

## Health Sciences Research in Medical Education

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### INTRODUCTION

The term '*health sciences*' is a broader concept which is increasingly replacing or absorbing the narrow domain and the perspectives of the '*medical*'. Since health sciences incorporates clinical, paraclinical, basic, allied and public health sciences, it would not be incorrect to visualize 'health science research' as 'health research' where all these sciences collaborate in different combinations and permutations. And for all practical purposes it would be appropriate to interpret 'medical education' as the 'academic setting providing medical or health sciences education'.

Academia, whether modern or ancient, has been the seat of knowledge and the guardian of research. The history of science and medicine show this statement to be compellingly true. And in Nepal, where we are trying to find answers to the question of how academia can strengthen the entire health care system, this traditional role of academia is scaling new heights and mapping uncharted territories. But, to be able to harness the great potential we have within us and within our country, we must first return to the basics, asking ourselves what we mean by scientific knowledge, scientific research, or for that matter, science itself?

This crisp text book definition of Science is not entirely untrue today, but now the emphasis is more on *the process*: Science being a way of thinking rather than a *status* of knowledge. Science is a systematic, disciplined way of thinking that involves continuous interplay of rational thoughts and empirical observations aimed at gaining knowledge about nature and society. I think it is important to internalize this concept since it makes clear

the organic relationship between science and research, and their product: scientific knowledge. "*Research Methods: A Process of Inquiry*" which leads us right into the heart of the matter.<sup>1</sup>

We often imagine scientists wearing white coats and spending time peering at complicated equipment in shining and mysterious laboratories. But scientific work can be done while sitting under a tree in the woods, thinking through a problem, and using apparatus no more technical than a pad and a pencil. This image is important for it emphasizes that the essence of science is its logic, science is above all else a way of thinking. The laboratories, the equipment, the computers, and the hardware are just tools used to promote and support the scientist's central activity- creative, systematic thinking. That intellectual activity is incorporated into a process of inquiry in which the scientist asks and answers questions about nature. That process of inquiry is what we mean by scientific research.

### THE LOGIC

The essence of science as a way of thinking, and research as process of inquiry, is logic. Whether for Einstein of modern times or Thales, the father of science of Greek era, or Hippocrates, the father of western medicine, it was the power of a logical and curious mind that led to discoveries. But when we say 'logic' we need to stress here that we mean scientific logic which combines a *dialectical* unity of inductive and deductive inference. We know that the history of human civilization started with empirical observation refined by experience and practice and verified by the objective evidence. Primitive science emerged as people combined abstraction and

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rational deduction with empirical observation. In the west this happened in the pre-Socratic Ionian period. In the East it was at the time of Lokayat's materialistic criticism, the Nyaya school's analytical approach and the Buddhist era of negation of soul and gods.

With the coming of Socrates and Plato and to some extent Aristotle, the Greek philosophy became increasingly abstract, mystical and deductive, making empirical knowledge less important and eventually joining the attack on empiricism. The axioms and religious dogma started to reign supreme with its monopoly of truth and any empirical challenge to it was suppressed by coercion or punishment. Such state of affair started changing only from Renaissance period -16<sup>th</sup> century onward - and much later in the East. As the material basis of a slave and a feudal society started weakening, science emerged with new vigour along with the rise of capitalism. This science did not cede to rational or deductive statements as unchallenged truth. It considered conclusions derived from deductive logic only as hypotheses - subject to verification by empirical observation. Present day emphasis on "evidence-based health sciences" is actually rearticulating this age old viewpoint.

The classic example of Aristotelian deductive syllogism - the set of logical derivations ending in a conclusion. A rationalist watching a bird on the ground would prove that the bird can fly by using deductive logic and not even bother to test his or her claim.

The general principle or major premise : All birds can fly

Minor premise : This is a Bird

Conclusion : Therefore this bird can fly

But the fact that these premises could be wrong leads to the need for its verification, by empirical observation. And that is what we do in research. We collect data and see whether the hypothesis can stand up to the test; in this case if it is an Ostrich then both the major premise and the conclusion would not hold. Or the conclusion will be wrong if the bird has some problem with its wings.

