The Health Needs of Epidemiology

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The development of epidemiology is described with particular emphasis on the role of the founders of the IEA. The purposes of the subject are outlined and comments on recent concerns discussed. The importance of strategic designs and questions in epidemiologic studies are highlighted with an example from an international study on chronic respiratory disease. Examples are given from recent studies on the need for proper design of a study in order to provide worth while answers for the application of the findings to the development of policy.


epidemiology design, chronic bronchitis, cot death, aircraft noise, doctor’s health

It is a great honour to be invited to give the Cruickshank Lecture. Robert Cruickshank was the first Chairman (we did not have Presidents) of the IEA, as well as being a founder member. He was a microbiologist, held Chairs at St. Mary’s Hospital Medical School and the University of Edinburgh. A major interest was in streptococcal infection. But in spite, or because, of his interest in infections and infectious disease many of his interests and much of his research was epidemiological. He was concerned with the application of his research and knowledge, and the improvement of health and clinical practice. Thus with Donald Reid, one of my mentors, he undertook a pioneering study of respiratory infections in families in Paddington modelled in some respects to that of Dingle in Cleveland. The involvement of local paediatricians at St. Mary’s ensured that the findings were then applied in the development of a “hospital at home” service for children. This was in the 50’s — long before the current popularity of community care! It was thus a slightly different study to that of Dingle which had a more educational focus.

Cruickshank’s concern for the dissemination of epidemiologic knowledge and practice was exemplified in his later years by the publication of a seminal textbook on “Epidemiology in Tropical Countries”. But my memories of Robert are more personal. As a youngster I had to attend and present the findings of an influenza vaccine trial to a Committee of the Medical Research Council whose members were very senior, mainly professors, and several of whom had a fearsome reputation. This was at the start of the 1957 influenza pandemic and as my message was of the need to give at least 3 doses of vaccine at monthly intervals, to provide any degree of protection, I was very fearful of the reception I would receive. I had thus shown that a policy of vaccination was unlikely to influence the incidence of influenza in the first few months of the pandemic. Robert asked me to sit beside him, although I did not know him, for this ordeal. During the meeting he encouraged me continuously and told me who the other participants were and various scurrilous reasons why I should not be overawed by them. In my early years in the IEA his pawky Scots humour and twinkling eyes enlivened many dull general and council meetings. It is thus a particular pleasure to follow in his footsteps. In my lecture I will try to be concerned with those things that Robert Cruickshank felt to be important.

From the perspective of an “ancient” there have been
remarkable changes in the attitudes towards epidemiology, its place in science and in the number of workers in the field.

**RECENT HISTORY**

When I was a medical student there may have been the odd lecture on the subject, but I have no recollection of it. My first experience of the subject was while doing my national service in the R.A.F in 1956. To illustrate the general knowledge of the subject my introduction to it is salutary - I was asked if I was interested in working in “Spirometry” by the Wing Commander (equivalent to Colonel) in charge of the postings of all medical personnel. As I had a degree in Physiology I was interested and thus went, as ordered, to see Dr Corbett McDonald at the Epidemiological Research Laboratory of the Public Health Laboratory Service. I was somewhat surprised that the job was in epidemiology, but decided to give it a try. The Wing Commander, who had sent me, was grateful to be told what the difference was between epidemiology and spirometry!

At the time that I became involved there were relatively few practitioners or academics in the field. In the UK there were really only a few professional epidemiologists. I hate to speak about this in the presence of Richard Doll, one of them, since I am sure he is able to give a far more accurate account. Their interests were largely in the field of chronic disease for example Doll and Hill in cancer, Morris in coronary heart disease, Reid in psychiatry and respiratory disease, Cochrane in population studies and respiratory disease. Few of the “great” in the UK were working on infectious disease.

