BUILDING RESEARCH CAPACITY IN PAKISTAN: EFFECTIVENESS OF AN EPIDEMIOLOGY TRAINING WORKSHOP TAUGHT BY TRADITIONAL CLASS-ROOM AND VIDEO TELECONFERENCING METHODS

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Building research capacity in health services has been recognized internationally as an important pillar for the production of a sound evidence base for decision-making in policy and practice. The developing countries are currently facing an increasing epidemic of non-communicable diseases in addition to non-resolving problems of infections, malnutrition and health problems of reproductive health. Clinical research is the link between advances in research and innovations in medical practice. Physician–scientists, trained in patient care and epidemiological research, are crucial in developing and performing cutting-edge clinical research in developing countries. Due to lack of local research capacity, these challenges have not been matched by the ability and capability of developing countries to carry out appropriate studies, the results of which will enable them deal with the health problems in their national contexts. An effort was made to build and strengthen local research capacity in Pakistan and conducted a 9-day workshop on epidemiology research methods to train the trainers.

Study objectives: (a) To assess the short and long-term effectiveness in terms of knowledge gain from the epidemiologic research training workshop offered to participants by face-to-face (F2F) and Video-teleconferencing (VTC) methods in Pakistan. (b) to assess the

impact of the workshop on students' future career goals in both F2F and VTC groups and (C) to assess the cost-effectiveness of VTC relative to F2F instruction of training.

Methods: This was a prospective study on 40 F2F and 18 VTC health care professional with post-graduate degrees. A 9- day epidemiological research training workshop was conducted by 5 research faculty from University of Pittsburgh who developed course contents. Pretest and post-test1 were on 1st and last day of the workshop respectively. Post-test 2 was conducted after one year of the workshop. Cost of both teaching methods were obtained using ingredient method and cost –effective ratios were calculated

Results: The total study sample included 56 and 49 for the short-term and long-term workshop assessment. Within each group, paired sample t-test showed significant improvement in scores after the completion of workshop (P<0.001 for F2F and VTC). In F2F, mean scores increased from 11.13 (pre-test) to 15.08 (post-test1) and in VTC scores increased from 10.67 (pre-test) to 13.22(post-test1). After one year, post-test2 scores remained higher than pretest scores in both the groups (2-sample T-test P=0.11) and were not statistically significant. On 2-way repeated measure ANOVA, both groups showed significant changes in mean scores over time (P<0.001), and no interaction was seen between time and groups (P=0.31). The between subject-effect of groups was found significant (P=0.013). The total incremental cost per score gained was higher for VTC group for both short-term ($166 incremental cost /score gained) and long-term ($458 incremental cost / score gained).

Conclusion: The epidemiology research training workshop was found to be effective in terms of knowledge gain in both the groups. This study presents a model for training doctors and other health care professional in research methods by providing in-house training to reduce increasing problems of brain drain.

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1.0 INTRODUCTION

Physicians and other health professionals are increasingly aware of their need for epidemiological research knowledge, not only in the role of researcher, but also if, as a clinical practitioner, one wishes to keep abreast of advances in the field. One alternative for the clinical researcher is to completely rely on a trained epidemiologist and biostatistician and blindly accept the answers obtained from such collaboration. For the clinicians reading the latest scientific journals in their field, this is equivalent to ignoring the methods section of the research articles. This practice is not prudent, for the obvious reason that an uneducated researcher is not in a position to critically appraise the literature or to effectively collaborate in a research team. For developing countries to build health systems, it is essential to build research capacity. The focus of building research capacity will be two fold; (a) to do research and (b) do research related to clinical care. Both these objectives require epidemiological research training.

Developing research capacity to effectively understand and carry out health research is an integral component of any medical health care system, at both the national and global levels. For developing countries, the process of embedding research in medical health care system, require competent scientists and strongly supportive enabling environment. This will allow research communities to grow and develop research goods that contribute to the health of the public. Although, there has been remarkable progress over the past two decades, the research capacity in

developing countries remains on of the world's unmet challenges. This is especially true for South Asian countries (India, Pakistan, Bangladesh, Sri Lanka and Nepal).

Identifying and training the right set of individuals with expertise in generating and using skills of research is one of the essentials steps in research capacity building. The biggest challenge is to train and continuously enhance the research environment to maintain the interest of researchers and those who use the research.

The increased burden of chronic diseases in developing countries that also have a high infectious disease burden is straining their health services, leading to growing economic costs (Jha & Chaloupka 1999). In most developing countries, inadequate financing and lack of manpower to address chronic diseases have been major impediments to chronic disease control. Other impediments are the failure to provide key decision makers with up-to-date evidence on the burden of chronic diseases; a lack of understanding of the economic factors that influence chronic disease risks, and the current orientation of health systems toward acute care.

The industrialized countries with the largest number of highly trained scientists working in well-equipped laboratories have deep funding resources resulting in quality research. A research tradition has become established in the scientific community of these countries. The same cannot be said for developing countries. The latter countries lack the appropriate self-sustained research capacities both in the number and quality of trained researchers as well as appropriate institutional capacities for high-level research. Many developing countries, for e.g. South Asian countries (India, Pakistan, Nepal, Sri Lanka & Bangladesh) have only had

independence in the last 50 years, and so the scientific tradition is just being developed. Their scientists are still numerically inadequate and ill- equipped for high quality research.

More than a decade ago the Commission on Health Research for Development called for essential national health research in developing countries, with at least 2% of national health budgets being spent on health research vital to developing countries (Commission 1990). This was in recognition of the severe lack of research skills in the developing world, the need for capacity development efforts, and a growing concern regarding the 10/90 gaps between the developed and the developing world in health research (Global Forum 1999). Capacity development efforts in the field of health research have been ongoing for decades by international, bilateral and private organizations. Usually such programs call for the provision of funds for training of scientists from the developing world, in centers of excellence in developed countries. Over the years, attempts have been made to ensure that such trained scientists return to their home country and contribute to national health research development. However, the problem of brain drain is on rise and is of major concern (Dodani & LaPorte 2005).

Research training is a fundamental aspect of physician's training. Internationally, a number of graduate and postgraduate training courses in epidemiology, biostatistics and other research fields have been implemented and evaluated. One must admit that research institutions in developing countries vary greatly in their characteristics and degree of development, but share in the constant need for improvement in the numbers of their trained scientists. Ultimately, all efforts at capability strengthening in South Asia is to build up self-reliance in their respective countries—capacity to innovate, compete, generate, adapt and use scientific knowledge for the improvement of the health of the population of their countries (Nchinda 2002).

The establishment and strengthening of research capacity in developing countries is of prime importance in empowering these countries to find rational and efficient solutions to their health problems through scientific research. There are more than 250 medical institutions worldwide; however there are only 70 Schools of Public Health (SPH) and not a single SPH in South Asian countries. In Nepal, a new SPH has just been developed.

Good Institutional linkages with other researchers in the developed and developing countries greatly facilitate the process of research strengthening through graduate study programs, technology transfer, 'hands-on' research training, expanded networking with partners' contacts, and continued scientific exchanges in the context of actual research programs. Capacity building and training of scientists should take place in a broad and co-coordinated manner through well-integrated activities and at the same time be cost-effective.

Learning and training are not one-time events but continue through a life time. Increasing globalization and rapid technological change, particularly in information and communications, have created a highly competitive market (Ducci 2001). For thousands of years, the traditional way of class-room education and teaching has been to bring the learners together in a single room (Marquardt et al 1999). This is now changing because traditional teaching and training are time consuming and expensive. Research has found that less than 15% of the material covered in the classrooms is often outdated or not available as technology has moved faster than the curricula can be developed

With the growing use of the Internet to gain access to health information, the need to educate the public and health care professionals is becoming increasingly important. Distance

education or E-health is another way to bridge know-do-gap in research building in developing countries in terms of both individual expertise and institutional capability. Traditional educational methods are inadequate to meet the needs of the health sector in developing countries. At the same time, there is increasing view among educators and medical practitioners that distance education in general and internet in particular, has the potential to revolutionize the way the medicine is taught to the students earned by students and health care professionals. There are several different courses offered through distance learning. These are cost-effective, cutting the total cost to one forth that of traditional methods of teaching (Moonen 2001)

The success of distance education delivery lies in understanding the individual participants and their different needs for instructional delivery. This understanding can lead to better design, delivery and services offered to meet the needs of distance learners. Distance education can enable students to participate in the educational training programs, courses and workshops who otherwise might not be able to do so due to their geographical or temporal factors. Potential students in rural areas may have great difficulty reaching centers of learning on a regular basis.

With the use of latest technology, training courses can be offered by different modalities for e.g. (a) correspondence (b) audio or computer conferencing (c) television, audio or computer transmission, such as open broad cast, closed circuit, cable, microwave, satellite transmission, video cassettes and discs, and web casting and pod casting (United States, department of education, 1999). The most recent technology is web casting which is the transmission of audio and/or video data over the Internet in order for web users to watch or listen via a web browser.

This can be in real time for a live event, or on-demand for archive material. Since costs for this can be kept quite low compared with traditional broadcasting, web casting puts global publicity within reach of anyone with a video camera and a computer offering connection to the Internet (Locatis 2003)

The demand for alternatives to traditional educational approaches has expanded more rapidly than anyone could have predicted a generation ago. As our society becomes more computer literate, and access to learning technologies more advance, its educational offerings delivered largely, or exclusively by some type of technology will expand. The transition from "traditional" to "technology- supported class-rooms" does not come quickly for most learners and instructors. The growing development in distance education since 1980 is two-way interactive video, called video-teleconferencing delivered through high-speed internet. These courses are considered two-way interactive because the student and instructor could both hear and see each other and exchange information in real time during the class room session (Sherow & Wedemeyer 1990). One- way and two-way interactive video comprise about the 80% of distance education courses in higher education (Cotton as cited in Collis 1996, p.346).

Video-Tele Conferencing (VTC) uses telemedicine technology for delivering programs over a geographic distance and provides visual connections to students. This provides new media of instruction in which the atmosphere resembles traditional class-room or face-to-face (F2F) interaction. TV monitors along with microphones, video cameras, VCR, and computerized graphics forms the elements of this innovative medium. The cost of VTC is half the cost as compare to traditional method of teaching. (Seibert 2004).

1.1 STUDY RATIONALE

Pakistan is a developing country and has a current population of 150 million which is projected to grow to 200 million by the year 2020. In its total life span of 55 years, Pakistan has been fortunate to have about 48 medical institutions including 5 dental colleges. Pakistan had only Government-run Medical colleges until 1983 when first private medical university of the country emerged followed by two others till 1992 and then a number of private medical and dental colleges surfaced and in 2003, raising the number to 48 medical institutions. Government run medical colleges are affiliated with the corresponding university present in the city or province. These colleges have a curriculum provided by the university prepared by the faculty of the medical colleges. The syllabi are purely subject & specialty oriented with 80% focus on secondary/ tertiary care health sciences. Focus on prevention in government institutions is almost non-existent. There are only few medical institutes (mostly private) which provide some epidemiology research methods training programs or offer courses in public health. Due to Epidemiologic transition and increasing burden of cardiovascular diseases (CVDs) in Pakistan and other South Asian countries, there is a considerable interest in, and necessity for, the development of strategies aimed at controlling CVDs in developing countries, an area of major concern and opportunity for public health training in the coming decades.

