hierarchies of evidence’ where some evidence is considered more trustworthy than others [21]. For example reviews of well-designed research evidence (e.g. systematic reviews) are generally

considered the most trusted forms of evidence at the top of the hierarchy. Some environmental health related systematic reviews already exist and we discuss these in Section 2 below, but their development and communication remains a long standing but overlooked priority for EH professionals. Next is experimental research i.e. randomized controlled trials followed by observational research including cohort studies, case control studies and cross sectional surveys. Case reports are listed as the least trust worthy [21].

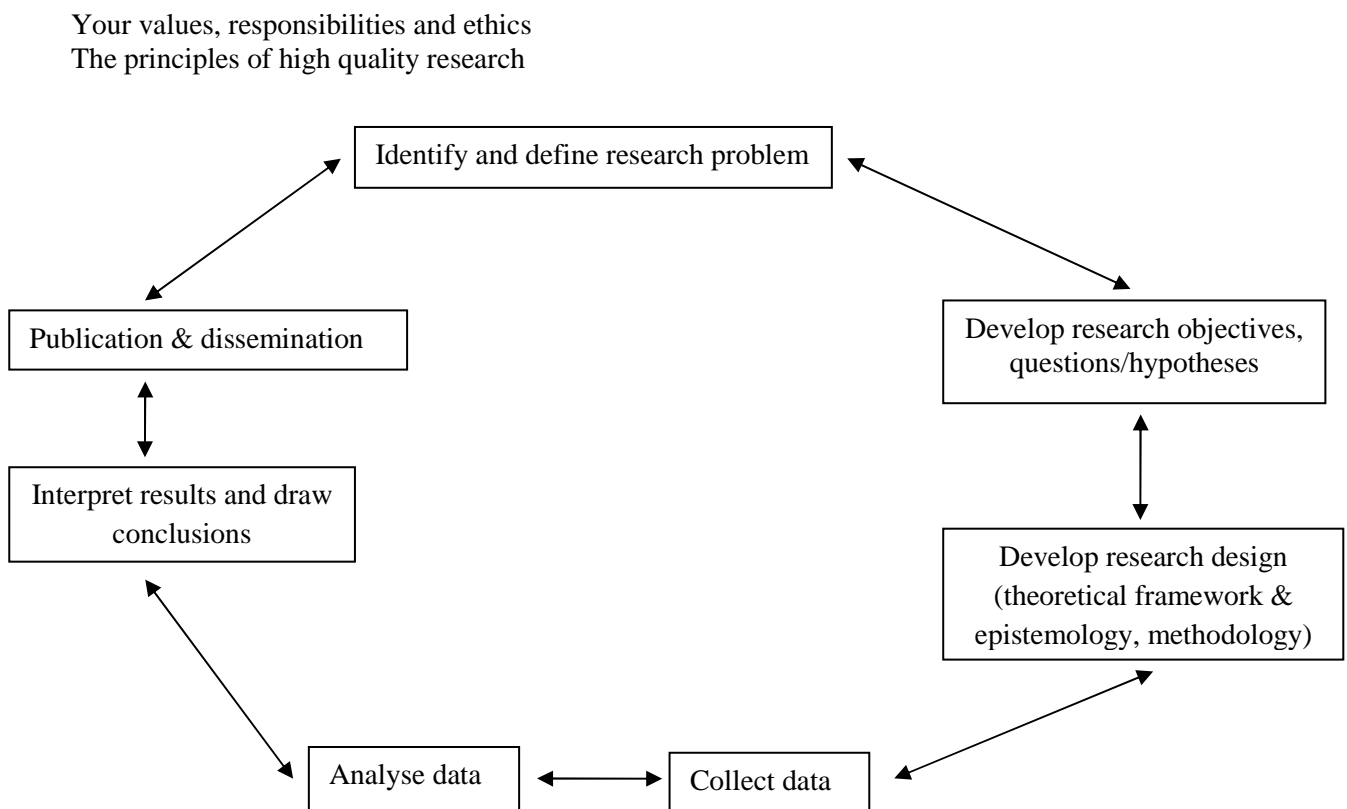
Qualitative research is not included in the hierarchy because it cannot be directly compared with quantitative research design. It is not that it is better or worse but it answers different types of research questions. It is therefore unfair to directly compare them. The quality of research methods needs to be assessed in relation to each piece of research - even systematic reviews and randomised trials that are ranked highly in the hierarchy can be done badly. These terms are discussed in more detail below and defined in the *Glossary* at the end of this chapter, but at this early stage EH professionals need to be utilizing all the research tools available towards a more evidence based environmental health. This chapter now explores a cycle model of environmental health research.

SECTION 2: THE ENVIRONMENTAL HEALTH RESEARCH CYCLE

Introduction

There are many models describing the research process, but here research is viewed as a cycle of seven linked and frequently overlapping stages as summarised in Figure 1 below. This model is based on the work of Sumner and Tribe [29 – page 102] and is a gross simplification but is useful for exploring the research process. The cycle is used because research is not a linear process. Instead the stages constantly inform one another and are frequently revisited and improved during the research process, where developing the confidence to move between these stages is part of being a good researcher. In this section we introduce you to each stage and important things to think about towards producing high quality research. To end the section we consider research ethics and your responsibilities as an EH researcher.

Figure 1 The research cycle (adapted from Couch et al. in [13])



Identifying and defining the research problem

Well-planned research seeks to build on what is already known and address gaps in our current knowledge about a particular issue. Choosing a topic can be challenging, as can refining an idea into a piece of research that can be carried out using appropriate methodology (see *Glossary*) within the time and resources available. The best advice is to choose a topic of genuine interest, as this will sustain you through the process. Inspiration may be found from articles, papers, seminars or colleagues; or there may be issues encountered by the practitioner in the field (see Box 1 below) or wider policies that could be investigated more deeply.

Box 1 The Art of Communication: A landscape shared between regulator and ethnic employer [30]

Empirical research identifies problems in communications between UK local government EH professionals and ethnic minority food businesses [19, 31]. Building on this and his own experiences, Northern Irish EH professional Eamonn Toner of Derry City Council conducted a literature review exploring the influence of culture and communications between the Chinese and EH professionals. This informed his research design, where a sample of 56 EH professionals and 91 Chinese caterers from five local authorities in Northern Ireland were investigated using both qualitative and quantitative methods (focus groups and questionnaires) to explore their views and experiences of shared communications.

Toner concluded that relationships between EH professionals and Chinese businesses were driven largely by the former with little consideration of the unique and complex needs of the latter, particularly the importance of non-verbal communications and the limited effectiveness of simply translating information. Evidence of innovative working by individual EHPs and their departments was also uncovered and there was much goodwill between both parties. The work has informed evidence based practice and on-going outcomes include improved awareness and understanding and much closer working relationships between EH professionals, Chinese employers and the wider Chinese community. Non-verbal communications training courses have been developed for EH professionals and the work has been presented at conferences in Ireland and the UK and influenced guidance documents including the UK Food Standards Agency's Resource Handbook on Working Effectively with Minority Ethnic Food Businesses [32].

Further, in 2013 Toner was awarded a Fellowship of the Chartered Institute of Environmental Health in recognition of this work and he remains a passionate advocate of the need to improve understandings between regulators and ethnic minority businesses and to support practitioners towards publication. His final report was published in 2010 and can be downloaded via: http://www.cieh.org/the_art_of_communication.html.