The change to chronic disease epidemiology in the USA began later — but whereas in the UK infectious disease epidemiology went “on the back burner” this was never true of the USA. In both the US and the UK, as well as most of the rest of the world, epidemiologists, were generally medically qualified. In the UK, when I started, except in John Pemberton’s department in Sheffield, and then Belfast, epidemiology was considered to be a pre-clinical subject. It did not have much of a presence in the medical school curriculum. It was included in the teaching for public health at the London School of Hygiene and in other schools involved in DPH courses. In the United States and other countries it was really only taught in Schools of Public Health. Although there was some perception of the uses of epidemiology — Jerry Morris with his book 5 really pioneered this — its standing outside Schools of Public Health was not high. To one interested in the history of public health and the historical development of ideas this is interesting and puzzling. Perhaps it was due to the recognition of common interests with clinicians and the concentration of many on studies of aetiology that changed. Perhaps at this stage I should apologise that most of my knowl-edge and examples come from the US and UK, but I am afraid I am limited by my experiences.

During the 2nd World War in both the US and UK many eminent clinicians, pathologists and public health physicians were involved in both epidemiologic research as well as the development of policies for the prevention of disease in armed personnel and civilians. I do not intend to list examples of these but I am surprised how few of those involved in these activities during the war became concerned with the place of epidemiology in the education of future doctors. In the UK, medical education in our field was concerned with “social medicine”. Examination of the components of this, as propagated by Ryle, were partly statistical, but largely concerned with social factors in the development of disease in the individual. There was little concern with epidemiology or even cognition of relevant work by epidemiologists, e.g. Ryle failed to refer in his publications 6 to any of the work by Doll and Avery Jones 7 on peptic ulcer, undertaken at about the same time, and even rejected the role of poverty/deprivation in the incidence of disease, particularly rheumatic fever, as suggested by Titmuss and Morris 8.

It must be realised that none of these conditions were then epidemics — as we now know them. It was imperative to find methods that would help search for answers to their questions which has transformed public health/social medicine to the science of epidemiology.

The change in emphasis from acute infections to chronic disease in epidemiology began to have an impact on the way the subject was regarded. In addition, the landmark studies on cancer of the lung, coronary heart disease and chronic respiratory disease began to attract the attention of both leading clinicians, medical academics as well as that of administrators and politicians. It was only later that public health practitioners and health service administrators realised that epidemiology was a powerful tool in the assessment of health needs, organisation and planning of services and their evaluation. I am not stating that this was anything new — merely that there was a greater appreciation. As a result more individuals were recruited to the subject, epidemiology began to enter the medical curriculum more widely and perhaps most important of all, leading clinical researchers from all parts of the world became interested. This was because of the ability to help answer questions on disease aetiology rather than concerns with health services. The roll call of the founders of the IEA and of the participants in early meetings and their papers is sufficient evidence of this 9a,b,c.

With the growth in interest and appreciation of the contributions that epidemiology could make there was growth in the number of full-time epidemiologists. This was particularly so in the United States where there was a great increase in the numbers of Schools of Public Health, courses in epidemiology and numbers of epidemiologists. However, whereas in earlier years the great majority of those who labelled themselves as
epidemiologists were medically qualified, in the United States in particular, the balance was reversed — there were few medically qualified entrants. At about this time the gap between Schools of Public Health and Schools of Medicine became more stark, particularly in the USA. It is not possible for me to judge how much of this was due to differences in salaries between medically qualified epidemiologists, and clinical practitioners — but we had avoided this trap in the UK and, until more recent years, the majority of our recruits were medically qualified. I do not intend to enter the minefield of semantics and different labels, but merely wish to observe that a by-product appears to be the development of “clinical epidemiologists”. Whereas, in the past, researchers were few and most learnt their skills “on the job” now there are many and it is considered essential to have been trained in courses and accredited by diplomas or degrees, and thus the need for appropriate titles may be important.

With the growth in numbers of epidemiologists there has also been development of its methods, chiefly in the last 25 years, particularly statistical, and the advent of computers has changed what can be done completely. We have realised that our subject can be applied to investigate many fields — and dissect many problems.

**PURPOSES OF EPIDEMIOLOGY**

After this brief description of recent developments it is worthwhile trying to dissect what our tasks really are — and whether we are meeting them. This is obviously a personal view, and many will disagree with it but, at least it may stimulate discussion.