Though the attitudes towards research are positive, they are deficient practically in terms of reading and writing literature, conducting research projects and capacity building. In recent years, there have been growing concerns about building research capacity. Pakistan has been the recipient of several training programs for the past three decades and more (World Bank 1999). For some years, multilateral and bilateral donors have provided aid and loans to the Government

of Pakistan for developing the intrinsic scientific capacity within the country. One of the largest programs in this regard was run by the Ministry of Science and Technology from 1985 to 1993. Under this program, a total of 1125 candidates were funded for doctoral level training abroad and of these 116 acquired a doctor of philosophy (Ph.D.) in health sciences. However, only 10% of these returned back and 90% resulted in brain drain (Dodani & LaPorte 2005). Of those who returned, no efforts have been made to assess the impact of returning scientists and their research training outcome. Such evaluations are important to assess the true impact of capacity development efforts, and even more importantly, to identify models and avenues for such training which may be more suitable for national needs in the future.

Various institutions and committees have emphasized a wide range of issues in developing countries, including the central need for research capacity building through training of health workers as a long-term investment in future implementation of programs and policies for public health training particularly by avoiding long distance transportation (Bovet 2004).There is an immediate need to improve research training in medical institutes to facilitate the development of the local literature both in terms of research utilization and production (Aslam et al 2004).

Since the expertise in epidemiologic research training programs are often limited in many low-income countries, and in view of the urgency to initiate prevention and control programs, it is important that some kind of epidemiologic research training workshops/courses provide potential local key players with basic, but broad knowledge and skills for epidemiologic research.

There are several advantages to these kinds of workshops and training courses:

1. Training involves participants from the same affected region, which promotes team work and networking.
2. The content of training can be adapted to meet the needs of the participants (both content and format)
3. Interaction between participants from the same region can greatly enrich the substance, scope, and relevance of the training;
4. Practical work permits the collection and analysis of data with potentially important local relevance
5. The process of organizing a training program can be a powerful tool for advocating the need for training programs, fostering political commitment, and accelerating program development.
6. The costs of training can be reduced substantially, particularly by avoiding long distance transportation for participants
7. Networking of students and teachers for continuous learning and feedback.

Of all the strategies for coping with research expertise shortages that have been attempted, the effort that has gained the most ground in the past 20 years is to invite expertise from developed countries to conduct workshops, courses, training programs to train the trainers. However, though very useful, these kinds of arrangements are often very expensive, concentrate at one particular institution or place and product of such workshops/courses may not be sufficient for a heavily populated country like Pakistan. But if such kinds of research training courses/ workshops are coupled with methods of distance education at the same time, like Video teleconferencing, a broad participation from different parts of a country can be involved and can

be cost-effective. In this way, large numbers of medical health professionals can be trained at one time at lower costs than with only campus-based traditional method of training. According to the available studies, training costs for distance education students are typically 1/4 to 1/2 as expensive as conventional instruction. At least 50 third world countries are estimated to be involved in some form of distance research training (Bovet 2003).

Given the necessity for research capacity development in Pakistan, and before setting the distance way of training as a standard part of medical schools' curricula, the impact and effectiveness of such kind of research training workshops should be studied. In addition, previously, research training programs seemed to be very effective if measured immediately after the course (Naidr et al 2002); however, the effectiveness in terms of long-term knowledge retention has not been studied fully.

To assess the short & long- term effectiveness of epidemiologic research training workshop using traditional and distance learning methods, the Aga Khan University (AKU), one of the private universities in Pakistan designed a 9 days epidemiology research course as a workshop. This was developed in collaboration with University of Pittsburgh and WHO-Collaborating for Disease Monitoring and Telecommunication. The main objective was to build research capacity and familiarize health professionals of Pakistan and other South Asian countries with the selected basic components of epidemiology and research methods.

This project is one of the first efforts to evaluate the effectiveness of an epidemiology training workshop in Pakistan using two different methods of teaching i.e. traditional face-to face method (F2F) and video teleconferencing (VTC). In this study, we plan to analyze the results of

knowledge gained from the workshop, both short term and long-term in two groups, i.e. F2F vs. VTC. We also plan to study cost-effectiveness of both methods.

The over all objective of this training course was to equip participants with basics of epidemiologic research methods skills and will help them provide directions for future research training. The workshop itself was limited to 40-45 participants to allow fruitful interaction, the VTC techniques were used to telecast some of the basic course lectures and sessions to other medical institutions in Pakistan. In this way, the yield of the workshop was increased by increasing the participation of health care professionals so maximum benefit can be achieved at a lower cost with no cost of travel. Participants were primarily health care professionals from Pakistan and the South Asian region who were either researchers or planning to be involved in public health. Facilitators of the workshop were from the University of Pittsburgh and co-facilitators were selected from different institutes of Pakistan. The F2F method took place at the Aga Khan University and VTC was broadcast in two other medical institutes of Pakistan, one in urban and one in semi-urban area. The teaching materials were prepared by all the main facilitators of the workshop.

1.2 RESEARCH QUESTIONS

1. What is the effectiveness in terms of knowledge gained from the epidemiologic research training workshop offered to participants by F2F and VTC methods in Pakistan?
2. What is the effectiveness of long-term retention of knowledge gained from the workshop in both F2F and VTC groups?

3. What is the impact of the workshop on students' future career goals?
4. What is the cost-effectiveness of VTC relative to F2F teaching method?

Null Hypotheses

1. There is no difference in the knowledge gain in students attending the research training workshop via F2F and VTC methods.
2. The level of knowledge gained is not maintained after 1-year of delivery of the workshop in both F2F and VTC groups.
3. The workshop did not provide a stimulus to pursue further training in research and public health.

In the literature review section, we have established the importance of research training workshops. Discussions are on approaches and methods used for training health care professionals in developing countries. We have also highlighted short comings of previous training courses and have presented the importance and need of epidemiology research method training programs in developing countries.

2.0 REVIEW OF LITERATUE

Education is our passport to the future, for tomorrow belongs to the people who prepare for it today Malcolm X, 1991

As the new millennium approaches, one is observing rapid transformation on all fronts; political, social and economic. This transformation is unequal in extent, depth and quality between the have and have-nots and between North and South. In endeavoring to enhance the well being of populations, especially the less fortunate the world faces formidable challenges. Recent studies (WHO 1996) have shown that, apart from the familiar problems of infections, malnutrition and health problems of mothers and children in developing countries, the next 25 years will be marked by the emerging epidemics of non-communicable diseases as their populations' age. These challenges have not been matched by the ability and capability of these developing countries to carry out appropriate studies the results of which will enable them deal with the health problems in their national contexts. The result is that within the nations of the world the poorest, particularly those from the South bear the greatest burden of the world's health problems and they are least capable of finding appropriate solutions to them.

Chronic diseases are the largest cause of death in the world, led by Cardiovascular Disease (17 million deaths in 2002) and followed by cancer (7 million deaths), chronic lung diseases (4 million), and diabetes mellitus- almost 1 million (World Health Report 2003). These

leading diseases share key risk factors; tobacco use, unhealthy diets, lack of physical activity, and alcohol use (World Health Report 2002). The current burden of chronic diseases reflects past exposure to these risk factors, and the future burden will be largely determined by current exposures. The global prevalence of all the leading chronic diseases is increasing, with the majority occurring in developing countries and projected to increase substantially over the next 2 decades (Murray & Lopez 1996). The basis for a prediction of a global CVD epidemic lies in the "epidemiologic transition," in which control of infectious, parasitic, and nutritional diseases allows most of the population to reach the ages in which CVD manifests itself. CVD is already the leading cause of mortality in developing countries (World Health report, 2003). Between 1990 and 2020, mortality from Ischemic Heart Disease (IHD) in developing countries is expected to increase by 120% for women and 137% for men. Predictions for the next 2 decades include a near tripling of IHD and stroke mortality in South East Asia, Latin America, and Sub-Saharan Africa (Leeder et al 2004). Risks for chronic diseases are also escalating. Smoking prevalence and obesity levels among adolescents in developing countries have risen over the past decade and portend rapid increases in chronic diseases (Jha & Chaloupka 1999).

Numerous developing countries and countries in transition have witnessed a rapid deterioration of their chronic disease risk and mortality profiles (World Health Report 2002). In the world's most populous country China, age-specific death rates from circulatory disease increased between 200% and 300% in those aged 35 through 44 years between 1986 and 1999, and by more than 100% in those aged 45 through 54 years (Bumgarner 2004). During the same period, cancer death rates increased between 100% and 200% in those aged 35 through 44 years and between 100% and 160% in those aged 45 through 54 years.

Chronic diseases have not simply displaced acute infectious ones in developing countries. Rather, such countries now experience a polarized and protracted double burden of disease (Frank et al 1989). India, the second most populous country, has the highest number of diabetics in the world and annual coronary deaths are expected to reach 2 million by 2010 (Basnayar et al 2003). At the same time, around 2.5 million children in India die from infections such as pneumonia, diarrhea, and malaria every year. In South Africa, infectious diseases account for 28% of years of lives lost while chronic diseases account for 25% (Steyn 2003).

The increased burden of chronic diseases in developing countries that also have a high infectious disease burden is straining their health services, leading to growing economic costs (Jha & Chaloupka 1999), with increasing evidence emerging for CVD (Leeder et al 2004), diabetes (International Diabetes Federation 2003) and obesity (Thompson 2001). Many developed nations have focused considerable efforts on addressing the burden of chronic diseases. In contrast, the rising burden of chronic diseases in developing countries has received inadequate attention (Beaglehole & Yach 2003).

Many key decision makers still believe that chronic diseases afflict only the affluent and the elderly; arise only from freely acquired risks, their control is ineffective and too expensive and should wait until infectious diseases are addressed.

These beliefs are based on a misunderstanding of the chronic disease burden. Chronic diseases in developing countries are not just diseases of the elderly, since CVD accounts for as many deaths in young and middle-aged adults as HIV/AIDS (World Health Report 2003). Also, in developing countries chronic diseases affect a much higher proportion of people during their prime working years than in developed countries. Male deaths during middle age could create a

significant cohort of widows, which increases the likelihood that women will live out their final years in poverty (Leeder et al 2004).

Although the disease burden is more variable in developing countries, the poorest populations, particularly in rapidly growing cities, in many cases already exhibit the highest risks for tobacco use, alcohol use, and physical activity, with evidence emerging for obesity. This will lead to a higher burden of chronic diseases over the long-term. Poverty also leads to greater co morbidity and decreased access to quality medical care.

Chronic disease control is not necessarily expensive or ineffective. For example, a recent review of tobacco control in Brazil, South Africa, Thailand, Poland, Bangladesh, and Canada showed that tobacco prevalence can be reduced cost-effectively in high-, middle-, and low-income countries through public health interventions (Debeyer 2003). Several clinical and public health interventions have the potential to reduce the burden of disease from CVD, diabetes, and hypertension significantly and at low cost (World Health Report 2002). There is, however, an urgent need to develop best approaches to prevent steep growth of CVD in developing countries. Research capacity in the South remains one of the World's unmet challenges.