It is interesting to note that just around the time of Aristotle, a more scientific syllogism was developed by Maharshi Gautam the proponent of Nyaya school of thought in Indian subcontinent. In its five steps using inductive-deductive inference, first the thesis or the conclusion is stated as a conviction of the speaker, as that which he intends to establish in the mind of the hearer, and then again at the end, reinforced after presentation of convincing argument. The first statement is in fact a statement of effect followed by giving the proper reason or cause for that effect, then providing an example which is comprised of the deductive major premise and

also an inductive observation, followed by application and conclusion. In contrast to the usual cause-effect sequence adopted by the west, the Eastern scientists/philosophers considered effect-cause, or Karya-Kartabya to be the proper sequence for an argument.<sup>2</sup>

So for the Nyaya logicians the above example would be restated like this.

- This bird can fly
- Because the bird has wings
- Whatever has wings can fly, as in the case of an eagle
- This bird has wings such as that which is invariably able to fly
- So it follows that this bird can fly

Even this logic is not fool proof since all winged birds may not be able to fly. But it is more comprehensive than Aristotelian logic since it does not satisfy with a mere statement of all birds fly but points out why birds are able to fly, giving an empirical example of a particular bird as well. Here the flying is the effect and flapping of the wings is the cause. General principles or axioms, such as "whatever has wings can fly", come only after a series of empirical observations and validations. And the human mind works with iterative series of such inductive-deductive reasoning to reach to conclusions. After the formulation of an hypothesis, collection of data, and measuring of effect, it is even more important for the researcher to use inductive-deductive reasoning in making a convincing causal inference. *It is for want of this rigour of mind and observation that many a time we are left merely with demonstration of association between risk factor(s) and outcome(s) rather than establishment of causation.* But I hasten to add that establishment of causation is an ambitious venture and may need many studies and meta-analysis for comprehension and verification. If we do a good job of establishing association between risk factors and an outcome or an intervention and its impact, this is no less important an achievement. Without such good studies, we can rest assured that causation can not be established, nor the magnitude of impact assessed, and we may be only be adding more chaos to the confusion.

## RESEARCH METHODS

This brings us to the challenge of doing research properly. We will not be doing good research if we do not ask good questions and do not have a good grasp of research methods - from study design to data collection and analysis. Asking questions is a creative endeavour and the researcher is a skeptic who finds intellectual excitement in creating questions and seeking answers

about nature and society. What?, How? and What if? are among his or her most basic terms because these questions help to tease out the truth from among the tangle of facts. Curiosity killed the cat, the saying goes, but it is also true that curiosity sustains the scientist. Robert Oppenheimer the famous nuclear scientist once said that the sciences are responsive to “primitive, permanent and pervasive human curiosity”.<sup>3</sup> And Linus Pauling, the Nobel laureate, thought that “satisfying one’s own curiosity is life’s greatest source of happiness”.<sup>4</sup> A good research question, applying inductive-deductive logic, leads to a sound research hypothesis which can be tested applying proper research design. The research methods and techniques of data analysis are applicable in all the disciplines of the health sciences, and with the aid of computers in modern times, that analytic work has become incomparably efficient and convenient for the researchers.

Just like advanced technologies such as computers and wireless internet, the most advanced research methods are applicable in developing countries like Nepal. Randomized clinical trials and Randomized community trials are being done in Nepal. Improvised case control studies are emerging as a time and cost efficient alternative to cohort studies which can produce equally valid measurements. Case-cohort studies are already gaining popularity and nested case-control studies can be an essential component of large follow-up studies. Surveys can also be utilized for comparison by applying a cross-sectional comparative study design, if the temporality factor is satisfied - that is, if it can be showed that the risk factor preceded the outcome. Exploratory study designs are also useful methods to formulate a sound hypothesis on a low budget. Alongside clinical epidemiology, molecular-genetic epidemiology and social epidemiology are also being accepted as important developments in the last decade. For aspiring researchers there is indeed a vast space and many frontiers to explore in the endless search for truth.

While health science research contributes to the generation of *new knowledge*, it also contributes to finding ways to *better apply* this knowledge. Policy makers, program managers and those working at the grassroots level, who are faced with the challenges of innovation and sometimes improvisation of health care delivery services in multi-sectoral settings, are particularly keen on this kind of research which is now better known as Health Systems Research. Academia, fulfilling the responsibilities of medical or health sciences education is usually more interested in generation of new knowledge. But now it is increasingly a global tendency for academia to balance both kind of research. Not only does this reorient and focus the best minds on

the challenges of improving health *action* at both the national and international level, thus strengthening the health system, it also makes health sciences education itself more aware of the need and priorities of the nation, community and population, thus sustaining and increasing its relevance and usefulness.