Reviewing the literature

Having identified a research topic you will need to carry out a literature review. The purpose of the review is to understand the knowledge that exists, and to identify a 'gap' which your work will help to fill. Here the following quote from Sir Isaac Newton is useful:

“If I have seen further it is by standing on the shoulders of giants” [33]

At these early stages it is tempting to follow initial ideas and to start developing questionnaires, interview schedules etc. immediately. But following Newton’s advice it is important to channel enthusiasm into a review of the knowledge that engages with the existing work of the ‘giants’ in the area of interest. This will help to identify gaps in existing knowledge and ensure that the research has not been done before. Exploring this work can also assist in focusing the topic further; identifying suitable research methods; highlighting potential challenges of researching the topic that has been chosen; and will inform the theoretical framework. The literature review therefore informs all stages of the research cycle, even when discussing findings reference will be made to work of others to put the results into context. Given the significance of reviewing previous literature in this process we now turn briefly to provide additional guidance on critical reading for research.

EH professionals need to read around their subject as part of their every-day role as recognised in official guidance for EH professionals like that for the Housing Health and Safety Rating System [34]. But Horder’s research [35] exploring the lack of reading in the practice of social workers is relevant here. He identified themes that are also common to environmental health including an oral working culture, where knowledge is often passed down from more experienced staff within a working context focused on ‘getting things done’, and limited access to reading materials in the workplace and the time to read them during the working day. These barriers remain, but by encouraging more research by EH professionals we hope the value of reading for research and evidence based practice will become recognised as an essential part of professional life.

Read and read again; as an EH professional find out everything about your area of interest and consider reading an active and critical process. That said how relevant information can be found depends on access to academic literature resources. In academic research, peer-reviewed papers in academic journals are typically the preferred sources of information because the peer-review process is one of the most accepted quality controls available. Ideally, systematic reviews of peer-reviewed research are the best place to start because they identify, collate, appraise, analyse and summarise good quality research around precisely defined research questions. Some already exist for environmental health (e.g. [36 - 38]) and organisations like the Cochrane Collaboration’s Public Health Group (<http://ph.cochrane.org/>) are constantly publishing open access systematic reviews of the best available environmental health evidence. However, systematic reviews of environmental health knowledge and its dissemination to those working in policy and practice remains a priority for

EH professionals. One major problem is that access to academic journals and books can be expensive for those not attached to an academic institution, though this might be slowly changing as the shift towards open access gains momentum. If access to an academic library is not possible, EHPs may be entitled to library access as a graduate of an institution where they have previously studied.

Alternatively, access to professional libraries may be possible with relevant collections or via the inter-library loans schemes operated by public libraries in countries like the UK.

Beyond systematic reviews and peer-reviewed papers and books, organisations such as governments, charities and think-tanks all provide important resources for researchers. These resources include technical reports and policy statements and are sometimes referred to as ‘grey literature’. They can be of the highest academic quality (e.g. [39, 40]) but are so-called because they have not been subject to formal publication. However, returning to the warnings above about evidence, many organisations present their evidence to support and promote their causes and therefore - as with all reading - requires a critical mind.

To find relevant resources, electronic databases enable searches across a variety of literature by subject, author, key words etc. Web based databases relevant to environmental health include *Assia*, *Embase*, *Web of Science* and *Medline* and practitioners are encouraged to visit them and follow their instructions to maximise the effectiveness of searches. *Google Scholar* is also a very powerful general database. Although it is not always possible to access journal papers free of charge, an increasing number are becoming open access and even if the whole article is protected it is often possible to see the abstract summary for free.

In the experience of the authors ‘environmental health’ and its core areas (e.g. food safety, health and safety, housing, environmental protection etc.) on their own are not very useful search terms, not least because these areas are so broad themselves and sometimes have limited recognition outside the UK and Commonwealth countries. Instead widening your searches towards the many disciplines that underpin environmental health could be more productive. For example using key words often listed below abstracts at the start of journal papers and/or focusing on key authors could yield better search results. The authors themselves are often happy to hear from those interested in their work and they could help guide you further.

Critical evaluation is an essential part of a literature review and many checklists have been developed to help readers identify and interpret the best available evidence. In the UK the health research checklists developed by the Critical Appraisal Skills Programme (CASP) are available for free (via:

www.casp-uk.net) and are particularly useful, but most checklists are based around the following critical questions (based on [21]):

- Is the research question clear?
- Can the methods answer the question, for example:
 - How was the sample chosen?
 - How was the data collected?
 - How was the data analysed?
- Has the researcher's perspective been discussed?
- Are the results credible?
- Are the conclusions justified?

Lastly, amidst information overload it's easy to lose track of what has been read, where you found it and what the key points were. There are now many ways to manage what is read and to make sure that the correct references are ready for when needed. Electronic reference management software (e.g. *EndNote*, *Mendeley*, *RefWorks*, *Zotero* etc.) are very useful for anyone who is reading for research and have many features to make it quick and easy to look up references and insert them into the work. Basic formats of these systems can often be downloaded for free, whilst more sophisticated versions can be purchased.

Developing research aims and objectives, questions and hypotheses

The literature review will help refine the particular research problem to be focussed on, and the best research has very clearly defined aims and objectives, research questions and/or hypotheses to provide a solid foundation from which the research has developed. Brainstorming potential research questions (e.g. who, what, when where, why, how etc) can also help to develop and focus ideas. Writing purpose statements is another useful exercise and the following examples in Table 1 below draw on the authors' PhD experiences.

The objectives of the research study are informed by the research problem and should be clear and realistic, not least because of the inevitable limitations all researchers face, primarily funding and time. It is easy to be over-ambitious and become overwhelmed at these early stages and therefore it is recommended that the project is as focused as possible. Developing research questions/hypotheses takes time and many attempts, but this stage is very important because it establishes the basis for the whole study. It is recommended that the practitioner works closely on the research design with a supervisor or more experienced mentor, and also with their employer or university as there may be local guidelines or criteria that need to be considered. It is also recommended that a research diary is

maintained from an early stage, recording developments in the research and also recording thoughts, ideas and learning.

Table 1 Examples of purpose statements to develop environmental health research

Rob's PhD	
Problem	Large and persistent environmental health inequalities in South African cities
Topic	Environmental health regulation in Johannesburg by local government EHPs
Purpose	To describe the factors influencing the decision making of local government EHPs and their implications for urban environmental health
Surindar's PhD	
Problem	Persistent health inequalities between people in different socio-economic groups
Topic	Public health policymakers approaches to tackling health inequalities
Purpose	To understand public health policymaking in relation to health inequalities and environmental health in England

In the last few years a preference for hypothesis-testing has been observed amongst UK EH professionals. It is suspected that this might be a legacy of university research methods modules taught largely by non-environmental health academics with a preference for quantitative research methods, but these methods are much broader than just hypothesis testing and what really matters is evaluating the strength or quality of the evidence presented instead of whether hypotheses are proved/disproved [21]. Research questions instead can provide broader and more flexible methods of enquiry and can be:

- Descriptive or exploratory (e.g. how does x vary with y?)
- Explanatory (e.g. which x causes y?)
- Interpretative (e.g. what is x?)
- Driven by the type of study envisaged (e.g. action research – see below)

(based on Mikkelsen in [29 – page 103])

Developing your research design: theoretical frameworks and epistemology

Having clearly defined what the research aims to achieve, it is time to develop the research design. In summary environmental health researchers must be clear about their theoretical and epistemological assumptions because they have such an influence on the whole research process. A theoretical

framework and discussion of epistemology are central to the development of the research design, but can be unfamiliar to EH professionals who may not have encountered them at university and who are accustomed to practical approaches and ‘solving problems’ in their daily work. Here we describe what a theoretical framework is and why they are important before providing three examples in Annex 2 at the end of this chapter. We then describe why epistemological considerations are so important to research.