In most developing countries inadequate financing and lack of manpower to address chronic diseases have been major impediments to chronic disease control. Other impediments are the failure to provide key decision makers with up-to-date evidence on the burden of chronic diseases; a lack of understanding of the economic factors that influence chronic disease risks; and lack of experts (researchers) to conduct studies to produce local reliable country data for policy implementation.

The capacity of 185 countries to prevent and treat chronic diseases was recently assessed by the WHO (Alwan et al 2001). Although there was a high level of awareness about chronic diseases among health ministry officials, this was not supported by comprehensive policies and budgets to develop integrated approaches to their prevention, surveillance, and control. Thirty-nine percent of countries reviewed had low budget lines for chronic diseases. Only a few developing countries have committed significant resources to chronic disease control.

The health research in developing countries faces problems at several levels. At the global level there has been an increase in organizational and institutional players in international health (Rx for Global Health Cooperation Beyond 2000) and a subtle but systematic erosion of national sovereignty. In some countries there is evidence that these players have been responsible for fragmentation of research and research capacity building (Lucas et al 1997)

At the national level, political instability is a problem (Lucas et al 1997). Where governments and health ministers are frequently changing, the translation of economic and social development plans to effective national and regional research initiatives is incoherent (Halstead, Tugwell & Bennett 1991). Gaps, duplication of efforts, and fragmentation of research are common. Priority setting, resource mobilization and allocation, quality control, and dissemination and utilization of research findings are similarly impaired.

At the institutional level research units have been over reliant on international funds, which have been diminishing in real terms over the past few years (Lucas et al 1997). They have also failed to establish good links to national policymakers, non-governmental organizations, and

the public. These two factors have resulted in much less research that has not been well geared to addressing national health needs.

In addition, many research units are struggling to cope with "brain drain" of scientists and clinical researchers to developed countries which offer more opportunities and greater political and financial security (Mejia 2004). Schools of public health in the United States train thousands of health professionals from developing countries, a small proportion of whom return home as potential future public health leaders. But the great majority results in brain drain (Dodani & LaPorte 2005). This is of growing concern worldwide because of its impact on health systems and loss in developing countries. These countries invest in educating and training young health professionals. This translates into a loss of considerable resources to their states when these people migrate, with the direct benefit accruing to the recipient states that do not need to fork out the cost of educating them. The intellectuals of any country are some of the most expensive resources because of their training in terms of material cost and time, and most importantly because of lost opportunity.

Researchers in developing countries are poorly paid. Many have to work in private practice to make ends meet. Schemes to promote research as a viable career option by giving research awards (Halstead, Tugwell & Bennett, 1991) and supplementing researchers' salaries have been tried but not yet systematically evaluated (Mervis 1998). Intellectual isolation is another problem, although the increasing use of the internet is fostering more exchange between researchers in developed and developing countries. Encouraging researchers to join national, regional, and global networks is another way that isolation may be overcome and motivation increased.

2.1 SCIENTIFIC PUBLICATIONS FROM DEVELOPING COUNTRIES

Active promotion of evidence-based decision-making at all levels of the health field is being actively encouraged in developing countries. There is much research ongoing to understand the different diseases and health conditions, to quantify their burdens and to generate tools and intervention methods for dealing with them. The more decision-makers are encouraged to use results of appropriate research to plan control strategies of the different health problems afflicting their populations, the greater the probability of improving the health of the population. Even in times of financial crisis as is presently experienced in developing countries, ways of using health resources more effectively are essential and will be greatly facilitated by research.

Comparative data on human resources for different regions of the world are not always easy to get and tend to be incomplete, fragmentary and often biased. However, estimates from UNESCO suggests that four-fifths of working scientists of all disciplines, including health, are concentrated in the Western industrialized nations, Japan and to a much lesser extent, some of the larger Asian countries (UNESCO 1996). Literacy rates at primary school level in developing countries remains low (25% in some countries in Sub-Saharan Africa and South Asia). The production of scientific publications in peer-reviewed journals requires a certain level of higher education, research capacity and infrastructure in the country.

In an assessment of publications in epidemiology particularly those relevant to Non-Communicable Diseases (NCDs) in some of the international epidemiological journals where epidemiological information about NCDs was generally available, (International Epidemiological Journal, American Journal of Epidemiology and Journal of Epidemiology and Community Health) were analyzed (Yach & Kenya 1990). Regional disparities were obvious in this analysis with the balance being grossly unfavorable towards the developing countries.

In the fields of medicine and public health, the overwhelming majority of publications originate in the United States and Western Europe. Scientific papers where researchers from the developing countries are the sole authors represent a very low proportion of published manuscripts.

Over the past few years, several articles have analyzed various aspects related to the under representation in international journals of public health problems and research conducted in developing countries. The major contributing factors are given below:

2.1.1 Poor Research Production

Although the highest burden of disease is concentrated in developing countries, data from the Institute for Scientific Information show large gaps in scientific production between industrialized and developing settings (ISI essential science indicators 2001). Scientific production is poor in developing countries settings, both in terms of quantity and quality. This is due to (a) the lack of proper research and public health training (b) insufficient public health training programs, (c) critical lack of continuous support for research and development activities

including basic infrastructure from both local governments and international agencies, and (d) lack of incentives for research activities. Furthermore, professional researchers are undervalued and their salaries are low, a situation that reflects the lack status accorded the scientific production and contributes to a scarcity of fulltime researchers ad hoc.

2.1.2 Poor Preparation of Manuscripts

Manuscripts exhibiting high-quality research may not meet the requirements of peer-reviewed international public health journals in terms of language and scientific presentation. Although, some journal policies include assistance for writing and language editing, this support does not meet the needs. Language proficiency remains a fundamental barrier for scientists whose mother tongue is not English. Poor presentation may also result from a lack of skills require to develop coherent arguments. Indeed, unlike developed countries where writing skills are essential components of higher education, writing abilities in developing countries are usually acquired informally on an ad hoc basis, at a later stage in a professional career.

2.1.3 Poor Access to Scientific Literature

Authors from developing countries are often not adequately prepared to participate in the international scientific debate, as they have limited access to the published literature. Out-dated and insufficient or under resourced library stocks, high journal subscription fees and poor internet access and computer availability represent serious limitations.

2.1.4 Poor Participation in Public Related Decision Making Process

Developing country experts are seriously under-represented on editorial boards and review rosters of international journals. Editorial boards of journals devoted to diseases that mostly occur in developing country settings (e.g. tropical medicine) where local experts are not proportionately represented are an example of this situation. As a result, submissions from poor countries are usually evaluated by experts who may not be knowledgeable about the constraints associated with conducting research in these settings and, therefore, do not have a positive attitude to provide the guidance that may make the work publishable.

2.1.5 Poor Education in Medical Schools Concerning Research

Majority of the government based medical institutions in South Asia and in other developing countries, research training is not offered as mandatory discipline. Primary focus is given to clinical secondary & tertiary care teaching and some community medicine training.

2.1.6 Bias of Journals

Editors, editorial boards and reviewers of international medical journals may be insufficiently interested in the areas to which most researchers from developing countries devote their work, and may consider them un-original or irrelevant for their readership. The existence of a bias against the so-called “diseases of poverty” has also been suggested (Horton 2003). This lack of interest may also reflect the preference of readership or advertisers. In addition, researchers from poor settings have a limited capacity to buy reprints, which constitute substantial source of income for scientific journals. Finally international journals are usually

more willing to consider papers that originate from prestigious research centers in developed countries than those from the lesser-known academic entities. It has been estimated that almost 25% of the world's scientists live in developing countries. However, these scientists publish <3% of the world's papers (LaPorte 1997). There are mainly top 7 from where majority of publications arise and these are the one with the 7 largest economies. Clearly, scientists from developing countries are publishing much less than those from developed countries.

The industrialized countries have the largest number of highly trained scientists working in well-equipped laboratories and having at their disposal financial resources to carry out good quality work. A research tradition has become established in the scientific community of these countries. The same cannot be said for developing countries. The latter countries lack the appropriate self-sustained research capacities both in the numbers and quality of trained researchers and appropriate institutional capacities for high-level research. Many developing countries, for e.g. South Asian countries (India, Pakistan, Sri Lanka, Nepal & Bangladesh) have only had independence in the last 50 years, and so the scientific tradition is just being developed. Their scientists are still numerically inadequate and ill- equipped for high quality research.

In addition, what ever the amount of research is produced, there had often been complete rupture between the scientists in South Asian countries with the policy makers in the Ministries. Results of research are never or hardly ever passed on for implementation. Even when this is done, policy makers complain that they are submitted in highly technical language with no clear recommendations that would facilitate implementation. The scientists on their part complained of indifference or even hostility to their work by Ministry of Health officials. Insufficient staff

motivation, isolation from peers, poor access to literature, very low salaries all compound the problem and prevent the few trained researchers from responding rapidly to ever-changing demands and needs of their countries. Finally rewards for productivity are hampered by non-merit considerations in appointments and promotions of senior staff and by restrictions in personnel policies. One can see clear differences in thinking.

Despite the problems outlined above, some international efforts have enhanced the research capacities and the research environment in many developing countries, some of which will be discussed in detail in the next section. Notable among these are the special program of Tropical Disease Research (TDR), the special research program in Human Reproduction (HRP) of the World Health Organization, the International Clinical Epidemiology Network (INCLEN), initiated by the Rockefeller Foundation; and the Field Epidemiology Training Program (FETP) initiated by Centers for Disease Control (Lucas 1997). The TDR and HRP programs have been jointly sponsored by the WHO and other UN agencies and are governed by special boards, with the WHO acting as host. The TDR and HRP have contributed significantly to strategic and applied research in Africa, Asia, and Latin America, primarily by providing good training and support of local scientists, and help to promote the uptake of research results by end users i.e. government, non-governmental organizations, private sector, and the public (Simon 2000).

Yet one must acknowledge that where information and technical capacity is the core of value, human resources become the society's most valuable tangible asset. Attracting and keeping the best brains is one of the most critical tasks for any government and technical organization. Even more than keeping the brains, their training is absolutely critical.

2.2 BUILDING RESEARCH CAPACITY IN DEVELOPING COUNTRIES

Public health is increasingly viewed as one of the important approaches for achieving national health goals (WHO 2001). Similar sentiments have been expressed in developing countries (Than 2002). The Calcutta Declaration from the 1999 Regional Conference on Public Health in South-East Asia in the 21st Century made specific recommendations for building public health capacity in the region, including the creation of appropriate career structures and strengthening public health education, training and research (Calcutta Declaration 2000). An Indian Expert Committee on Public Health System in 1996 recommended development of a contemporary national health policy, a modern Public Health Act, development of a career track for public health professionals, and establishment of regional schools of public health (Expert Committee of Health System 1996). The National Health Policy–2001 for India refers to the shortage of public health expertise and the outdated curricula that are unrelated to contemporary community needs (Indian National Health Policy 2001). There is no such document so far developed by Pakistan Government.