(a) The Causes of Diseases and Abnormal Function

Historically we have always been most concerned with knowledge of the aetiology of an abnormality, the investigation of outbreaks or the identification of the risk of a particular habit. Bradford Hill 10 and others have expounded on the dangers of assuming causation when all we can determine is an association, and I do not intend to dwell on this again.

(b) Prevention and Treatment

With knowledge of an association we are able to contribute to the formulation of preventive strategies — whether it be the reduction of cholera or cancer of the lung. But this has always been central to our tasks. We are also able to test aetiological hypotheses and the efficiency/effectiveness/efficacy of interventions.

(c) Management, Administration and Planning

Although our contributions to decisions on the planning, evaluation and organisation of services to the community, or to individual patients, may appear to be of recent origin, — it is salutary to remember that there are examples in the past e.g. quarantine, mental illness, occupational hazards to which our predecessors contributed, — although perhaps many have classified these contributions under the headings of cause and prevention 10.

**CONCERNS ABOUT EPIDEMIOLOGY**

A number of articles have recently appeared, e.g. in Science 19, questioning the ability of epidemiology to respond to some of society’s needs. Others, e.g. in the AJPH 18, have questioned the way problems are tackled. As expected these have evoked a variety of responses, 14,a,b,c,d,e,f including several meetings. Perhaps the best analysis is that of Moyses Szklo 19 which I quote verbatim:

“Epidemiology was born out of the need to provide research and evaluation tools for the public health practitioner. Until about 20 to 30 years ago most epidemiologists had significant public health experience, and considered as their responsibility to apply results of epidemiologic research to the solution of practical public health problems. Take, for example, Morton Levin, recently deceased. Levin was one of the first investigators to report the association between smoking and lung cancer, and the first to develop the concept of population attributable risk. He spent the last years of his professional life as a visiting professor in a school of public health. Thus, his contributions to epidemiologic research and teaching were considerable. Yet, he was surprised at being chosen as recipient of the Frost Award for excellence in epidemiology because he saw himself as a public health administrator, not as an epidemiologist! This self-image also explains why he believed that his most important contribution to public health had been to facilitate the poliomyelitis vaccine trials as a New York health officer.

I have often wondered how many “academic” epidemiologists see themselves as public health practitioners these days, particularly because of the schism that has often occurred between those who carry out epidemiologic research in academic epidemiology departments and data users. Epidemiology training in Schools of Public Health generally places little emphasis on the interface between epidemiology, public health practice and policy making”.

These expressions of concern are not surprising. Any developing subject which is growing evokes critical comments of its place in the firmament, especially if it challenges or questions conventional practice or political or commercial interests — and we do all of these things! But we should attempt to examine some of the factors that we need to take into account.
when we practice our subject.

**EPIDEMIOLOGIC STRATEGIES**

All epidemiologic investigations need to recognize the fact that the great majority of questions it tackles are multifactorial. This is as true of infective outbreak investigation, as well as the study of chronic disease. The corollary to this is that we need to be clear as to what questions we are trying to answer, and, most importantly, what we intend to do with the results. For example many conditions are linked to age or sex or socio-economic class. We may be unable to do anything to “correct” these factors — but they certainly need to be taken into account in both design and analysis and in the application of results, e.g. in prioritising preventive interventions and services.

Most epidemiologic investigations begin with descriptive studies of the problem, the formulation of hypotheses, testing the credibility of the hypotheses posed, and finally, in an ideal situation experimental verification. Unfortunately sometimes some of these steps are omitted, or available data/information is used as a substitute for the careful design of an appropriate investigation. This may be inevitable because of the question posed, restriction of funds, or time-scale, but should, whenever possible be avoided. With the increasing capability of computing power and sophistication of statistical programs we are often able to develop models of disease, of causes, progress and spread as well as options for intervention, planning etc. Available data may be used to verify underlying assumptions and to formulate credible hypotheses. The ready availability of large data sets from health administrations and household surveys may enable this to be done without the need for primary data collection. But precautions should be taken in view of the possible inadequacies of such data sets.