Theoretical frameworks

In scientific research the term ‘theory’ is used to refer to a system of ideas constructed to explain phenomena. Theories help us to understand why and how things happen and to make predictions and they are built up over time, not simply from one piece of research. The theoretical framework of a piece of research explains the theories that are relevant to a practitioner’s research and how they interact:

“A theoretical framework consists of concepts, together with their definitions, and existing theory/theories that are used for your particular study. The theoretical framework must demonstrate an understanding of theories and concepts that are relevant to the topic of your research paper and that will relate it to the broader fields of knowledge in the class you are taking” [41]

Using a theoretical framework helps to embed the research within previous knowledge and enables the researcher to make it clear what their contribution to knowledge will be, for example:

- Are you hoping to test a current theory?
- Are you providing evidence in support of another theory?
- Are you trying to generate a new theory because existing theories fail?

Less experienced researchers can become quite distressed at the idea of a theoretical framework but it is not the terrifying proposition one may think. If the researcher has a research question and has done some reading around it, the chances are that they already have one but maybe just don’t know it!

Think about the definitions, terms and concepts that are regularly used in the research - where did they come from? To construct a theoretical framework it will have been necessary to read around the subject to be researched, to have identified the previous theories that have been developed or used in relation to the research problem and to describe how the particular question relates to those previous theories.

Theory can also help to shape the methods chosen and help the researcher to interpret the results and draw conclusions. Therefore becoming more aware of the role of theory in shaping the research will enable the EHP to make much more informed decisions at all stages and to write in more powerful ways. To illustrate their potential the following three theoretical frameworks were chosen for their relevance for informing questions about why EH professionals do what they do. They are summarized in Annex 2 at the end of this chapter:

- Street level bureaucracy – by Michael Lipsky [20]
- Why EH regulators generally consider prosecution as the last resort? – by Steve Tombs and Dave Whyte [42]
- Environmental health regulation as modern state power – by Tom Crook [17]

Epistemology

Epistemology is concerned with the theory of knowledge and asks what the researcher considers ‘knowledge’ to be, or when can we say that we *know* something about the world? The researcher’s epistemological position has important implications for the methods used, what the research is trying to achieve and the nature of the relationship between the researcher and the researched.

The origins of epistemological thinking date back to the Ancient Greeks, but since this period Western philosophers have identified and debated different ways of knowing the world and the work of EH professionals has long been informed by many different epistemologies. For example, those with positivist views of the world argue that there is one, observable and measurable reality and that the researcher can remain objective and independent of the researched [29]. For EH professionals, epidemiology for example utilises inherently positivist positions associated with quantitative research methods like randomized control trials (see below and *Glossary*).

Alternatively, relativists argue that there are multiple realities in the world that can be experienced. In this case the researcher is subjective and not independent of the researched [29]. For EH professionals immersed in the messy realities of the streets every day, the relativist tools of the social sciences like qualitative methods (see below and *Glossary*) could be more suitable. For example in her research on compliance and environmental health, Lange [43] uses relativist arguments to reject over-simplistic and legalistic descriptions of offences and instead argues that compliance is constructed in the field from the relationships between rules and social practices.

Critiques of the positivist-relativist debate provide alternative assumptions about knowledge and reality that the practitioner should be aware of and could help to shape the research. For example

feminist approaches broadly question the relationships between knowledge and power, particularly how 'knowledge' is not objective and typically reflects a male world view [44]. The aim of feminist inquiry is to facilitate female emancipation and greater understanding of female world views [45]. Alternatively, those following participatory approaches consider research as a cooperative and emancipatory activity; participatory action research for example considers the aim of knowledge inquiry to be liberation and empowerment of the community [44]. It is hoped that participatory action research could empower EH professionals as researchers and they are urged to explore how other professions like nursing have made progress here (e.g. [46 - 48]).

Developing your research design: how is the research going to be carried out?

Building on the previous stages and other factors (e.g. personal limitations) the choice of methodology is now considered, along with methods and analytical techniques. The term methodology refers to the overall research strategy followed to answer the questions/test the hypotheses and includes the researcher's theoretical position and the methods used to collect, analyse and report the data [29]. In contrast, methods are the detailed tools and techniques used to collect and analyse primary or secondary data (see *Glossary*). The choice of methodology will be shaped by the epistemology, theoretical framework, the discipline(s) underpinning the study and any limitations faced by the researcher. Another important factor is choosing between quantitative or qualitative methodologies or a combination of both?

Quantitative and qualitative research

Quantitative research generally refers to studies that collect and analyse numerical data and often includes high numbers of participants but little or no direct involvement between the researcher and participant [28]. A wide range of quantitative research designs and methods are available and include randomised controlled trials, cohort studies and case control studies (see *Glossary*). Sampling is often random and data analysis structured around tests of statistical significance. Both these aspects will require careful planning long before any data is collected.

Qualitative studies tend to use data derived from language (written and oral) [44], not numbers, to "explore the meaning and develop in-depth understanding of the research topic as experienced by the participants of the research" and the researcher is often more closely involved with the participant who may play a role in shaping data collection and analysis [28]. Sampling here tends to be more focused on which participants are related to the area of interest, with data analysis based on the coding of data and the development of themes [28]. Commonly used qualitative research methods include interviews, observations, focus groups and questionnaires. Examples of qualitative approaches include:

- *Grounded theory* – data is collected and analysed to generate theory (e.g. explanations of social phenomena) [45];
- *Ethnography* – a community is observed in real time to answer questions about how the community behaves [45];
- *Action research* – practitioners and researchers work together to address everyday issues about practice and develop a systematic approach to implement and evaluate change [28].

The flexibility of the research is another important consideration and will depend on the methodology chosen. A fixed design is integral to most quantitative research designs (e.g. randomised controlled trials) and sets out very specific requirements for the research process, particularly in defining sample size and how data are to be collected and analysed. But for other approaches, especially for some qualitative designs, a flexible design may be more appropriate because the stages of the research process can overlap and inform each another. A flexible design is also important if dynamic workplaces are being researched, like those of many EH professionals where interviews, for example, could be cancelled at the last minute due to reactive workloads.

Mixed methods research

Environmental health researchers commonly draw on both quantitative and qualitative or ‘mixed methods’ approaches. For example Hutter’s [19] classic study of the work of UK local government EH professionals is based on qualitative data (via interview, observation and document analysis) but supported by quantitative data (e.g. workplace performance and law enforcement data). Similarly, Fairman and Yapp [49, 50] use mixed methods to investigate compliance with environmental health law in small and medium sized food businesses in the UK. Therefore the authors agree with Baum [51] and reject the argument that randomized trials (towards the top of hierarchies of evidence) are the ‘gold standard’ and priority for all public health research; instead EH professionals must utilise all the research tools available to develop an understanding of environmental health and select the most appropriate tool(s) for the problem being investigated.

Data collection and analysis

Data collection sees the research design come to life, but before embarking on the main study it can be very useful to pilot test the design on a small sample and refine it if necessary. For example even pilot testing and analysing draft questionnaires with family/friends or even on the researcher themselves can provide invaluable information about the process, not least the (considerable) time it can take to collect and analyse data!

A detailed examination of the many data collection methods available is beyond the scope of this chapter, but the reading and references at the end of the chapter will be useful. Things can and do go wrong during data collection, but the response to these difficulties is important. Responsibilities as an EH researcher (see below) will also come to the fore at this stage and the practitioner should be careful to ensure that ethics are not compromised in the pursuit of interesting research.

Depending on the methodology, data analysis might take place during or after data collection and typically starts with organising and then processing the data. For those using quantitative methodologies this stage could involve the careful entry of numerical data into computer software packages (e.g. *SPSS*, *Minitab*) for further statistical analysis. For qualitative methodologies, language data are likely to require transcription and then coding and comparison around themes in accordance with the chosen approach (e.g. grounded theory, action research etc). Computer software packages can assist the transcription (e.g. *Express Scribe*) and coding process (e.g. *Nvivo*), but Greenhalgh [21] warns about the rule of GIGO (garbage in, garbage out) and that other older techniques like VLDRT (very large dining room table) can also provide excellent qualitative analysis.