Health research capacity is the ability to define problems, set objectives and priorities, build sustainable institutions and organizations, and identify solutions to key national health problems (The 10/90 report on health research 2000). This definition encompasses research capacity at the levels of individuals, research groups, institutions, and nations. Research capacity can broadly be divided into four domains: skills and competencies; scientific activities; outcomes; and impacts on policies and programs (Simon 2000). Measures on process, outcome, and impact are necessary to capture a comprehensive picture of research capacity.

"Learning by doing" approaches, usually in the form of hands-on-training are effective approaches that complement academic degree offerings (Lansang 2004). These methods are also most appropriate for building capacity on the "demand" side, so that those who use research findings understand and appreciate their value in improving health outcome. This kind of training was demonstrated in India through a series of action-research workshop and "learning by doing" exercises for more than 150 community- based organizations in the country (The 10/90 report on health research 2000).

Research capacity strengthening consists of two main closely inter-related and inter-dependent activities, which, together, form the basis of institutional development. The two parts are:

1. Improving, through appropriate training, the capabilities of scientists to undertake quality research.
2. Providing institutional support — equipment, supplies and other logistic support to the institution in which the trained scientists have to work.

For the interest of this study project, we will focus on Research training.

2.2.1 Research Training

Experience shows that many developing countries with primary focus to South Asian countries have both quantitative and qualitative shortages of scientists for most disciplines. In order to carry out adequately multidisciplinary research, it is necessary to identify and train scientists in a wide range of disciplines, with focus to epidemiological research (Global forum

for health research 2005). Those being trained should include scientists working at central, regional and district levels and should also include all members of the health team. In this way health professionals concerned with issues of the best mix of, and alternative strategies for providing health care to different populations, health policy and epidemiological research and the more strategic type research of a biomedical and clinical nature will receive training. Policy makers have to be involved in the whole process from identification of trainees to ensuring that all training provides competence to deal with topics within the context of the national priority research agenda.

One must admit that research institutions in developing countries vary greatly in their characteristics and degree of development but share in the constant need for improvement in the numbers of their trained scientists. All discussions on numbers of trainees and mix of disciplines have to keep this in mind. Ultimately, all efforts at research capacity strengthening in South Asia is to build up self-reliance in their respective countries—capacity to innovate, compete, generate, adapt and use scientific knowledge for the improvement of the health of the population of their countries (Nchinda 2002).

Training of scientists, the key to capacity strengthening, should take place in a broad and coordinated manner through well-integrated activities, which are clearly identifiable under the following headings:

(a) Identification of young and talented nationals interested in epidemiological research for which training is needed.

(b) Organizing and providing them with appropriate epidemiology research training in a suitable research environment.

(c) Providing them with the financial and technical facilities for putting into practice knowledge acquired during training.

(d) Ensuring that their research activities are sustained through adequate remuneration for their work, ensuring the existence of an appropriate research career structure for researchers and providing adequate infrastructure and resources to maintain research efforts.

(e) Providing them with mentorship on continuous basis for further coaching and training

Over the last two decades, research capacity building has been recognized as a priority by the international research community. Epidemiological research in the field of public health is still an underdeveloped area in South Asian countries. The need for more expertise in epidemiological research in developing countries is well acknowledged. Numerous efforts have been undertaken in the past 20 years to build up local capacity in public health research (Trostle 1992). Some early initiatives for research capacity building were taken by World health Organization (WHO) in 1970s

In the past, World Health Organization (WHO) and several non-governmental organizations (NGOs) have been involved in developing countries towards research capacity building initiatives (White et al 2001). These programs share the common goal of building local capacity for scientific research, thereby empowering communities. However, in many developing countries, research building capacity has been hindered by the migration of local

researchers to other countries following their training, the so-called "brain-drain," particularly those who have had portions of their training internationally (Dodani & LaPorte 2005).

2.2.2 Epidemiology and Research Training in Developing Countries

Organized public health efforts for the prevention and promotion of diseases, and quality of life rest on the scientific core of epidemiology (Institute of Medicine, 1988). Epidemiology is essential for the detection, control, and prevention of major health problems. Described as the foundation of all public health functions, epidemiology provides information needed to perform essential public health services (CDC MMWR 2001). Within a public-health system, epidemiology contributes to etiologic research, planning and evaluation of interventions, public health surveillance, and health policy formulation (Brownson 1998). Accordingly, leaders of state health departments ranked epidemiologic skills highest among 11 areas of importance to their agencies (Morris 1994).

The accomplishments of epidemiology and public health have extensively changed the pattern of death and disease in modern society. Over the 20th century, life expectancy from birth has risen from 48 to 74 years in men and from 51 to 80 years in women in the US (World Health Report 2003 & National Center for Health Statistics 2003). *This represents an increase of over two days of life expectancy for every week since the beginning of this century. That is most fascinating.* Only about five of the additional 30 years gained in life expectancy can be attributed to the work of the medical care system (Bunker et al 1994). It is likely that the majority of the gain in life expectancy can be attributed to provision of safe water and food, sewage disposal, control of infectious diseases through immunization, and other population-based, public health

activities (CDC 1993). These accomplishments are more seen in developed world due to extensive epidemiology training programs throughout than in developing countries.

One of the examples of success of epidemiology is in reduction of cardiovascular diseases, particularly coronary heart disease (CHD) in the United States. CHD has been the leading cause of death in the United States for most of the twentieth century. Since 1968, the decline in CHD mortality has been consistent and nearly uniform across race and sex groups. The decline is steeper in younger than in older age groups. By 1993, the age-adjusted mortality rate for CHD was 248 per 100,000 (National Center for Health Statistics 2003), representing a decline of 54% since 1965. The decline in CHD mortality is not fully understood. Improvements in medical care and treatment of CHD are also likely contributors to the overall decline; however, major contributor is likely a change in lifestyle risk factors (e.g., cigarette smoking, hypertension, physical inactivity, poor nutrition). *In the United States, these modifiable risk factors were identified through large-scale epidemiologic studies such as the Framingham Study (Dawber 1980). Based on the findings of these epidemiologic investigations and subsequent successful public health programs (e.g., the National High Blood Pressure Education Program begun in 1972 (Roccella and Horan 1988)), awareness of the modifiable nature of many CHD risk factors has increased among health professionals and the general public (Kannel 1995). Similar efforts in developing countries could result in decline in CHD which is currently on rise due to epidemiologic transition (World Health Report 2002 & 2003).*

Principles of epidemiology are increasingly used to shape and evaluate the changing health care system. Managers of health care systems are recognizing that the most cost-effective

strategies will be achieved through a population-based perspective, which places epidemiology in a pivotal role (Oleske 1993). Measures of the performance of delivery of health care services are being demanded as evidence of value of health care.

Applications of epidemiology in a modern health care organization encompass a wide range of activities including: 1) linking national or regional policy initiatives with institutional efforts, 2) strategically developing new services or planning changes in existing ones, 3) deploying resources to provide care to a population, 4) monitoring system performance with respect to process and patient outcomes, and 5) measuring the success of institutional linkages and/or system configurations to effect changes in the health status of the population (Lerner 1995).

The changing health care system will call for new skills and competencies among health care providers. Among the necessary skills are the abilities to: assess the health care needs of the population, develop intervention programs, and evaluate cost, efficacy, and effectiveness of interventions. These skills relate closely to the intellectual discipline of epidemiology. New opportunities abound for training epidemiologists to meet the needs of health care organizations and for re-training clinicians in areas epidemiological research.

Establishing public health and health care priorities in an era of limited resources, such as seen in developing countries is a demanding task. The use of epidemiologic tools and approaches can make important contributions to priority setting. Measuring progress toward explicit goals has become an essential feature of goal setting.

Health policies should be based on epidemiology and epidemiologists can play a key role in policy-related interventions (Terris 1980). First, through etiologic studies, epidemiologists can identify potential interventions based on causal criteria (Hill 1965 & Susser 1973) and their likely impact on disease burden based on the population attributable risk. Second, epidemiologists can work closely with scientists in designing interventions and evaluation protocols. And third, following implementation of a particular intervention, epidemiologists can assist policy makers in evaluating the effects of the intervention and in formulating broader policies related to the intervention.

Research training is a fundamental aspect of physician training. Internationally, a number of graduate and postgraduate training courses in epidemiology, biostatistics and other research fields have been implemented and evaluated. The need for more expertise in health research in developing countries is well acknowledged. Numerous efforts have been undertaken over the past several years to build up local research capacity in epidemiologic research (Trostle 1992). Some early initiatives for research capacity building in developing countries were undertaken by WHO, CDC and several other organizations are discussed below.

In 1951, the Epidemic Intelligence Service (EIS) Program was created at CDC as a combined training and service program in the public health practice of epidemiology (Thacker et al 1990). The EIS Program is a practically oriented 2-year experience for health professionals who are interested in careers in epidemiology and preventive medicine. The program is based on a philosophy of "learning while doing". EIS Officers provide service while learning applied

epidemiology on the job. The emphasis in the training is on the development of epidemiologic judgment. EIS Officers are selected each year from a variety of professional categories, including physicians, veterinarians, nurses, graduate epidemiologists, and others (Thacker et al 1990). Compared with earlier decades, persons applying to the EIS during the 1980s tended to be older in their early to mid-thirties, rather than late twenties, are more experienced in public health, and more extensively trained in public health.

These officers selected are assigned to specific positions at CDC headquarters or one of its seven field stations located around the country. Some are assigned to State or local health departments. The training courses range from 3-6 wks didactic lectures in applied epidemiology and biostatistics, as well as a field exercise. The in-service training in epidemiology is primarily a function of the 2-year assignment to a CDC program, a State or local health department, or another Federal agency. In these assignments, EIS Officers learn the basic skills of epidemiology under the supervision of an experienced mentor while they conduct epidemiologic investigations and research in the public health setting either in a specific program area, such as chronic or infectious diseases, or in a State or local health department.

Since 1980, both the content and nature of the training of EIS Officers has evolved dramatically. There have been additions of several programs of applied epidemiology, biostatistics and increased field work (Foege 1981). Nearly 1,000 persons who had served in the EIS prior to 1980, there had been only one graduate (doctoral level) epidemiologist. Since then, 52 incoming EIS Officers have held doctoral degrees in epidemiology. In addition, prior to 1980 few physicians had master's-level degrees or training in epidemiology and public health; in the

class of July 1990, 51 percent of the physicians already had obtained such degrees.

Since the creation of the EIS Program in 1951, EIS Officers have played important roles in landmark epidemiologic projects (Langmuir 1995). EIS Officers have participated in more than 3,000 epidemiologic projects (mostly tailored towards infectious diseases) of national and international importance (Goodman 1990).The impact of EIS officers program has had tremendous impact in public health and to strengthen systems for disease detection and response in the United States with less involvement in developing countries (Thacker 1990). The Epidemic Intelligence Service continues to use practical apprenticeship-style training to provide service and to train health professionals in applied epidemiology and other public health competencies. During the past 25 years, applied epidemiology training programs (AETPs) have been established in 28 countries as extensions of the Epidemic Intelligence Service model (Schultz 1990). These programs are primarily geared towards teaching different research skills (30%) and research field work focused on a particular disease or pattern of diseases. As of January 2001, AETPs have graduated an estimated 945 public health leaders, and another 420 persons are currently in training (table 1 & figure 1).