However, as an “oldie” I have a clear preference for the more laborious method. To elaborate, — 40 years ago we were concerned with the factors contributing to the development of chronic bronchitis. A striking observation was its geographical distribution, commoner in urban centres than rural areas, more in poorer individuals than the better off, more in some occupations than others, and strikingly mortality was highest in the UK.

Although some studies had shown the acute effects of air pollution, the chronic effects of the latter were still doubtful. In addition the relative contribution of air pollution and smoking had not been disentangled. Obviously one strategy might have been to survey general populations in a number of different areas using the appropriate questionnaires and lung function measurements. This had been done, to some extent, by a study of patients attending general practices in the UK. But this had numerous problems, e.g. observer variability, inability to disentangle the relative effects of occupation, area of residence, selection of population, etc. We chose a different approach. We studied workers of the same age and sex (men, 40—64 years old) doing the same job in different areas. There are a number of comparable occupations world-wide. We chose Post Office and Telephone company van drivers. In most countries the jobs of these individuals were the same in 1960-62, — driving vans to deliver sacks of mail, or to mend telephone installations. There was little likelihood that there was an occupational hazard in this group for chronic respiratory disease (although we did ask about dust exposure). We were able to choose four areas in England, — central London, Peterborough, Norwich and Gloucester and in the United States, — Washington DC, Baltimore Md, and Westchester NY, where there were measures of air pollution available providing contrasts, and in these areas there were sufficient numbers of drivers to be able to decide on the meaning of any differences found. We showed, for chronic respiratory disease, that the disease was commoner in the UK than the US. In the UK it was commoner in London than the country towns. The differences in the US towns of levels of pollution were insufficient to show any meaningful differences in respiratory symptoms or lung function. In all areas we showed that smoking habits, and quantity smoked, was associated with both respiratory function level and frequency of symptoms. The effect of smoking was far greater than the effect of pollution.

The design of this study had several advantages:—

1. The size was such that one observer could participate in the investigation of men in all areas - thus enabling us to have an estimate of the contribution of inter-observer variability.
2. Although we examined workers in 2 countries, and 7 areas - the criteria of entry into the chosen occupations were almost the same, and all the men had been medically examined on entry to employment. Thus we had some measure of population comparability.
3. Details of premature retirements, and their reasons, were available for all workers since beginning to work for the Post Office or Telephone Company.
4. Details of all deaths in service, and their cause, were available.
5. Details of sickness absence were available.

Thus we were able to ensure that the populations we were studying were comparable, could take into account any differential loss due to the conditions being studied and had an independent measure of morbidity (sickness absence). I am pleased to say that all these measures confirmed our initial findings e.g. premature retirements and deaths were commoner in the UK for respiratory conditions, and for cardiovascular disease in the US. (I am not going into the second aspect of our study which was concerned with heart disease). Sickness absence figures also confirmed our findings for differences between areas.

I realise that we were working under reasonably ideal conditions, that occupational groups in the 60’s were relatively sta-
ble, and that we were able to do the investigations in the employers time with the full co-operation of the unions and thus obtain a very high response-rate (90%+!). But what I wish to illustrate is that:

(a) We were asking a clear question.
(b) The design was economical — even if we spent about 1 1/2 years in preparation of the field studies.
(c) The result was clear-cut, and did not depend on complex statistical manipulation.

**RECENT EXPOSURES**

Having dealt with a historical example — chosen to illustrate a strategy, but not considered in any way as perfect, I would like to deal with more recent examples to which I have been exposed in the past 2 years which demonstrate some of my concerns.

1. **Cot Death — Sudden Infant Death Syndrome**

As a member of a government committee to consider the validity of a variety of hypotheses on the causes of this, in particular the emission of noxious gases from mattresses, I have had to examine a variety of studies. I do not pretend that my knowledge is exhaustive but I have been struck by the contribution epidemiology could make. If we are concerned about the emission of noxious gases from, for example, mattresses we need to be able to identify the gas both quantitatively and qualitatively. Epidemiology has little role to play in this.