Interpretation of results and conclusions

The interpretation of data and the drawing of conclusions is perhaps the most difficult stage of the research process and will be framed by the previous stages and factors, particularly:

- The research problem;
- The aims, objectives, questions/hypotheses;
- The research design – especially your theoretical framework and methodology;
- The values, responsibilities and ethics

Fundamentally, the researcher's conclusions must be justified by the results and this requires consideration of the credibility of the results and the interpretations of them. For quantitative studies, determining the credibility of the results might involve consideration of the precision of measuring devices or error in tests of significance (e.g. confidence intervals). For qualitative studies, credibility could include results supported by verbatim quotes that can be traced back to the original source [21] and a full description of the position of the researcher (see *reflexivity* in the glossary). For quantitative studies distinguishing between the results obtained and the interpretation of those results is fairly straightforward, but for qualitative studies this is more difficult because the results are themselves an interpretation of the data [21]. However, Mays and Pope [52] suggest three questions for determining whether the conclusions of a qualitative study are valid:

- How well does this analysis explain why people behave in the way they do?
- How comprehensible would this explanation be to a thoughtful participant in the setting?
- How well does the explanation cohere with what we already know?

Publication and dissemination

The publication and sharing of results should be an integral part of the research process, but this stage is particularly important because it has been observed that EH professionals often do not publish their work. There are many formats available for publication. Alongside more traditional peer reviewed journals, books, newspapers and professional magazines are an increasingly wide range of more accessible social media formats like websites and blogs. Ideally EH professionals should be aiming to publish in peer reviewed journals, preferably those with policies of open access to ensure all can read them. Annex 3 includes a list of peer-reviewed journals that have published environmental health research in the past to illustrate the considerable breadth of interested titles.

Publishing in peer reviewed journals makes the researcher's work available in the databases mentioned above and available to be cited in other research as valid, high quality work. As well as traditional research reports some journals offer the opportunity for new authors to publish and others accept short opinion pieces (e.g. 500-1000 words) that might not be so daunting. Even experienced authors sometimes find an opinion piece a relatively quick way of disseminating their work in a good journal, but the practitioner needs to study the guidelines for authors before deciding which are likely to accept the topic/argument. The EH professional must also ensure that it is their work to publish in terms of the ownership/permissions/acknowledgements and that the work is original, high quality and ethically sound (see below). The work must not have been published before and should only be submitted to one journal at a time.

Other options for publication include books/book chapters, newspapers or writing for environmental health related professional magazines. Conferences, seminars and workshops are a great way for an EH professional to disseminate their work and for testing the research findings with interested people. The EH professional may be invited or choose to submit an abstract for consideration. Sometimes, a guaranteed publication follows or it may be possible to convert the presentation into an article for publication further widening its impact. Much will also be learned during the process, particularly when questioned by peers. As the UK Environmental Health Research Network the authors have developed their own social media (via: <http://ukehrnet.wordpress.com>) which are free and took minutes to set up. They are still very new and as yet it is not possible to say how effective they have been, but it is encouraging that in the UK there is an emerging research debate amongst EH professionals.

Having now explored the main stages of the research cycle introduced at the start of this section, two important themes that cut across all the stages are now explored – ensuring high quality and ethical research.

What is high quality environmental health research?

Establishing the quality of research is the subject of much debate and has historically been influenced by what Becker et al. describe as four ‘traditional criteria’ derived from quantitative research:

- *Validity* - the extent to which there is a correspondence between the data and the ‘truth’;
- *Reliability* - the extent to which observations are consistent when the study is repeated;
- *Replicability* - the extent to which it is possible to reproduce an investigation.
- *Generalisability* - the extent to which it is possible to generalise findings to similar cases which have not been studied [53 – page 7]

However, most of the 250 social policy researchers and research users in this study only considered validity and reliability appropriate quality measures for qualitative research, whilst replicability and generalisability were considered much less crucial. The same study therefore revisited four alternative criteria originally developed by Lincoln and Guba [54] for qualitative research:

- *Credibility* - the extent to which a set of findings are trusted.
- *Transferability* - the extent to which a set of findings are relevant to settings other than the one or ones from which they are derived.
- *Dependability* - the extent to which a set of findings are likely to be relevant to a different time than the one in which it was conducted.
- *Confirmability* - the extent to which the researcher has not allowed personal values to intrude to an excessive degree [53 – page 8].

In Becker et al.’s study the majority of social policy researchers considered credibility and confirmability the most important quality measures for qualitative research, with dependability and transferability much less important. Several researchers also considered reflexivity (see below and *Glossary*) an important quality criterion for qualitative research.

However, establishing the quality of environmental health research is further complicated by two factors. First, the use of mixed methods is not uncommon in environmental health research. Becker et al.’s found most researchers suggested a combination of traditional and alternative quality criteria

should be used, but with different criteria for the quantitative and qualitative components. Other quality criteria for mixed methods include a clear rationale for using mixed methods and transparency in their use [53]. Second, different perceptions exist between the disciplines about what constitutes high quality research and therefore the interdisciplinary nature of environmental health has the potential to create further complications. Thus more work is needed towards establishing what constitutes high quality environmental health research, but engaging with debates about the quality of the data and how it relates to other populations and settings is critical. For example, assuming that it's possible to describe what the 'best practice' of EH professionals could look like, how can it be known that the 'best practice' within one sample population would be as effective in another?

Lastly, the concerns of environmental health with policy and practice raise important issues about subjectivity and bias throughout the research process. Arguably all research is biased to a degree. This could be unintentional (e.g. personal values) or deliberate (e.g. not declaring the vested interests of your funders), but what's important is recognising and controlling acceptable bias throughout the research process whilst avoiding unacceptable bias (e.g. rejecting data that contradicts your position) [29]. There are no easy ways around these issues and their consideration is another research priority for EH professionals, but research will be compromised if bias is ignored.

Values, responsibilities and ethics of EH researchers

EH professionals are accountable in many ways, not least to their employers and the ethical codes of conduct of the professional organisations to which they belong. By its nature environmental health work is shaped by moral and ethical issues, for example balancing the tensions between economic growth, environmental degradation and the public's health. Conducting research is no different and requires EH professionals to engage with the values, responsibilities and ethics of their study which will now be explored.

All researchers must conform to established standards of ethical practice; aside from being a moral imperative it is also a standard condition for many publishers. In practice, this could involve written approval by university ethics committees, or from a similar body within the workplace, or perhaps from the professional organisation. Green and Thorogood identify three typologies to help understand the relationship between researchers and the wider society in which they operate:

- *The neutral outsider* – Researchers should strive to be disinterested in political and social values, as their role is to produce knowledge for its own sake. This approach implies that researchers should not be concerned about the impacts of their research on individuals or society.

- *The liberal relativist* – Researchers should follow their own (professional) conscience, because ethical standards are not uniform and are differently constructed in different settings.
- *The radical* – Researchers should be openly partisan about their work, striving to redress inequalities and increase social justice through their practice. This is because we do not exist in isolation and the proper role of research is to improve society [44 - page 55].

Arguably, environmental health research leans towards the radical typology, but Green and Thorogood also acknowledge that a researcher's position might not fit solely with one typology and could change.

The principle of informed consent is a cornerstone of ethical practice and it must be ensured that individuals participating in the study have given their informed consent. This means that people cannot be forced to participate, must be aware of their participation, and must understand the consequences of their participation [44]. To illustrate, researchers observing the practice of local government EH professionals might also need to inform all those using their offices (e.g. administrators, non EH staff, cleaners), the regulated themselves (e.g. business owners) and the wider public (e.g. complainants) about their study.