AETPs comprise a global resource for surveillance and interventions to improve health. These programs are a source of practical training for young professionals in the detection, surveillance and prevention services associated with high-priority public health problems. Because trainees function as active members of public health service programs, AETPs create a setting in which evidence-based public health systems that serve communities effectively and efficiently can be established. Some of the developing countries participated in AETP programs

however; the involvement was at small scale with almost insignificant impact (Betts et al 1998).

Table1. Estimated number of graduates and trainees of selected Applied Epidemiology Training Programs (AETPs) as of January 2001*

Country	Program started (year)	Graduates to date (no.)	Current trainees (no.)
Canada	1975	68	11
Thailand†	1980	80	13
Indonesia	1982	50	42
Mexico	1984	111	28
Taiwan	1984	88	22
Philippines	1987	57	12
Peru	1989	39	45
Saudi Arabia†	1989	58	5
Australia	1991	46	13
Colombia	1992	38	7
Italy	1992	6	0
Egypt	1993	22	7
Zimbabwe	1993	33	17
Spain	1994	29	11
Uganda	1994	42	20
European Union (EPIET) ††	1995	56	9
Hungary	1995	9	0
Cote d'lvoire	1996	5	5
Germany	1996	7	6
Ghana	1997	77	24
Vietnam	1997	24	42
Jordan	1998	0	7
Japan	1999	0	12
WHO†	1999	0	8
Brazil	2000	0	12
Central America†	2000	0	23
Korea	2000	0	10
India	2001	0	9
Total		**945**	**420**

* Excluding the Epidemic Intelligence Service in the United States.
† Provides training for more than one country.
†† EPIET, European Program for Intervention Epidemiology Training; WHO.

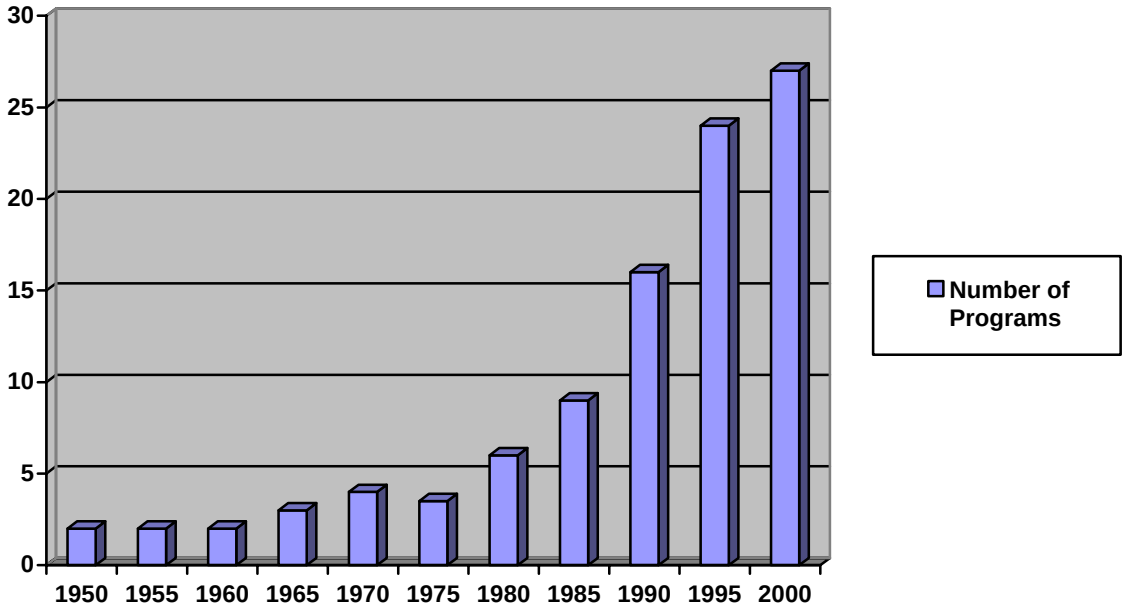


Figure 1. Global number of applied epidemiology training programs, 1950–2001

Every country needs a minimum capacity for epidemiologic services to help to ensure the quality of health promotion and disease control programs. Successes of the EIS led to help build the national epidemiologic capacity in many other countries. To meet this need, in 1975, the Canadian government, in consultation with CDC, developed a competency-based training program in field epidemiology that evolved into the Canadian Field Epidemiology Training Program (FETP). Than in 1980, CDC partnered with the WHO and the Kingdom of Thailand in 1980 to establish an FETP modeled on the Epidemic Intelligence Service, which involved assigning a CDC consultant to serve as the in-country technical advisor to the program for several years (Bennett 1983). FETPs are modeled on the EIS Program and adapted to the needs and resources of individual nations. Since 1980, FETPs similar to that in Thailand have been established in Indonesia, Mexico, Taiwan, the Philippines, Saudi Arabia, and Peru. Collaboration on an FETP is generally based on extensive consultations between CDC and a

Ministry of Health, and a formal plan is developed to fit national needs. Startup resources, generally needed for the first 5-7 years, include the support for a trained epidemiologist supplied by CDC as a resident consultant. Financial support for an FETP comes from multiple sources, but primarily the host country and international organizations such as WHO. CDC provides continued technical support to the FETPs through the Global Epidemic Intelligence Services (Kickbusch 1997).

Since the mid-1990s, broader models that teach applied epidemiology and other public health competencies have been developed. All of these models of field Epidemiology training are collectively referred as Applied Epidemiology and Training Programs (AETPs). AETPs build capacity in health service agencies by providing training in field epidemiology and other public health competencies in the context of health service delivery systems. In these programs, epidemiology is used as a tool to design, evaluate, or improve interventions to protect the health of a population. These models emphasize competency-based field epidemiology. Since 1986, AETP trainees and staff have participated in annual scientific international conferences that provide a forum for trainees to present papers selected on a competitive basis.

In 1997, WHO and CDC created Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET). Members and supporters of the network included representatives of the training programs, CDC, and the WHO. The mission of TEPHINET is to strengthen international public health capacity through supporting, networking, and initiating field-based training programs that enhance competencies in applied epidemiology and public health interventions (Thacker 2001). The Training Programs in Epidemiology and Public Health Interventions Network provides a voice for the programs on the global stage and provides a

venue for developing shared curriculum, national and regional training programs, and quality assurance. The network also coordinates participation in WHO-sponsored and other multinational outbreak response teams. It also provides technical assistance to improve surveillance, disease prevention, and health promotion programs.

Of the total number of countries, 19 of the AETPs listed in table 1 have been in existence more than 4 years. Of these 19, almost all (95 percent) continue to produce graduates and provide service to their governments. These programs have been sustained because they provide valuable services to their ministries of health both during and after training. However, because of the challenges involved in coordinating AETPs and academic programs, most AETPs do not grant degrees, and new AETPs face substantial challenges in persuading government personnel systems to recognize graduates for technical positions (Betts 1998). This holds true for developing countries with greater emphasis on South Asian countries where awareness regarding epidemiology and public health is still in infancy. In particular, the development and ongoing training of the public health workforce have been neglected over recent decades in poor developing countries (Beaglehole et al 2001)

The Rockefeller Foundation was instrumental in establishing many of the most prestigious schools of public health in most regions of the world. In 1992, the Rockefeller Foundation launched the Public Health Schools Without Walls (PHSWOW) initiative in Africa, which later expanded in Asia. The PHSWOW program is an attempt to integrate public health training with health system reforms and especially the emphasis is on community-based services with the decentralization of authority and resources (The Rockefeller Foundation 1999). The goal of the PHSWOW program is to train graduates competent to respond to practical health

problems and to manage health services, especially at the district level. In all countries the ministry of health plays a significant role in the PHSWOW program. A feature of the PHSWOW curricula is the substantial period of supervised field training (up to 75% of the course), during which the trainees are expected to acquire and demonstrate competence in key areas, including the ability to: investigate important local health problems; design, manage and evaluate health programs; assess and control environmental hazards; and communicate effectively with individuals, communities, colleagues and policy-makers.

A recent evaluation of the PHSWOW concluded that, despite the lack of pre-formulated milestones, the PHSWOW provides one foundation on which public health capacity in developing countries can be built and is possible to undertake high-quality public health training in diverse settings in developing countries (Beaglehole 2001). However, for a PHSWOW to take off in many developing countries, strong local leadership is necessary for capacity-building initiatives and substantial external resources is required which is deficient in many of the developing countries.

In 1982, the Rockefeller Foundation established the International Clinical Epidemiology Network, currently a self-supporting body (INCLEN), to develop clinical epidemiology units at medical schools in developing countries. The INCLEN training program began in 1984 as a worldwide program that competitively selected physicians from developing countries for a one-year post-graduate training program in clinical research methods ((Halstead et al 1991).

The goals of the INCLEN programs were to develop units of excellence in clinical epidemiology research at the participating medical schools in the developing countries. The ultimate hope is that with qualified researchers in a country, the country's pressing health

priorities would be adequately researched. As such, the program not only provides training to the future investigators, but also time protection for conducting research activities and the necessary biostatistical and other support required upon their return to their home institutions. For their training, physicians attended centers at research universities in Canada, Australia, or the United States for 12-18 months of training. The idea was that trained clinical researchers, after returning home from training, would have a 'second home' in which to pursue careers in clinical research, in addition to, but separate from their clinical discipline. There was protected time for research - 20% or one day a week – so that their skills in research would be used and the clinical demands would not overcome their entire time. Most physicians did not have any statistical or epidemiological training prior to their participation in the program. Currently, INCLEN has regionalized the training by creating Clinical Epidemiology Research and Training Centers (CERTC) in those CEUs that have progressed in their infrastructure, in such diverse countries as Brazil, Chile, Colombia, Thailand, Philippines, and India (Bangdiwala 2001). The training curriculum is basically the same as at the original training centers, only with a different venue and faculty. However, at the regional training centers, it was decided to provide a greater emphasis on epidemiological and statistical training for the health professionals. The CEU comprised of various clinical researchers from a variety of medical disciplines, plus a biostatistician, a health economist, and a health social scientist. The idea was to have a multidisciplinary team of researchers to collaborate effectively. Since its inception, the INCLEN program has trained over 500 health professionals world-wide.