Medical universities and hospitals have been criticised as Ivory towers and disease palaces when they are alienated from the ground realities of their surroundings. In response, concepts of “universities with teaching districts” and “hospital without walls” have had emerged in the past. The Institute of Medicine had taken the lead in this direction, followed by BP Koirala Institute of Health Sciences (BPKIHS) and National Academy of Health Sciences (NAMS) and now new comer like Patan Academy of Health Sciences (PAHS). Therefore it useful for the health professionals to be well acquainted with our national health research policy, national health research priorities, the research section of our Three Year Interim Plan and the framework of Essential National Health Research in order to attune their own research with national needs.

Every health institute must be aware of the strong health policy drive to establish health as fundamental right of the people and to provide basic health care free of cost. Attention to such endeavours will enhance the merit of research proposals and is likely to draw national and international funds for research. Now, the Ministry of Health and Population has decided to create a fund for supporting teaching hospital’s and institution’s research activities via the Nepal Health Research Council. The budget would be put for the coming fiscal year and mostly executed via institutional research committees. It should also be noted that since 1990 there has been a strong global demand for allocating 2% of national health budgets to health research. This position has been reiterated both in Mexico and Bamako ministerial level meetings on research for health and Nepal is a signatory to the actions calls from those meetings. It is likely that we may be close achieving to this target in the coming fiscal year in Nepal.

## RESEARCH ENVIRONMENT

The task before us is to create a conducive research environment for development and propagation of research culture. A culture that continuously reminds us that we should seek truth from facts and that we have no right to speak without examining the facts. With the ability to visualize things as they are we will find the keys to the secrets of technology and development and at the same time make our health actions more efficient and productive. To create such a culture researchers also need to learn the skills of research management,

resource mobilization and communication of research findings to the policy makers and the public, and most importantly be able to deal with the requirements of research ethics. Research can be ethical and unethical. So ethical approval is a must to protect human and animal subjects and a humane approach is mandatory while carrying out research. Not only the faculties but the students also need to be aware of these issues if they want to be good researchers. In fact the formative years of student life are the best time to plant the seeds for a thriving research culture. All the students have an inherent tendency for research which should be supported financially and otherwise by the institutions, even the 30<sup>th</sup> meeting of the Advisory Committee on Health Research WHO SEARO 2007 urged the member countries to encourage students to undertake research.

The health sciences research can greatly benefit by working together with the experts of traditional and indigenous Medicine, mining the knowledge base of medicinal plants and their uses. In his visit to Nepal the former President of India, Mr. Abdul Kalam, has offered five solutions to Nepal's development and medicinal plants had topped the list. The discovery of anti-malarial Artemisinin derivatives from the *Artemisin annua* plant has been a breakthrough in recent times, pointing to other such unearthed hidden treasures. Nepal has always been regarded a treasure house of medicinal plants and with two giant neighbours who are keen to utilize this treasure it would be a gross negligence in our part to be oblivious of this fact. Indeed, is it critical that we be very alert, in order to preserve and protect Nepal's rights in these rich natural resources, as well as to discover their uses for the benefit of the population and overall development.

How can all the health science faculties combine their efforts to carry out health science research which spans from clinical to public health and lab research? The experience of the Mayo Clinic's of developing a "department of health science research" is of some relevance for us. It has four divisions: Epidemiology, Biostatistics, Biomedical Informatics and Health Care Policy and Research. These seem to be the axis which connect all the different faculties of health sciences in a collaborative research effort. Perhaps we do not need

a separate department. But it is important recognize the central importance of these units in gluing together and harnessing the strengths of diverse faculties of health sciences for carrying out multidisciplinary health research.

## PREPARED MIND

Along with the importance of systematic thinking and inductive-deductive logic there is also an importance of imagination, flashes of insight, and accidents in discovery. When Einstein said imagination is more important than knowledge he was precisely trying to make this point. The researcher's pursuit of curiosity follows unknown paths sometimes resulting in dramatic and unanticipated discoveries that may appear accidental. And a scientist needs to be prepared to greet such accidents with a bit of imagination and what is called a "prepared mind" - "a disciplined curiosity that makes them sharply alert to the possibility of unanticipated discovery".<sup>1</sup> A succinct definition of discovery is provided by Albert Szent-Gyorgi: "A discovery is said to be an accident meeting a prepared mind".<sup>4</sup>

In this context a comment by Louis Pasteur is worth pondering. In a large reception where he was the guest of honour someone asked Pasteur "Isn't it extraordinary these days how many scientific achievements are arrived at by accident? " Yes" replied Pasteur, " it really is remarkable when you think of it, and furthermore, did you ever observe to whom the accidents happen?"<sup>5</sup>

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