Cot death is a rare event — suitable definitions need to be developed in order that if comparisons are made, whether it be by time or by place, that these are reasonably sound. Most paediatricians believe that changing babies from lying on their front to lying on their back has been responsible for the drop in incidence that has occurred in recent years. Most studies have been of the case-control type. But, to act as devil's advocate, the belief of the importance of position is based on similar findings in many studies. Yet no one seems to have considered the maxim that if you make the same error or bias in all studies you are unlikely to get any different answer.

The corollary of smoking and air pollution is salutary — for many years all studies had shown that respiratory disease was commoner in polluted areas and thus concluded that pollution was bad and smoking less relevant. But no one had asked about smoking habits. When this was done, it was shown that people living in polluted towns not only smoked more but also started to do so at an earlier age compared to people living in rural areas.

The incidence of cot deaths is much higher in the poorer sections of our community, but there are few studies that have attempted to ascertain some of the cultural, environmental or other factors that might be important in child-rearing in these groups. Furthermore there are inconsistencies in the secular trends of cot death, particularly the variability of onset and rates of reduction in mortality by region, which do not correspond to the change in habit of how to place your baby in a cot. Thus, as an outsider, I am not as convinced as some about the importance of position in the reduction of cot death incidence.

There are other questions such as the varying incidence in different countries and ethnic groups within the same country, but the lesson that I wish to draw from this involvement is:

(a) The relative scarcity of fully trained epidemiologists working in the field.
(b) The dominance of clinicians working on the problem and the importance of statistical results in the conclusions.
(c) The relative absence of social scientists, including anthropologists.
(d) The importance of politics and the media to the problem of Cot Death.

2. **Aircraft Noise**

As a resident of Kew, an area near Heathrow, for 30 years, I have become increasingly bothered by aircraft. However my concerns were increased when I received a consultative document from our Department of Transport about night flights. This stated that its policy was based on a scientific study which purported to measure sleep disturbance around 4 airports and relate this to aircraft movements. The summary of this document was remarkably obscure. I, therefore, decided to review it rather more rigorously and a number of problems were evident:-

(a) The normal method of measurement of sleep disturbance had been questionnaires — but the authors did not wish to rely on this because of their subjective nature and wished to use an objective measure. The gold standard is stated to be EEG activity, but this would be difficult to use on a population-wide basis. They, therefore, used a measure of wrist movement, an actinometer. But they neglected to be concerned with the lack of correlation between the few EEG and actinometer measurements.

(b) The method whereby the volunteers were chosen to wear the actinometers was not at all clear, neither was the relation between the houses and types of houses of the volunteers and the aircraft noise measurement.

(c) The levels of outside noise measured were confined to a small band (60-80dB). The authors concluded there was no dose-response effect — but omitted to refer to previous findings that (1) at higher levels the dose-response is much less steep and (2) one would expect the number of awakenings to increase from lower levels.

(d) The volunteers were paid per night of measurement, — and knew the purpose of the study. Many people who live close to airports depend on them for their livelihood. There was no description of the occupation of the participants. It has been shown that people employed at airports complain 25% less
than others living in the same area.  
(e) I will not go into the problems of the analysis which was also open to criticism.

However, the fundamental problem with the study was that it was counter-intuitive. The authors did not comment on their findings that more people were woken if the windows were closed rather than open, or that their conclusion that only about 4% were woken by aircraft noise when more than 60% of respondents of all population questionnaire studies had previously complained and that in the population investigated in this study about 25% stated that they were woken by aircraft noise!

I have obviously curtailed my critique and I am glad to report that no epidemiologist was involved or consulted. There have been a number of other studies of the problem of aircraft noise, both in the UK, USA, Germany, Netherlands etc. Some of these were good and unexceptionable but talking to some of the investigators, particularly in Australia, there are certain lessons

(1) The problem of aircraft noise is highly political - governments, are interested in aircraft and airports. It is surprising how often:
(a) Obstacles are put in the way of well-designed investigations by both funders, airport operators, politicians and airlines.
(b) As with all epidemiologic studies we need proper measures of both environmental and individual exposure to noise, we need agreed, repeatable, valid, end-points, and defined populations with knowledge of selection factors, e.g. have people moved away because of the noise.
(2) The problem of aircraft noise is a highly political-commercial issue. It will thus attract media attention, and may be important in local elections. This may mean that it is difficult to undertake independent studies or that the criticism of studies that are done may be cursorily dismissed, if they attack this particular commercial-political interest.