The progress and evaluation of INCLEN centers and CEU showed that INCLEN training program have achieved reasonable success in many countries, but at the same time, the success

of this endeavor in training physicians to be clinical epidemiologists has been mixed. One of the original intents of the INCLEN program was to establish these CEUs as centers for excellence in various countries so that local well-trained clinical researchers would study the health problems faced in those countries. Other training programs with such lofty goals have failed in the past, as trainees did not return to their countries, thus creating a 'brain drain.' The establishment of a CEU that provided a career path in research, coupled with a variety of monetary and travel incentives was the planned answer. This has worked in some situations, but in others, given the value of these trained individuals, internal brain drain has meant that the qualified trained clinical researchers and biostatisticians have left the CEUs for more lucrative positions within private enterprise and international organizations. This is especially true for the epidemiologists and biostatisticians which are rare commodity in many countries, but also because they do not have high salaries within the medical faculty since they are not clinicians. Possible training methods (Bangdiwala 1993), and the specific methods of the Training health and medical professionals in statistical methodology is not a threat to the statistical profession, but actually enhances our profession. The training of epidemiologists to work effectively as team collaborators with the clinicians has been a harder battle to win. Challenges exist in many institutions from an administrative standpoint, such as in reduced possibility of an academic appointment in a medical school, and limited ability to get promoted within the medical faculty as an epidemiologist, coupled with reduced salaries because of no clinical practice.

Epidemiologists and biostatisticians are thus more likely to be lured away by private enterprise, and thus the CEU suffers. From a training standpoint, this INCLEN model requires 3-4 years to train a clinician as a clinical epidemiologist, the expenses are not covered by the

original funding agency. Finally, from a health professional standpoint, the career development of an epidemiologist requires continued contact and interactions with other epidemiologists and especially continued education. However, there is still a gap in updating the training with the recent advances in computer intensive methodologies in the statistical field, by the fact that trainers within the Network may not be in a position to provide such continuing education, while outsiders command high honoraria. The challenges in training professionals to research the pressing health priorities of developing countries are numerous. Until a critical mass of Researchers and epidemiologists are available within a country, continued education courses for the statisticians on advances in the field are essential for their career development.

The INCLEN focused over a 20-year period on improving the epidemiological skills of clinicians but did not address the need for a modern public health workforce in a resource-constrained setting (Jain 2001), thus resulted in a serious lack of appropriate public health training opportunities in most of the developing world. Most of INCLEN programs are not very applied epidemiology related and basically involved in research projects from developing countries. The focus is given more to provide support than training the trainers and resulting non-sustainability of the programs.

One other major pitfall of these training programs/courses is from country's health priority list point of view. Individuals trained as epidemiologists, researchers and biostatisticians are often uncommon professionals in many countries. This can have advantages from a scarce commodity standpoint, but more often they face special challenges. In some countries their special skills are not recognized as relevant to the country's health priorities. Clinical researchers

face the challenge of the pressing needs for their clinical expertise, and often their research skills go under-utilized as they are pressured to treat patients by their institutions or government.

With respect to developing countries, training programs have been established to meet the research needs – for example, the new Master of Public Health program at Muhimbili University College, Dar es Salaam, Tanzania, which is supported by the University of Heidelberg and the Deutsche Gesellschaft für Technische Zusammenarbeit. A Swedish initiative based on the International School of Public Health, Umea, combines course work in Sweden with field work in the home countries of the MPH candidates (Wall 2002). New schools of public health are being developed, for example in Bandung, Indonesia, and in Kazakhstan; the Bangladesh Rural Advancement Committee has proposed a new school for Bangladesh. There is scope for further development of "twinning" relationships between institutions in the North and those in the South, and for South-to-South arrangements.

2.3 ISSUES IN HEALTH RESEARCH & CAPACITY BUILDING IN PAKISTAN

Pakistan is a South Asian country with a population of 150 and population growth rate of the country is 2.6% per annum. The national infant mortality rate is 90 per 1000 per year and the maternal mortality rate is 300–399 per 100 000 per year (National Health Policy, 1997). Life expectancy at birth is 60 years for both men and women. The under- 14 years age group accounts for 44% of the population, with the age group over 65 years forming 5% of the population. The national literacy rate is 38%. The country's per capita income of US$480 is above average for South Asian countries. However, according to the UNDP listing of countries on the basis of their

Human Development Index (HDI) Pakistan is ranked 138 among 174 countries (International Development Association Project, 1998). In the health sector the program/project approach has been used to deal with the immense health problems of the population. These programs and projects have been specific objective-focused and have been mostly vertically implemented.

Three critical deficiencies have been present in all the programs to date

- Lack of an information base
- Lack of community participation and
- Lack of a cross-sectional approach to implementation.

As a result, despite decades of effort, not much change has occurred.

There are many reasons for the failure of years of effort to make a positive impact on the health status indicators of the population. A critical factor is the lack of an information base for policy and planning. The health sector has no organized system to generate information. Routine documentation and record keeping are extremely poor. A research culture has failed to develop and, as a result, there is no research capacity and no demand for research. Since the beginning of the 90s, an effort has been under way to introduce a Health Management Information System (HMIS), but it is still too unsatisfactorily established to contribute to decision making.

Pakistan became an independent sovereign state on 14 August 1947. At the time of independence the territories that became Pakistan had one medical teaching college and attached hospital and one university in Lahore. The health care delivery system consisted of a few district and civil hospitals. As early as 1954 a Medical Reforms Commission was set up to advise the

government on the organization and structure of the medical services. In the first two decades of independence, rapid expansion occurred in the health sector. By the early 1960s, there were 6 medical colleges and one National Health Laboratory, now called the National Institute of Health (NIH). A journal for the publication of original research, called the Journal of the Pakistan Medical Association (JPMA), was also launched. The Pakistan Medical and Dental Council was established to set standards and oversee medical education. Today the country has 48 undergraduate medical institutions and five dental colleges. Among several private medical universities, Aga Khan University (AKU) was established in 1983 in Karachi by Aga Khan Development Network (AKDN), an international NGO.

However, the expansion and development of the health sector, as outlined above, has not been in the framework of any policy or long-term planning. Since the early 1960s, development has occurred in the context of 5-year plans and annual development plans. An abortive attempt at health policy making was undertaken in 1990. It was in 1997 that the first national health policy was announced. The policy aims to improve the health status of the nation by providing universal coverage of quality health care through an integrated primary health care (PHC) approach. The 2010 vision for the health sector development, as set out in the policy document, provides for comprehensive and quality health care for all segments of society (Pakistan National Health Policy, 1997).

Research in Pakistan has remained a low priority area in all fields. This is illustrated by the total scientific and technical manpower of 14, 576 and a total number of 1,843 PhDs in all fields in a country of over 150 million (Government of Pakistan: Planning Commission 1955 –

1998). In the field of health, the number of research scientists is 966, with no more than 42 PhDs, 24 of whom are at the Aga Khan University, Karachi (UNDP Human Development Report 1998).

2.3.1 Health Research Institution in Pakistan

The Pakistan Medical Research Council (PMRC) was built in 1962 as an autonomous body with functions of promoting, organizing and coordinating health research and linking it to national socio-economic development planning. To achieve its objectives, the PMRC adopted the strategy of establishing research centers in medical teaching institutions, where it was assumed that the research capacity will concentrate. The Council has 18 such centers at present, located in major public sector undergraduate and Postgraduate Medical Institutions. Besides its routine hands-on training at its research centers, the PMRC organizes several research training workshops from mid-1980s. The Council, in collaboration with WHO and other NGOs in the past have worked on several research projects and developed research management policies. Despite all this, the present situation is such that even the Council itself has hardly any trained researchers on its staff. Unfortunately this strategy has also failed to deliver the desired results. One reason is the failure of the PMRC to attract competent researchers and develop a core of research trainers. With a severe lack of capacity in its own research centers it has been unable to develop health research human resources in the country (Pakistan Council for Science and Technology 1999).

The PMRC's assumption that adequate research capacity is available within medical institutions, and that all that is needed is the provision of technical and logistical facilities

through the centers to promote research, has proved wrong. Research know-how is severely deficient, and the PMRC needs to concentrate on capacity building for several years to come before any change can be brought about. The private health sector's contribution to the GDP of the country exceeds that of the public sector. The first National Health Survey of Pakistan (NHSP) conducted from 1990-1994 with CDC has shown that 80% of curative care visits are to private health practitioners (Pakistan National Health Survey 1995). Some very well equipped and high quality hospitals have been established by the private sector, the notable ones being the Aga Khan University (AKU) Hospital, Shaukat Khanum Cancer Hospital and Shifa International Hospital. The specialists in these hospitals contribute to the research effort, with the AKU especially in the forefront of medical research. However, their impact on the research environment has yet to be seen.

2.3.2 Original Research Publications from Pakistan

The Pakistan Medical & Dental Council (PMDC) is the regulatory body for medical education in the country. The Council requires a specified number of original publications for induction to, and promotion in the teaching profession. This should have helped to promote health research in academia but, unfortunately, many ways have been found to get around it. Owing to a lack of research expertise, mostly inexperienced persons review the publications submitted by candidates. Therefore, all sorts of substandard publications are approved. Currently three medical journals are indexed and peer-reviewed. In March 1991, the PMRC, with AKU organized a conference to set health research priorities for the 1990s. However none of the institutions involved were able to identify and arrange funds to undertake research on the priorities identified. In fact, in the 1990s, national funding for health research registered a decline

owing to the mounting economic problems of the country. In 1997, INCLEN trust was approached by PMRC, but due to political instability, INCLEN training programs could not be established in Pakistan till 2005 when AKU obtained INCLEN membership and developed INCLEN training unit within the university. This center is currently in development stage.

2.3.3 Failure of the Development of Research Culture

Despite the establishment of the many institutions listed above and putting in place of an elaborate infrastructure for the promotion of health research, both the volume and quality of health research have remained low. The major reason is an overall lack of research culture in the country. In a socio-cultural milieu that actively discourages the questioning of authority, and an educational system where learning is mostly by asking questions is taboo, the potential for enquiry fails to develop. The essential quality of critical analysis is, therefore, lacking, even in those who attain high-level educational qualifications. Low-income countries, such as Pakistan have less than 0.05% of the national budget dedicated to research (Wagner et al 2001). Government health systems face numerous challenges in meeting the health needs of the people. Standards in training and accountability are difficult to regulate. Institutions are perpetually under-funded.

The PMRC centers were established on the premise that qualified faculties of the medical teaching institutions know and understand research, but do not have sufficient facilities to undertake it. Even heads of departments and senior level professors use to come to PMRC with a request to identify a research problem that matches their research interest. In the research done for postgraduate degrees and diplomas, the faculty of a respective institution maintains a

stereotyped list of problems and topics that are handed out to students without any meaningful dialogue and discussion.

2.3.4 Lack of Demand for Research

Policy, planning and decision-making are dominated by bureaucrats and politicians, who are mostly generalists with a poor understanding of research. The professional posts are generally filled by mediocre candidates. In the absence of attractive incentives and salaries and the lack of authority invested in most posts, high caliber professionals are not attracted. The result is that neither the generalists nor the professionals have created a demand for research. Organizations, like the PMRC, have never been asked by policy- and decision-makers to provide information for any purpose and the professionals of these organizations have themselves not effectively disseminated their research and advocated its use. The academicians of the many teaching institutions in the country are mostly clinically trained and, with their responsibilities for teaching and patient care during working hours and private practices in their free time, have hardly any time for research. The passive recipients of their teaching, the uncritical student body and the illiterate, uninformed patients, further depress any urge for critical evaluation of existing practices. The number of scientists and researchers is very low in Pakistan, even when compared with other countries of the region and other Muslim countries of equivalent socio-economic development level. The following are some of the attempts made in the past to develop a critical mass of researchers in the country**.**

2.3.5 Ministry of Science and Technology (MoST)

The Government of Pakistan created a separate Ministry for Science and Technology in 1972 and over a dozen research institutions were established under it. In the field of health specifically, an external funding source was obtained by MoST in the 1980s and early 1990s, which funded candidates who were awarded a PhD in fields like microbiology, molecular biology and oncology etc., in order to develop a critical mass of professionals in these fields. According to evaluation report of Government of Pakistan, 90% of those sent abroad did not return. Those who returned either did not find suitable posts or were unable to get postings in line with their training and qualifications.

