EDITORIAL

Research – The Game of Knowledge Enhancement

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Knowledge facilitates openness and flexibility of mind. Research is the search for knowledge or a systematic scientific investigation with an open mind to establish novel facts. Research provides scientific information and theories for the explanation of nature and properties of the world around us. Someone has described research as the knowledge that removes cobwebs of ignorance and doubt from our minds. Very few of us know how much we have to know, in order to know, how little we know. Research is the game of significant ideas that lie in the beauty, utility and enhancement of knowledge. Research may be 'primary research' involving generation of data that does not yet exist or 'secondary research' (also referred to as 'desk research') that involves collation and/or synthesis of existing research. Knowledge embodied in books is the knowledge created in the past and is the best example of secondary research. Principal methodology in secondary research is the systematic review to provide exhaustive summary of literature relevant to a research question. Primary research is usually undertaken after the researcher has gained some insight into the issue by collecting secondary data. Primary research addresses specific research issues. Compared to secondary research, primary data may be very expensive in preparing and carrying out the research. It also takes longer to undertake primary research than to acquire secondary data. Good research produces results that are examinable by peers, methodologies that can be replicated and knowledge that can be applied to real-world situations. Research study provides food for thought to the new researcher and makes him a better learner. From educational perspective, a research study can enhance critical and analytical thinking of students. Therefore, in most institutions small research studies are made an essential component of the syllabus.

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Research is 1% inspiration and 99% perspiration. Newton once said, "If others would think as hard as I did, they would get similar results". Opinions might differ on whether there is difference between thinking and thinking hard, but thinking hard implies 'never letting something go out of focus'. According to Dr. Richard W. Hamming, a retired Bell Labs Scientist, "Given two people of approximately the same ability and one person who work 10% more will more than twice outproduce than the other. The more you know, the more you learn; the more you learn, the more you can do; the more you can do, the more the opportunity". Another reason for success in research, according to Hamming, is the drive and the commitment. People who do great work with less ability but who are committed to it, get more done than those who have great skill and dabble in it or those who work during the day and go home and do other things and come back and work the next day. They don't have deep commitment that is apparently necessary for really first-class work. He further adds that if you are deeply immersed and committed to a topic, day after day after day, your subconscious has nothing to do but work on your problem. So you wake up one morning or on some afternoon and there's the answer. For those who don't get committed to their current problem, the subconscious goofs off on other things and doesn't produce the big result.

Well-conducted research is vital to the success of global heath endeavors. However, before any research is initiated, it is important to define the type of research to be carried out, the place where it has be undertaken, how is the outcome of this research likely to impact us and who is going to fund it. Research in industry is product driven, whereas research in

academia is idea driven. Typically, research in academia is not bound by a particular product, can afford to focus on ideas exclusively and have longer gestation periods. Publishing outcome of a study is the initial step to make research known to global community. However, one problem that often plagues progress in global health scenario is slow translation of research into practice. Oftentimes, a disconnect exists between those who create the evidence base and those who are positioned to implement research findings. According to Wikipedia, Alexander Fleming had published his discovery of penicillin in the British Journal of Experimental Pathology in 1929, but little attention was paid to his article and it was not until 1940 that Ernst Chain and Edward P Abraham isolated and concentrated penicillin and proposed its correct structure.

It is also believed that knowing the right questions is the first step in knowing the answers. According to Hamming, "Often great scientists, by turning the problem around a bit, change a defect to an asset". For example, many scientists when they found they couldn't do a problem began to study why not. They then turned it around the other way and said, 'But of course, this is what it is' and got an important result. There also are many instances of accidental discoveries in history, but it invariably has been the prepared mind that timely visualized the importance of discovery. In most cases, investigator(s) might have been prompted to discard the only culture with penicillium taking it as a contamination, but for the prepared mind of Alexander Fleming that led him to focus on why the staphylococci that had immediately surrounded it had been destroyed whereas colonies further away were normal. Fleming grew the mould in a pure culture and found that it produced a substance that killed a number of disease-causing bacteria. He identified the mould as being from the *Penicillium* genus, and, after some months of calling it '*mould-juice*', named the substance it released as 'penicillin'. According to him, "When I woke up just after dawn on 28 September 1928, I certainly didn't plan to revolutionise all medicine by discovering world's first antibiotic or bacteria killer, but I suppose that was exactly what I did". He investigated its anti-bacterial effect and noticed that it affected staphylococci and many other Gram-positive pathogens that cause scarlet fever, pneumonia, meningitis and diphtheria, but not typhoid or paratyphoid fever, which are caused by Gram-negative bacteria, for which he was seeking a cure at the time. It also affected *Neisseria gonorrhoeae*, which causes gonorrhoea although this bacterium is Gram-negative. He also discovered very early that bacteria developed resistance whenever too little penicillin was used or when it was used for too short a period. Fleming's accidental discovery and isolation of penicillin marked the start of modern antibiotics.

Another accidental observation that changed the course of medical history is the discovery of *Diabetes mellitus*. German researchers Joseph von Mering and Oskar Minkowski (in 1889) while studying digestion using domestic dogs surgically removed a small gland called 'pancreas' (named from the Greek words 'pan' meaning 'all' and 'kreas' meaning 'flesh') located just below the stomach. In those days, animals were housed in the same rooms where scientists carried out experiments. The operated animals deposited their urine in a corner of the room. Remarkably, ants in large numbers tended to be attracted to dog urine. This stimulated the curiosity of a laboratory assistant that eventually led researchers to their famous discovery. Doctors tested the urine and were surprised that samples were extremely high in sugar, indicating high blood sugar levels. It was logically reasoned that the pancreas, which had been removed, had something to do with control of blood sugar levels. Another interesting point about this discovery of a disease affecting millions world-wide is its full name, 'Diabetes mellitus'. 'Diabetes' (known in the 17th century as the 'pissing evil') comes from the Greek word for 'siphon' and implies that a lot of urine is made and 'mellitus' comes from the Latin word 'mel' which means 'honey' and was used because the urine was sweet. Ants, however, were the real discoverers, indicating to the laboratory workers that the urine had special properties worth investigating.

But what prompts one to focus on such chance observations? Louis Pasteur, the French microbiologist and chemist who pioneered the Germ theory of disease and invented the process of Pasteurization, in his lecture at the University of Lille on 7 December 1854 stated that 'in the field of observation, chance favors only the prepared mind'. Hamming, however, believed that 'it is partly luck and partly the prepared mind'. Wisdom thus is to stay observant and open to creative opportunities and solutions.