Maintaining data confidentiality is vital and covers issues such as data security and protecting the identities of individuals and fieldwork sites [44]. These safeguards need to be considered at the earliest planning stages, particularly for those researching potentially vulnerable groups (e.g. children, harassed tenants) or unique cases where reassurances of anonymity and confidentiality could be unrealistic [44]. This is important because the removal of names alone maybe insufficient to prevent identification.

Researchers also have a responsibility to consider how power and values can shape the research process. For example, when interviewing it is important to ensure that individuals are respected and not reduced to mere carriers of 'good data' [44]. There are other issues which can cause power imbalances between the researcher and interviewee which should be taken into account, for example the location of data collection and consideration of whether others are present, and their relationships. During research one of us found that several interviewees chose to speak in cafes and locations away from their places of work, whereas others invited their colleagues to take part in interviews held in their offices. Also important is consideration of whether the researcher is a professional 'equal' or has something in common with those being researched such as occupation or connections which can lead to a greater intimacy and candidness [55]. Chew-Graham et al. [56] also found that people were also willing to express some vulnerability where there are shared backgrounds, but because of this

important issues could remain unchallenged. Conversely, another of us (Caroline) found that her position as an 'outsider' meant that some participants were more willing to share issues and opinions that may have been considered controversial within the community.

Factors such as experience and background are particularly relevant, where an experienced EH professional might have a different perspective to an inexperienced one or someone from a different public health background, which in turn could influence how research is carried out and understood. These are examples of reflexivity, i.e. the reflections of the practitioner as a researcher upon their actions and values during the research process and the effects they might have [45].

Personal safety is also critical and it is important to properly risk assess planned actions. Those researching areas like outbreaks of infectious disease or poor housing might find it emotionally difficult and require additional support. Checking that there is full insurance cover is also critical, particularly if the research is not part of the day job or involves lone working or brings the researcher into contact with areas affected by infectious disease or war for example.

In summary, engaging with and balancing the values, responsibilities and ethics surrounding the study requires careful and on-going consideration throughout the research process. Sound ethical practice is essential if environmental health researchers are to realise the potential of the research to contribute to the development of the EH profession and to improve the public's health.

SECTION 3: HOW CAN I BECOME MORE RESEARCH ACTIVE AND MAKE WORK MORE EVIDENCE BASED?

This final section explores some of the challenges EH professionals are likely to face in trying to become more research active and evidence based and how they might be overcome. A series of questions raised repeatedly in EHRNet workshops and by the recommended Aveyard and Sharp [28] is used to structure this final section, but there are no easy answers here for any EH professional.

Are EH professionals researching already?

In one word, yes, but the problem is more that EH professionals often don't see their work as research nor perhaps more importantly realise its' potential for improving environmental health policy and practice. Returning to the discussion in Section 1 above, the need for EH professionals to engage with the best available evidence during their day jobs remains a priority. But returning to the work in Couch et al. [13] it is argued here that EH professionals could find they already have many transferrable skills for research.

Evaluating evidence and using it to piece together a 'picture', interviewing people, being able to communicate effectively at all levels, carrying out critical analysis of documents, skills of observation and an ability to make accurate notes, and being well organised and tenacious (and sceptical) are common attributes of both good EH professionals and researchers [55]. By viewing their daily work as a research cycle it is suggested here that EH professionals could become better at maintaining and improving the public's health.

Dr Richard North's *Some observations on food hygiene* [24] continues to be essential reading for all EH professionals, whichever area they work in, because of his application of critical research eyes to the inspection process. North's work is summarised in Table 2 below to argue that EH professionals are researching already because the in the first column the basic stages of the research process (from Figure 1 – research cycle model) closely mirror those of North's own inspection stages. Additional comments and advice have been added to further illustrate research as inspection or vice-versa.

The authors agree with North that inspection, like research, should be viewed as a cycle, i.e. part of a continuous process of maintenance and/or improvement. For example North argues that post-inspection discussions, revisits and additional works identified in future inspections are part of a programme of continuous development and not, as some argue, due to the inadequacies (e.g. inconsistencies) of previous inspections. Further, North has much to say about cross cutting themes

like the values, responsibilities and ethics of EH professionals and what could characterise high quality research/inspection as summarised at the bottom of Table 2.

Table 2 The inspection process as a research process? (Adapted from Couch et al. in [13])

Research cycle stages	North's inspection stages and further comments/advice to illustrate inspection as research
Identify & define research problem	Prevention of food poisoning
Develop research questions/hypothesis	Developing generic model <ul style="list-style-type: none"> Using standards prescribed by law, codes of practice, principles of hygiene etc.
Develop research design	Developing sector & site specific models <ul style="list-style-type: none"> To reflect sector (e.g. butchers/caterer) and unique circumstances of each premises.
Collect data	The conduct of inspection, inspection techniques and data recording <ul style="list-style-type: none"> Utilising observation, interview, document analysis methods in busy kitchens. Observation notes require great discipline, where plans & photographs can be invaluable.
Analyse data Interpret results & draw conclusions	Analysis and interpretation <ul style="list-style-type: none"> Reviewing findings to identify patterns. Not all findings are easy to interpret; Relate findings to site specific model and wider context (e.g. other kitchens in hotel group) and benchmark for future inspections.
Publish research findings	Framing the report <ul style="list-style-type: none"> Does the report clearly indicate the risks in the operation and set out recommendations in a way that, if followed, would adequately control/remove/contain all risks identified? Are requirements framed to enable understanding and implementation without specialist advice?
Your values, responsibilities & ethics	<ul style="list-style-type: none"> Recognising your outsider status and how your presence influences observed events (see also [30]); working with key insiders (e.g. chefs) to advise on, explain & interpret inspection data.
High quality EH research	<ul style="list-style-type: none"> Establishing reliability of data by comparing observation results to interview responses of staff and key documents.

The following quote is drawn from the analysis and interpretation stage in Table 2 above to bring the ‘inspection as research’ argument to life for busy EH professionals. Here North explores why inspection findings must be seen in context:

“...Analysis [of inspection findings] requires data and the more data available, the more accurate it can be. In particular, the inspector must be aware that visual observation of conditions may not always provide sufficient evidence on which to base judgements. Therefore, the fact that data are to be analysed itself provides the incentive for a more thorough inspection. Where cleanliness in a kitchen was observed to be substandard, one might expect any harassed manager confronted by an inspector to claim that any drop in standards was temporary – the result of meeting unusual pressures. The inspector will have to determine whether that claim is true. For the skilled inspector, this is not too difficult. In the same way that there is a contrast between soiling levels where there has been a rapid clean-up, there is usually a distinct difference between recent and long-standing accumulations of dirt. Again, the difference will be at its most pronounced in the contrast between visible and less visible areas. But the difference will be that visible soiling may be present, but less obvious areas will show signs of good maintenance, i.e. absence of long-term soiling. Only then can it be assumed that the overall standard reflects short term neglect. If, however, in addition to visible soiling, long term soiling is present in less obvious areas, claims that the standard overall is simply a short-term problem may be less credible” [24 – page 90].

More work is needed on the development of higher quality models and methods of inspection (e.g. better observation, interview techniques), data analysis and report writing but we agree with North’s comment that EH professionals could ‘make the difference’ they aspire to “...not by retreating into the bunker and issuing forth a stream of edicts couched in a language which has been inelegantly but accurately called ‘corporate-speak drivel’, but by getting back to its roots and exploiting the skills for which the profession has in the past been justifiably proud” [24 – page 127]. Such sentiments are in accordance with a more evidence based environmental health.

How can I fit research related activities into my day job?