2.3.6 USAID

The US Agency for International Development (USAID) under several training programs trained group of 30–40 health researchers in a series of workshops. The group's subsequent contribution to research is not known.

2.3.7 Undeveloped Capacity for Research Dissemination

The most critical lack in the health research field is expertise in data processing and reporting of research. Biostatisticians are almost non-existent and epidemiologists are in short supply. The statisticians available have poor applied skills and are generally unable to contribute adequately to the research effort. Owing to this lack of data processing expertise, a large proportion of whatever research is undertaken remains unanalyzed. The dissemination of the little research that is done is further reduced by the lack of writing and reporting skills among

health professionals. Development of communication skills, especially writing and reporting, is not emphasized in any of the curricula of health professionals. The replacement of essay writing in examinations by multiple choice questions is further affecting the ability to write. Thus, effective communication of the results of research and personal experience remains low. Through individual efforts a few medical journals are being published, but both their frequency of publication and their standard are far from satisfactory.

2.3.8 Need for Research Training and Research Capacity Strengthening

Despite all the efforts undertaken in the past, there is urgent need to establish training and build research capacity in Pakistan. The most suitable method to develop local players is to collaborate with research institutions, within the country and abroad.

WHO and other NGOs within country can help to promote collaboration between Pakistani institutions and institutions abroad especially those in the developed countries. Collaborative research helps to develop research skills, brings in funds and generates good information for the country. There is an urgent need to develop research training programs which are tailored toward health professional needs and are developed keeping in mind the country's economical conditions. *However, since not every health professional or physician is either willing or able to attend and complete a full-time academic program, it is desirable to increase the flexibility of epidemiology research training in terms of content, form and outcome. The form can be as a course, workshop, training module etc. Outcomes can include certificates, diplomas, Master of Public Health degrees and doctoral degrees. This flexible approach to training will not only develop interest in physicians and nurses, but will also give incentives to those who*

want o take it further their career as researchers and pursue for additional training. The development of local-based public health training fosters the retention of health personnel in-country, and slows the brain-drain.

Research is a luxury owing to economic constraints, and many scientists hold several other jobs. The lack of scientific careers, scientific tradition, institutional support and collaboration within the local scientific community aggravates the problem, along with the fact that available training is often operational in nature rather than research-oriented. However, some of the most intractable challenges are cultural and political issues, exacerbated by the scarcity of resources. Learning to navigate the countries' political situation is crucial, because high-level changes in the Ministry of Health—which tend to occur frequently—can directly affect research projects. Yet it is not only essential but also exhilarating to overcome these obstacles and to succeed eventually in conducting relevant research and in training cadres of scientists in the process. The struggle only makes the success sweeter, and all progress, no matter how small, is a big step forward.

The distance learning approach to education is transforming professional education through the use of improved information and communications technology. These techniques though small in number, are available in developing countries and their usage for training of health care professional will give high yield at low cost. Even students in remote areas can be linked to such programs through several methods like audio and videotapes, and video-conferencing. A very real obstacle to this approach is the inequity in access to technology and

connectivity across the globe and within populations. The poorest and most marginalized people are less likely to have access to or knowledge of computers and the internet.

2.4 EPIDEMOLOGY TRAINING USING DISTANCE EDUCATION TRECHNIQUES

The last two decades of the 20th century has promised to be a period of great scientific changes in the World. The advances that have taken place in information technology and speed of travel have, in a very real sense, brought the world much closer together.

There is no doubt that we are in the midst of "Internet Age". We are mesmerized by and obsessed with the information technology. There is a constant flurry of activity regarding the internet. No matter where you are, the internet is a topic of conversation. This allowed the access to information for everyone; thus everyone wants to be connected to the Net. Among the dramatic changes brought by the appearance of internet are those involved with the ways of education delivered.

Distance education or distance learning is not a new strategy to the field of education. Distance education is often described as institution-based, formal education where the learning group is separated geographically (Chute 1999). It was also defined in 1998, Amendment to higher Education act, as a process that is characterized by separation, in a time or place between instructor and student.

Educational technology has changed the definition of classroom in terms of location, size, composition, learning environment, and teacher role. Distance education is generally defined as the provision of academic courses and entire degree programs on the condition of geographical separation between instructor and students (Schweitzer et al 2001). Kaye (1986) identified seven key characteristics of distance education.

- Separation of instructor and student
- Influence of an educational organization
- Use of Technical Media
- The provision of two-way communication
- The absence of group learning, with students taught largely as individuals
- The industrialization of educational process, which is not necessary a defining feature of distance education, but which is evident in a distance education system.

As computers, telecommunications technology and other electronic media have reduced the constraints imposed by geographic location; increasing numbers of organizations are using information technology to geographically disperse education.

In the available literature, various terminologies are used for distance education. Some of the terms cited by Belanger and Jordan (2000) include; (a) open university, (b) open learning, (c) distance education, (d) distance training, (e) distance learning, (f) virtual learning, (g) virtual universities, (h) computer mediated education, (i) computer assisted instruction, (j)computer mediated training, (k) open learning environments, (l) tele-learning, (m) asynchronous learning networks and finally, (n) web-based instructional systems.

Although American distance education does not have a long history, distance education delivered by a technology is said to have begun in 1980s, when correspondence courses began to be carried out through American higher education institutions (Moore and Kearsley 1996). Since 1980s, new, advances and increasingly affordable telecommunication and information technologies have enabled higher education to be "mass produced". And institutions have been able to network people and remote locations with flexibility (Schweitzer et al 2001). In today's distance education, wide range of technologies is utilized and combined to meet diverse distance education learner's needs.

For institutions to realize the potentials of distance education, they must ensure their stake holder's quality of distance education that includes educational quality equal to main campus offerings, easy access to learning resources and well planned university services (Schweitzer et al 2001). Today, information-and communication-technology driven distance education provides variety of faculty-learner, learner-learner and learner institution interactions. For example wired classrooms may require regular class attendance at work or at home and create a similar college course experience for all students.

2.5 A SYSTEMS APPROACH AS A CONCEPTUAL TOOL

A systems approach is a helpful conceptual tool for understanding and analyzing any distance education. Kaye (1981) presented three main key features involved in any distance education system. These are

- Target groups and their key characteristics
- Learning material and teaching methods
- Logistical and economic features

In a distance education system, two sets of operating subsystems can be distinguished: course subsystem and student subsystem. The course subsystem is concerned with the design, production and distribution and reception of teaching materials. The student subsystem involves the management and control of student's progress through the program and includes student's concern such as registration, tutorials, fees, course material, certification and maintenance of students records (Kaye 1981). Degrees of organizational complexities, however differs according to how the two subsystems-courses and students- interact with each other. Accordingly, understanding the factors involved in distance education may help an institution make effective decisions appropriate to the whole context.

2.6 DISTANCE LEARNER'S SATISFACTION

Student's satisfaction is a significant intermediate outcome goal connected to the ultimate program goals such as student's performance and achievements (Schweitzer et al 2001). Because achieving higher student's satisfaction is expected to produce higher levels of student's motivation, greater commitment to the program, and to result in better retention of knowledge (Biner, Dean and Mellinger 1994). According to Schweitzer and colleagues (2001), Students, who are satisfied with distance education, are more likely to produce better learning, higher achievements and successful program completion to enroll in other higher courses/programs.

Several specific factors affect distance learner satisfaction and these can be grouped into two categories: those associated with instruction and those related to students services.

Satisfaction with instruction is related to: 1) instructor's teaching ability relevant to delivery mode; 2) Access to the instructor. Learner's satisfaction tends to increase, when the instructor manages the electronic class procedure well (Biner et al, 1994), and when they feel they are provided with adequate opportunities of access to the instructor outside of the class room (Biner et al, 1994), as well as inside the class (Cyris 1997), and when the instructor provides constant feedback about their improvement (Pierre & Oslen 1991).

2.7 DELIVERY MODES OF DISTANCE EDUCATION

As computers, telecommunications technology and other electronic media have reduced the constraints imposed by geographic location; increasing numbers of organizations are using information technology to geographically disperse education. The advancement of technology has impacted the progress of distance education. As costs decrease and the convenience of technologies improve, the technology-using population continues to broaden, and the flexibility of delivery continues to grow. In particular, the popularization of computers and of high-speed internet connection contributes to the breaking down the constraints of time and space in education (Howell et al 2003).

In distance education programs, one or more communication technologies have been used to mediate instruction. The most commonly used media include correspondence courses,

telecourses, teleconferencing, computer-based courses and web-based courses. Employing the advantages of various kinds of technologies, varieties of hybrid teaching approaches are emerging (Martyn 2003). In this way, various kind of technology mediated distance education may affect a variety of faculty-learner, learner-learner and learner-institution interactions.

2.8 TYPES OF DISTANCE EDUCATION

Distance education is not a new strategy to the field of education. Correspondence education was the earliest form of distance education. It began as a tutorial program in the mail and evolved into university-administered correspondence and extension programs. These programs relied heavily upon print media to deliver instruction. By 1959, some 2 million Americans were using correspondence education (Sherow & Wedemeyer 1990).

Twentieth century developments in technology from the advent of radio and video communications led to more sophisticated methods for the delivery of correspondence courses (Holmberg 1995). As a result, distance education was used to describe correspondence education now utilizing the technology in the delivery instruction (Moore, 1990). Audio and video allowed for non-interactive, one-way interactive and two-way interactive delivery of courses. Non-interactive courses were delivered via audio tapes or video tapes and did not allow for any exchange of material during instructional event. One-way courses could be delivered via audio and video tapes where the participants at the origination site could hear but could not see the distant participants. Two-way interactive courses were delivered through satellite or high-speed interactive video- networks. These courses were considered two-way interactive because the

student and instructor could both hear and see each other and exchange information in real time during the class room session (Sherow & Wedemeyer 1990). One- way and two-way interactive video comprise about the 80% of distance education courses in higher education (cotton as cited in Collis 1996, p.346).

The success of distance education delivery lies in understanding the individual participants and their different needs for instructional delivery. This understanding can lead to better design, delivery and services offered to meet the needs of distance learners. Distance education can enable students to participate in the educational training programs, courses and workshops who otherwise might not be able to do so because or either their geographical or temporal factors. Potential students in rural areas may have great difficulty reaching centers of learning on a regular basis.