3. Doctors’ Health

In the UK there has been increasing concern on the health of practising doctors not only because of the threat to themselves but also of the effect on patient care. The SMR for suicide in doctors has, for many years, been one of the highest for any occupational group. It was suggested to us by the Nuffield Provincial Hospital Trust that we should investigate the problem.

So far three studies have been undertaken, with limited resources. The first was an anecdotal investigation. We chose 8 districts, 4 of which had a high doctors suicide rate and 4 with a low rate. The areas were matched for such characteristics as teaching and urban-rural. We interviewed, in each District, senior managers, senior hospital consultants, GP’s, hospital junior staff, industrial relations officers and representatives of community health councils. The semi-structured interviews were designed to explore health concerns and take-up of health services by sick doctors. We found a remarkable consistency of views, of the problems of the service for doctors, the health problems of doctors and possible means of rectifying these.

As a result of these exploratory, descriptive study we then undertook a survey of GP’s in 2 family health service administrations, all hospital doctors in 3 hospital Trusts and a group of employees in a multi-national accountancy and management consultancy company as controls. For the doctors we had an over 80% response rate, for the “control” group, 67%. In addition, in depth interviews were conducted with 64 doctors who had experienced a recent illness. We showed that although the illnesses of doctors were similar to that of the “control” group, the way that the doctors and the health service responded was different, and although both groups were exposed to stress at work — both the type and nature varied, with GP’s being the worst affected.

As result of these two studies a third study has been done in which possible models of coping with the problem of doctors health were tested by interviewing decision-makers and “clients” in 3 districts. In addition the Nuffield Provincial Hospital Trust published a report with recommendations of what should be done. We now await the response of the government and NHS Executive of what they will do to cope with the problems.

I use this last example to show:—
(i) The stages that are required to explore, describe and put forward solutions.
(ii) This study involved the co-operation of social scientists, including psychologists, epidemiologists and medical statisticians.
(iii) The study utilised published data, in-depth interviews and survey questionnaires.
(iv) It was closely linked to the concerns of those involved.

CONCLUSION

I have tried to consider the prerequisites for epidemiology. There is a great deal of turbulence in our field, and a feeling of insecurity by some. These could be alleviated if we consider fulfilling a number of conditions which would secure the continuing health of our subject. These can be summarised as

1. We must be clear about the question(s) we are trying to answer in any particular study.
2. The questions that we tackle should be of public health relevance.
3. Most of the problems epidemiology tackles are multifactorial. We must co-operate with and seek the help of other scientists with appropriate experience, in the design and execution of an investigation.
4. It is crucial that we design investigations appropriate to the
question being asked, and not be seduced by the ready availability of large databases collected for administrative or other purposes. These may help to define questions and develop hypotheses but must not replace carefully designed epidemiological studies.

5. In undertaking epidemiologic studies we should not only rely on appropriate analytic, statistical methods but be concerned and measure as accurately as possible the exposure to a purported risk in the test and control population, the response to the “risk”, the selective factors which have played a role in the population being studied including differential migration, differential morbidity and mortality and the observer subject variability in surveys and field studies. The problems of the validity of data recorded both by our epidemiologic methods as well as that collected for clinical or administrative purposes must be a crucial concern.

6. Even if we do all these things perfectly we should bear in mind the way that our results will be interpreted, disseminated and used by the media, politicians, industry and others. But we must accept responsibility for our work and cannot shrink from being involved in its application.

I do not have any fears for the future of my subject but do have concerns that with present trends in the development of academe throughout the world, with the universal growth of market rather than public service attitudes, with curtailment of research funding and with the need to “publish or perish” and get quick results that careful, well-designed studies will become less frequent. Whatever happens we must remember the purpose for which we do epidemiology and must ensure that our expertise is utilised in the investigation of appropriate subjects.

REFERENCES

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