Finding the time and resources to conduct research and review the best available evidence is hard enough at the best of times, but one way is to think of all research activities as an investment in personal and professional development. One of the lesser publicised benefits of research is in the creation of space in an otherwise hectic day for thinking and reflection. The creative power of having time to think like when travelling to and from your workplace should not be underestimated. Further, publications should go straight on the CV and are recognised as continuous professional development.

Team meetings are an obvious opportunity to discuss research and evidence but there may be a need to change the culture of meetings, where the usual day to day operational issues are covered alongside more in depth reviews of recent cases or the exploration of what works based on the latest research evidence? When an EHP attends a conference any notes can be written up and circulated to colleagues, presented to them and discussed at team meetings. Similarly in the housing context, when considering the most appropriate course of action following an HHSRS inspection (see [34]) a ‘case conference’ approach might be better to discuss the issues and evidence rather than leaving the practitioner to make the decision alone. Such meetings should be written up anyway for use in any future appeal.

Do not underestimate the power of environmental health students. Could they help identify the best evidence available or discuss current thinking about a topic from their University studies? The access students have to academic resources could prove particularly useful, but at the same time EH professionals must not delegate their research responsibilities to inexperienced and under-resourced students. Further, can the practitioner become more involved in existing professional environmental health networks or those at your local university; they might welcome a presentation or debate about research and evidence from someone in the field?

How can a manager be convinced to support evidence based environmental health?

Again, there are no easy answers here, particularly when many EH professionals work within cultures dominated by ‘solving problems’ and ‘meeting targets’. On the other hand, with the likelihood of ever greater scrutiny of the public health outcomes of EH interventions, can practitioners afford not to become more evidence based? This argument is well stated in Day’s [57] reflections based on a metaphor from Schön’s [58] work on reflective practice. Here Day questions whether EH professionals are prepared to descend in to Schön’s swamp of complex problems that defy ready solution, or will they remain in the hills managing tasks and solving relatively unimportant problems using traditional methods?

The public inquiry into the 2005 *E.coli* 0157 outbreak in Wales [59] arguably provides an extreme illustration of this. It calls for stricter enforcement and better risk management but largely avoids ‘swampy’ questions about the problems of risk management for small and medium sized enterprises (SMEs), why EH professionals were consistently deceived by the butcher at the centre of the outbreak and why local authorities rarely prosecute? Answers to some of these questions can be found in research by Hutter & Amodu [60] and Fairman and Yapp [49], amongst others, but very few EH professionals seem to be aware of this work.

Perhaps the descent of EH professionals into Schön's swamp of complex problems also remains unlikely because cultures are sustained at all levels. Environmental health students are mainly taught by academics employed because of years of practical experience but who often no longer practice and do not have backgrounds in research nor the time and confidence to be research active. In the UK, professional examinations and portfolios are very focused on the development of problem solving skills. Organisations representing EH professionals voice support for research, but remain reluctant to invest and uncertain of its benefits. Employers continue to experience pressures to deliver with dwindling resources, so returning to the original question, how is research 'sold' to busy managers?

To answer this question perhaps there is a need to look at research in a different way? How can stronger arguments be developed for research activities by EH professionals as an investment in public health? If EH professionals could show that making their work more evidence based could improve public health outcomes (e.g. reducing poverty and inequality), the case for investment will be so much stronger than it currently is. Once again, systematic reviews of environmental health knowledge could help to build on the solid foundations of what is already known and to identify gaps in knowledge.

What funding is available to help my organisation become more research active?

Unfortunately there are also no easy answers to this. In the UK for example competition for government research funding is becoming increasingly tough, therefore it might be easier for EH professionals to build links with universities with well-established environmental health research groups. This is the case in other countries such as Australia. The interdisciplinary nature of EH research means it may also be of interest to other academic departments such as public health, sociology and law. Productive relationships with universities therefore need not be limited to EH departments. Another potential funding option involves joint funding applications with government agencies, the European Union, United Nations organisations, the private sector and others. Charities, foundations and trusts might also support EH research activities. Some link directly to universities and therefore university websites are worth checking, in the UK the *Directory of Grant Making Trusts* is produced annually by the Charities Aid Foundation. EH professionals in developing countries have good links to governments and charities who might be able to support EHPs in becoming more research active and evidence based.

Am I a good enough role model for evidence based environmental health?

One of the greatest influences on practice for students and practitioners comes from the role modelling of other EH professionals. Indeed, in her classic study of local government EH

professionals, Hutter [19] found the influence of colleagues to be a powerful determinant of law enforcement decision making but individuals countering the predominant enforcement cultures in offices risked being ostracised by their colleagues. Given this, and a mixed response to constructive challenge seen amongst EH professionals, it will take time for evidence based environmental health to become embedded in daily practice. However, Aveyard and Sharp [28 – page 139] have some good collaborative suggestions that could make the EHP a more effective role model which has been adapted here:

- Ask colleagues for a rationale for their decision making and judge what they provide, particularly whether the same decision would be made based on the evidence available? If such a rationale cannot be provided, suggest ways in which it would be possible to work on this together.
- Consider reactions to having practice challenged (personal and that of colleagues) – are such challenges seen as personal criticism or an opportunity for professional development? Could more be done to encourage challenge in one’s own practice?
- Could links be established with more involvement with the public health programmes at the local university in an attempt to bridge the gaps between research, policy and practice?

How do I challenge the practice of others?

Challenging the work of any professionals must be approached carefully and constructively. The following quote about UK EH professionals from a trade official suggests that inexperience, lack of confidence and a macho culture could explain why challenge is not always welcome amongst EH professionals:

“Newly qualified officers in particular tend to be very officious, arrogant, defensive, prickly, unwilling to listen, unreasonable in their demands (everything is black and white), more likely to serve improvement notices and prosecute, and tend to exaggerate the seriousness of the situation and use threatening language e.g. ‘you realise that I could close you down’ when there is no justification for such a statement. Much of this behaviour I believe is borne out of a lack of experience and maturity. They are not used to inspecting, are unfamiliar with the industry, are unsure where to set the standard so go for perfection, feel their professional competency is threatened if any of their views, statements, are questioned and feel they have to prove themselves to their superiors” (Bushell in North [24 pages 107-8]).

It is also likely that EH professionals sometimes lack confidence and become defensive because of a lack of a research and knowledge culture that invites criticism and debate and embraces uncertainty.

This understandable where there can be an over-emphasis on education or enforcement and intervention options are limited. Instead of being motivated by not knowing all the answers, this is seen as a threat and practitioners retreat back into their legal and technical comfort zones. Developing more of a research culture will take many years and until this time it is important that any challenge to the practice of others with care. With this in mind Aveyard and Sharp provided more suggestions that can be adapted for EH professionals:

- Plan and discuss with colleagues/academics/students what to do if practice is observed that conflicts with the best available evidence;

Before challenging the practice of others:

- Consider whether that practice is inappropriate or unsafe and your responsibility as an EH professional to advocate for those whose environmental health is adversely affected;
- Consider what you don't know (e.g. vital information you are not yet aware of) and why your evidence suggests a different course of action;
- Unless immediate action is necessary, avoid challenging others in public;
- Compile your evidence and be prepared to hand it over for review;
- Be ready to present your evidence in the form of questions, not accusations, and invite the perspectives of others on this issue.

(adapted from [28 – page 140])

Why doesn't evidence influence environmental health policy and practice more?

The work of the Research and Policy in Development (RAPID) group of the Overseas Development Institute is useful here (see www.odi.org.uk/rapid) for exploring research and policy relationships, particularly why some research findings influence policy and others don't and how to promote more research informed policy making [61]. Their framework rejects simplistic 'research produces policy' relationships in favour of more complex and dynamic relationships shaped by the relationships between evidence, its political context and those who bring research to life like EH professionals. Further, they found these relationships are also shaped by wider economic and cultural factors. Research exploring these relationships and how to make environmental health more evidence based is another priority for EH professionals, but research and experience suggests the following could be important:

- Many EH professionals do not know what is known about environmental health, hence the need for systematic reviews and other initiatives to provide a foundation for evidence based environmental health. Towards this end one of us [62] worked with more than 20 other EH professionals to compile case studies of environmental health interventions and strategies in UK private sector housing.
- A professional culture where ‘solving problems’ predominates and EH professionals are not encouraged to engage with the more complex reasons and theories (see Annex 2) about why environmental health problems persist [19];
- The reluctance of some EH professionals to think critically and get political. The historian Dr Tom Crook [17] identifies such attitudes dating back to late Victorian times and associates them with the justifications of ‘science’, the gradual professionalization of environmental health characterised by self-proclaimed values like independence and impartiality and a reluctance of EH professionals (as public servants) to criticise the institutions upon which their status depends;
- The evidence doesn’t sit comfortably with how EH professionals like to see themselves. For example, in her study of UK local government EH professionals, sociologist Professor Bridget Hutter [19] found that being ‘reasonable’ was the hallmark of their work and she concluded that EH professionals considered their moral mandate at least as important as their legal mandate, or even more so when the law conflicts with popular or individual morality. It is likely that some EH professionals will be uncomfortable with evidence describing their decision-making influenced as much by stereotypes and personal beliefs as law and science.
- EH professionals in many areas lack strong networks, particularly between those researching, teaching and practicing environmental health. Other organisations and networks (e.g. policy makers, professional organisations, think-tanks, charities) could provide much needed expertise to help EH professionals communicate better. Investment is needed to build stronger networks and one open access journal paper provides some useful advice here from EH professionals in South West England [23]. Work is also needed to explore further why some evidence-policy-practice initiatives in environmental health are more influential than others [11].

Lastly, becoming more research active and evidence based could help make environmental health more visible. Rayner and Lang’s *Ecological public health* [63] is highly relevant here, particularly its first chapter exploring why public health suffers from ‘cultural invisibility’. They recognise that such invisibility has always dogged its history and how the case for public health “...always has to be built, argued and won. And, once won, it continues to need to be argued for” [63 – page 6]. The many

(centuries old) arguments against public health persist across the world, but they argue that public health is deeply ingrained in the structures of all our societies; what's needed are "stronger and more daring combinations of interdisciplinary work, movements and professions locally, nationally and globally" [63 – page i). This chapter illustrates the potential for research and evidence based environmental health towards moving in this direction.

The EHRNet vision for evidence based environmental health

This chapter ends with a vision for a more research active and evidence based environmental health, but the question remains whether there is a critical mass of EH professionals with the will to become more research active and evidence based? Returning to Day's [57] use of Schön's metaphor, are EH professionals prepared to descend into the swamp of complex problems that defy ready solution or will they remain largely in the hills managing tasks and solving relatively unimportant problems using traditional methods? Having got this far the reader is probably a swamp convert, but it is believed the following vision is not as daunting as it sounds and could be achieved by building on what EH professionals already have.

EHRNet dream of a time when environmental health evidence:

- is accessible to all EH professionals and those affected by their decisions;
- informs debate about EH policy and practice in the classroom, offices and streets;
- shapes EH policy and practice at all levels and alongside professional judgement and the preferences of citizens and the public.

EHRNet also dream of a time when organisations and individual EH professionals:

- understand, value and support evidence and research activity;
- read beyond traditional media (e.g. law and guidance documents) to encompass wider reflection on research from other disciplines;
- learn how other professions have become more research active and made their policy and practice more evidence based;
- welcome criticism, debate and challenge as opportunities to improve EH policy and practice;
- organise to support individuals and organisations with research and direct their research activities towards known gaps and priorities;
- move outside their comfort zones and build stronger links with other public health professionals, researchers and wider society for the benefit of all.

The authors hope this chapter encourages and supports colleagues to embark on their own swampy research journey towards a better environmental health for all.

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Annex 1: Glossary of common research terms (adapted from Couch et al. 2012:88-89)

Action research: A qualitative research approach where practitioners and researchers work together to address everyday issues about practice and develop a systematic approach to implement and evaluate change [28 – page 71].

Case control study: A study where people (or premises etc.) with a particular disease/condition (cases) are compared to those without the disease/condition (controls) [21]. One environmental health example is Jones et al. [27].

Empirical research: Refers to research based on observation or experience. The opposite is theoretical research which uses ideas to explain phenomena.

Environmental health professional/practitioner: We use this term to refer to all those working to maintain and improve environmental health, not just those with traditional environmental health qualifications (e.g. a degree in environmental health). This inclusivity is driven partly by the authors' own varied backgrounds and in recognition that they have worked with so many other professionals (and others) towards improving public health over the years. This work is also intended to be relevant to EH practitioners around the world. There is also a desire to avoid the insider/outsider politics common to so many professions.

Epistemology: The branch of philosophy concerned with theories of knowledge which include positivism, realism and relativism.

Ethnography: A qualitative research approach where a community is observed in real time to answer questions about how the community behaves [45].

Evidence: Information that indicates whether something is true or valid and can be based on anecdote (e.g. expert opinions, something that's worked before) or, ideally, research.

Evidence based environmental health: Environmental health policy and practice supported by the best available evidence, taking into account the preferences of citizens and the wider public and the judgment of EH professionals.

Grey literature: These include technical reports and policy statements that have not been subject to formal publication. They are sometimes of the highest quality but might not have been subject to peer review and (as with all literature) should be read with critical eyes.

Grounded theory: A qualitative research approach where data are collected and analysed to generate theory (e.g. explanations of social phenomena) [45].

Hierarchies of evidence: A system concerned with the effectiveness of interventions and used to determine which evidence is the most trustworthy [21].

Methods: The detailed tools and techniques used to collect primary or secondary data.

Methodology: The overall research strategy followed to answer questions/hypotheses which includes the theoretical basis for the study and the methods used to collect, analyse and report the data [29].

Mixed methods: Methods incorporating a mixture of quantitative and qualitative tools and techniques to answer research questions. These are not uncommon in environmental health research, for example see Hutter [19] and Fairman and Yapp [49].

Peer review: This is the process used to decide what is published in an academic journal where the editors appoint experts in your field to assess the quality and importance of your research.

Primary data: Data collected by the researcher themselves, in contrast to secondary data collected by someone other than the researcher.

Qualitative research: This tends to use data derived from language (written and oral) [44], not numbers, to “explore the meaning and develop in-depth understanding of the research topic as experienced by the participants of the research” and the researcher may be involved with the participant who may shape data collection and analysis [28 – page 68].

Quantitative research: This generally refers to studies that collect and analyse numerical data and often involves high numbers of participants with little or no involvement between the researcher and participant [28].

Randomised controlled trials: A trial where participants are randomly allocated to one intervention or another to determine the effectiveness of the intervention [21]. Environmental health examples do exist and the recent and free publication by Haynes et al. [64] is a good place to start.

Reflexivity: The process of researchers reflecting upon their actions and values during the research process and the effects they might have [45].

Systematic review: A literature review conducted in accordance with a defined approach as exemplified by the reviews of the Cochrane Collaboration.

Theoretical framework: A theoretical framework consists of concepts, together with their definitions, and existing theory/theories that are used for your particular study [41]. It helps to embed research within previously generated knowledge and enables the researcher to make it clear what their contribution to knowledge will be.

Annex 2: Three examples of theoretical frameworks

Street level bureaucracy – by Michael Lipsky [20]

Political scientist Professor Michael Lipsky developed his theory during the 1970s when the competence of poorly resourced American front line public services was being called into question - does this sound familiar? By reviewing a vast empirical literature on front line public officials, including American EH professionals, Lipsky argues that public policy is not best understood as the product of governments or high ranking policy officials but is instead the product of the crowded offices and daily encounters of front line workers like EH professionals. Here “the decisions of street-level bureaucrats, the routines they establish, and the devices they invent to cope with uncertainties and work pressures, effectively become the public policies they carry out” [20 – page xii].

This happens because the uncertainties characteristic of their work gives street-level bureaucrats enormous power over service users and considerable autonomy from their employers. But this power is set against the many dilemmas of being at the sharp end of resource allocation where demand far exceeds supply. Front line workers therefore find themselves making decisions in circumstances not of their own choosing and devise strategies to protect their working environment. For example they make decisions back in their private offices or mechanically ‘process’ clients into categories, whilst reserving the treatment they would ideally like to give all towards those clients more likely to succeed.

One might consider this justification for greater controls on the discretion of EH professionals, but Lipsky is bleak about its effectiveness amidst workplaces with high staff turnover where performance is difficult to measure and greater supervision can be counterproductive. Clients, particularly the most vulnerable, are also relatively powerless to hold street-level bureaucrats to account, whilst legal systems can be poorly equipped for discretionary decision making. Professional organizations also do not escape Lipsky’s criticism with their ‘careerist’ tendencies and reluctance to hold fellow professionals to account.

Published research has mentioned the relevance of street-level bureaucracy for describing the work of UK EH professionals [49], but regrettably more than 30 years after publication Lipsky’s work remains largely untapped by EH professionals.

Why EH regulators generally consider prosecution as the last resort? – by Steve Tombs and Dave Whyte [42]

In their book *Safety crimes*, the sociologists Professor Steve Tombs and Dr Dave Whyte explore four competing theories questioning why safety regulators (including EH professionals in the UK) generally consider prosecution as the last resort? They argue that consensus theories of regulation are broadly pluralist (i.e. power is shared between political parties) and based on the belief that the most effective regulatory strategies are those involving persuasion, bargaining and compromise through close relationships between the regulator and regulated that remain dominant in Western societies. Alternatively, in capture theories, such relationships can get too close and government and regulators become vulnerable to capture by powerful interests like big business. Neo-liberal theories of regulation argue that society is over-regulated by interventionist states; instead market mechanisms (e.g. competitive advantage, compensation, insurance) could better protect environmental health.

Tombs and Whyte (2007) critique each of these theories before describing their preference for what they call 'critical approaches to regulation' that move beyond struggles between state versus capital only. Their preferred critical analysis argues that regulation is best viewed as a process determined by the product of struggles between states and business **and** states and the electorate; here power is distributed unequally but spaces for challenging power are not closed down or captured. The role of EH professionals as regulators in managing inevitable conflicts between opposing interests is therefore critical to maintaining social order and a functioning economy.

Environmental health regulation as modern state power – by Tom Crook [17]

The historian Dr Tom Crook applies three theories of modern state power to help us understand why environmental health regulation emerged in the late Victorian/early Edwardian period that could help today's EH professionals better understand why they began doing what they (largely) still do.

The first theory used by Crook associates inspection with the gradual movement away from a *laissez-faire* (non-interventionist) state in the late Victorian period towards an increasingly bureaucratic and interventionist state as characterised by the emergence of professionally qualified inspectors. They were bound by rules but had considerable discretion and were appointed by new local government structures to carry out their legal environmental health duties. Note that here the term bureaucratic is used not in its derogatory sense but to describe the appointment by the state of professional officials to inspect. The second theory associates inspection with the rise of the bureaucratic surveillance state in which the bureaucratic administration just described is embedded within a broader theory of social power characterised by a belief in the legality of rules and the rights of rule bound inspectors to issue environmental health commands to discipline and control populations.

Crook accepts that sanitary inspection, as environmental health was then known, can be seen as both a form of bureaucratic intervention and surveillance by the state. But these top-down theories obscure the interpersonal nature of inspection and its operation within a critical and sometimes hostile public sphere with which EH professionals reading this might be all too familiar. Instead he argues that inspection is better understood as a form of liberal surveillance and part of a liberal culture of governance. Here “[p]ower circulates between and inhabits all these agents [state and society, experts and public] as they, by turns, resist and co-operate with one another... in this way freedom is not a goal but a means of liberal governance, a process it works through as a form, however messy, of social ordering... governance *was* the struggles inspectors endured and sought to overcome, which informed all aspects of their job, from direct encounters with the public to the ongoing battle for greater professional independence” [17 – page 393].

Indeed Crook’s ‘struggles’ closely resemble those of Tombs and Whyte’s [42] ‘critical approaches to regulation’ above and viewing the work of EH professionals through these theoretical lenses has much utility for describing the complexity of environmental health work today. The nature of environmental health problems is always changing but wherever one works these power struggles are always there and continue to shape the policy and practice of all EH professionals.

Annex 3: Some peer reviewed journals that publish environmental health research

American Journal of Public Health
British Journal of Criminology
Critical Public Health
Development Southern Africa
Environment and Urbanization
Environmental Health Perspectives
Epidemiology
Geoforum
Habitat International
Health & Place
International Journal of Environmental Health Research
Journal of Environmental Law
Journal of Environmental Health Research
Journal of Health Psychology
Journal of Public Administration Research and Theory
Journal of Risk Research
Journal of Victorian Culture
Law and Policy
Occupational Medicine
Organization Studies
Perspectives in Public Health
PLOS One
Social History of Medicine
Social & Legal Studies
Social Science and Medicine
Urban Studies

Annex 4: Suggested further reading

For first time researchers:

Bell, J. (2014) *Doing Your Research Project: A Guide for First-Time Researchers* McGraw-Hill Education, UK

For more detail on the research process, particularly methods:

Bruce, N., D. Pope and D. Stanistreet, (2008) *Quantitative Methods for Health Research: A Practical Interactive Guide to Epidemiology and Statistics* Wiley-Blackwell, UK

Costley, C., G. Elliot and P. Gibbs (2010) *Doing Work Based Research: Approaches to Enquiry for Insider-Researchers* Sage Publications Ltd, London, UK

Dytham, C. (2010) *Choosing and Using Statistics: A Biologist's Guide* Wiley-Blackwell, UK

Green, J. and N. Thorogood (2009) *Qualitative Methods for Health – Third Edition Research* Sage Publications, UK

Greenhalgh, T., (2014) *How to read a paper: the basics of evidence-based medicine - Fifth Edition* Blackwell Publishing Ltd, Oxford, UK

National Institute for Health and Care Excellence (2012) *Methods for the development of NICE public health guidance - Third edition* (Available for free via:
<http://www.nice.org.uk/article/pmg4/chapter/5-reviewing-the-scientific-evidence>)

Reed, J. and S. Procter, (Eds.) (1995) *Practitioner Research in Health Care: the inside story* Chapman & Hall, UK

Robertson, D. and P. McLaughlin (1996) *Looking into Housing: A Practical Guide to Housing Research* Chartered Institute of Housing, Coventry, UK

Robson, C. (2011) *Real world research: a resource for social scientists and practitioner-researchers – 3rd Edition* John Wiley & Sons, UK

World Health Organisation. (2001) *Health research methodology: A guide for training in research methods – 2nd edition* (Available for free via:
http://www.wpro.who.int/publications/docs/Health_research_edited.pdf)

For more on evidence based practice and why it's needed:

Aveyard, H. and P. Sharp, (2013) *A beginner's guide to evidence based practice in health and social care – Second edition* Open University Press, Berkshire, UK

Dodd, S. and I. Epstein (2012) *Practice-Based Research in Social Work: A guide for reluctant researchers* Routledge, London, UK

Goldacre, B. (2009) *Bad Science* Harper Perennial, UK