To simplify classification of distance education further, there are two methods. **Synchronous** and **Asynchronous** distance learning. **Asynchronous Distance Learning** is any learning event where interaction is delayed over time. This allows learners to participate according to their schedule, and be geographically separate from the instructor and could be in the form of a correspondence course or web-based or e-learning. Interaction can take use various technologies like threaded discussion. **Synchronous distance learning** is defined as interaction at a distance that happens at the same time. New technologies such as two-way audio and video interactive television provide new media of instruction in which the atmosphere resembles traditional class-room or face-to-face (F2F) interaction. TV monitors along with microphones, video cameras, VCR, and computerized graphics forms the elements of this innovative medium

(Seibert 2004). One-way audio and video constitute another form of synchronous interaction. In this form, students and instructors can see each other and remote site, can hear the instructor, however, students at remote sites can only communicate through telephone or fax.

The most recent and growing development in distance education since 1980 was two-way interactive video delivered through high-speed internet. For the purpose of this study, we have focused one of the synchronous distance learning methods, **Video-Tele Conferencing (VTC)** which uses telemedicine technology for delivering programs over a geographic distance and provide visual connections to students.

2.8.1 Video-Teleconferencing (VTC)

VTC due to its two way synchronous communication, is also called "remote classroom" since it closely replicates, traditional, lecture based classroom environment. Students can see there instructors and their remote classmates and experience a feeling of interaction. The interaction occurs during the instructional event between the instructor ad participants at the origination or remote site. The teaching faculty has the ability to observe students' facial expressions and body language for signs of understanding, enthusiasm, confusion, or frustration. However, participants and facilitator quickly come to realize that VTC is still a remote learning environment with technology shaping the interface between faculty and participants.

There are three delivery methods of VTC instruction; coaxial cable, microwave and fibro-optic lines. Currently microwave and coaxial cable are most frequently used (Havice & Knowles 1995). The VTC models usually rely heavily on video based lectures that are live

(Synchronous). There is usually some means for the teacher to request feedback from students. Students often travel to particular place in order to view the lectures in a group. The principal motivator of this type of learning is to capitalize on a limited expertise in a specific field that might be concentrated in a particular location (at a particular place in traditional class-room form). For the purpose of this study, we will use face-to-face (F2F) terminology for traditional class-room method.

2.9 STUDY RESEARCH QUESTIONS AND HYPOTHESIS

Research Questions

1. *What is the effectiveness in terms of knowledge gain from the epidemiologic research training workshop offered to participants by F2F and VTC methods in Pakistan?*
2. *What is the effectiveness of long-term retention of knowledge gained from the workshop in both F2F and VTC groups?*
3. *What is the impact of the workshop on students' future career goals in both F2F and VTC groups?*
4. *What is the cost-effectiveness of VTC relative to F2F instruction?*

Hypotheses

1. *There is no difference in the knowledge gain in students attending the research training workshop via F2F and VTC methods*

2. *The level of knowledge gained is not maintained after 1-year of delivery of the workshop in both F2F and VTC groups*
3. *The workshop did not provide a stimulus to students in both F2F and VTC group to pursue further training in research and public health*

3.0 STUDY METHODS

Design: Prospective Cohort study

3.1 STUDY SAMPLE

All participants for the epidemiology research training workshop were post graduate doctors. Post graduate doctors in Pakistan are defined as those doctors who after 12-14 years of secondary level education have completed:

(a) Five years of bachelor training in medicine and obtained a degree of MBBS (Bachelor of Medicine and Bachelor of Surgery) or equivalent, and

(b) Completed one year of compulsory internship in medical or surgical specialty, and

(c) Have either completed residency (3-5 years) in a specialized field or about to complete.

Preference was given to those participants who have had some previous research experience and were less than 40 years of age.

3.2 INCLUSION CRITERIA (F2F)

- All post-graduate students and faculty who have received some kind of prior research training, like a diploma in public health, Masters in epidemiology or equivalent, or have attended courses/ workshops in research methods
- Are interested in pursuing research as their future career.
- Are interested in conducting research studies
- Are interested in publishing papers in national and international journals

3.3 STUDY SAMPLE

3.3.1 Selection of Participants for F2F group

After the organizing committee finalized the workshop program, the chair of the committee circulated workshop invitation letters to all medical institutes within Pakistan and in several of South Asian Countries (India, Nepal, Bangladesh & Sri Lanka), inviting participation in the workshop. The eligibility criteria were very clearly specified. Registration forms were made available on the website (www.aku.edu) with workshop program details (Appendix B). A total of 130 applications and registration forms were received from Pakistan and 8 from Bangladesh. All registrations were sent to the organizers at the University of Pittsburgh for selection of 40 eligible candidates. Three of the five faculty reviewed the forms for candidates' selection. Keeping in mind participants previous research experience and interest in future research, a total of 40 were selected, 36 from Pakistan and 4 from Bangladesh. Importance was given to have representation from all four provinces of Pakistan and to keep balance between

government and private institutes for homogenous participation. 10 other participants were short listed in case if there were any drop outs.

The F2F method of teaching took place at the Aga Khan University (AKU). The selected participants were post-graduate health care professionals with majority specialized in cardiology and others have related medical specialty degrees. From the educational point of view, homogenous sample of participants with similar or equivalent qualifications from all over Pakistan were selected, so that academic level can be maintained. This population was heterogonous with respect to geographical location within Pakistan and was representative of many medical institutes from all over Pakistan. The four participants selected from Bangladesh were cardiologists, two from government and two from private institutes.

3.3.2 Selection of Participants for VTC group

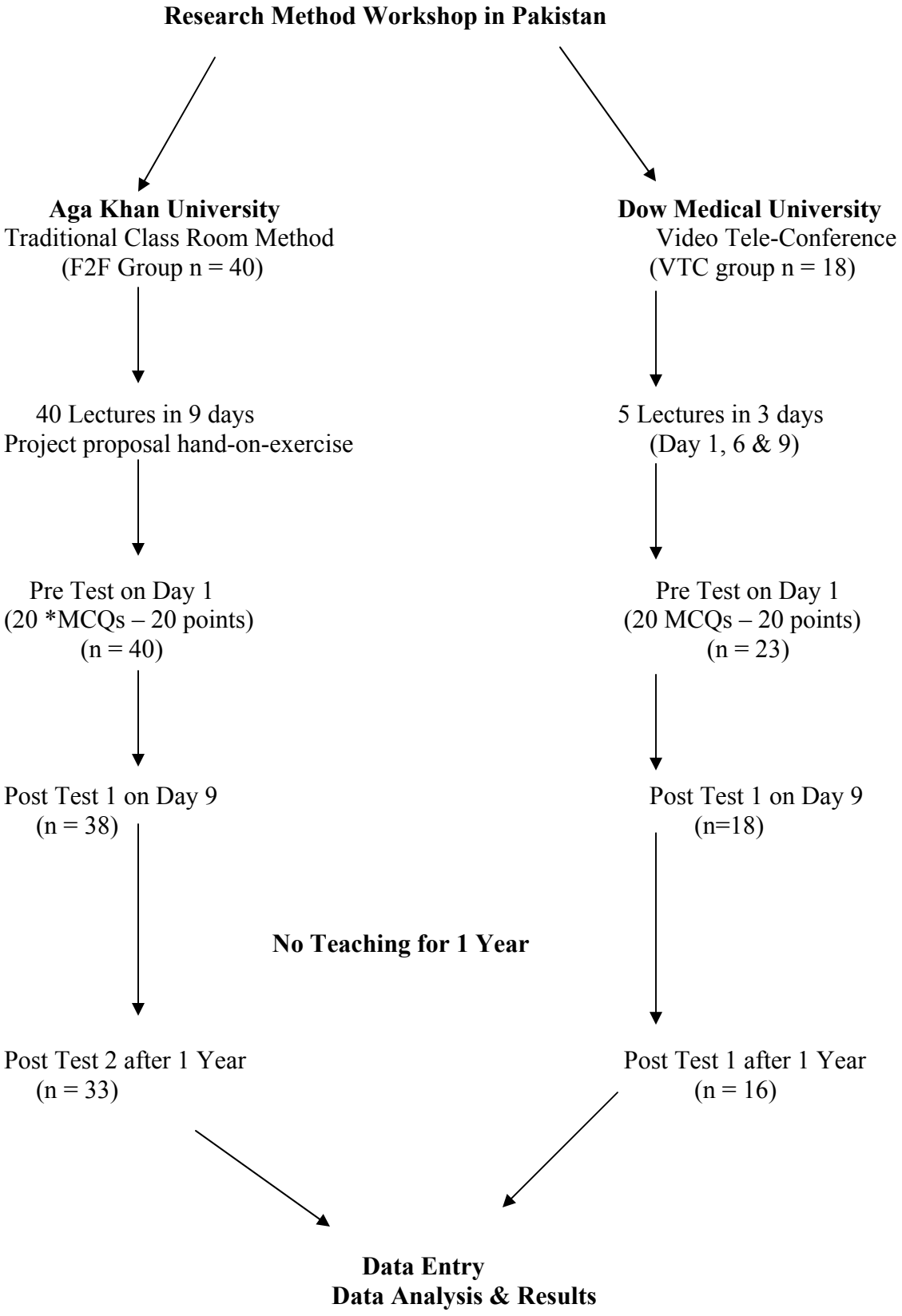
Keeping in mind the availability of VTC facilities, two medical institutions within Pakistan were chosen for broadcasting workshop lectures using VTC; Dow University of Health Sciences (DUHS) in Karachi (a metropolitan city) and Khyber Medical College (KMC) in Peshawar (semi-urban city). The institutional chancellors were contacted for consent. After the consent, VTC arrangements were made in the auditorium room of each institute to conduct VTC lectures. One faculty from each institute was appointed to help the organizing team in arranging activities and supervising the broadcast of the workshop lectures. In addition, selected faculty

maintained participants' attendance every day and distributed pre-test and post test questionnaires before and after the end of the workshop respectively.

With the help of University dean, information was circulated to all university departments about the VTC of workshop lectures. To increase workshop participation, special letters to departmental chairs and heads were also sent. University dean also wrote individual letters to university faculty who had research positions and were interested in learning further epidemiology research skills. VTC flyers were posted as "special announcement" on university notice boards

VTC sessions were carried out in both the institutes concurrently at the same time as the F2F group i.e. a lecture delivered at AKU with F2F group was also telecast through VTC on the same date and time in both the institutes (synchronous distance education). Because of the technical problems and high cost, five basic lectures; one each from epidemiology, biostatistics, international health, molecular epidemiology and cardio-vascular diseases (CVD) epidemiology were telecast on day 1, 6 & 9 of the workshop. Selection of lectures for VTC telecast was made by faculty from the University of Pittsburgh.

A flow-chart of the study design is shown in figure 2.



*MCQs= multiple choice questions

Figure 2. Flowchart of Workshop for F2F and VTC group

3.4 EPIDEMIOLOGY RESEARCH METHOD WORKSHOP: COURSE CONTENT

Faculty from the University of Pittsburgh were the main teaching facilitators of the workshop with some invited speakers from Sri Lanka and India. The facilitators developed a 9 days Research Method course. The course content was as follows:

- Basic Epidemiology (1-hr lecture/ day) total of 9 lectures
- Basic Biostatistics (1-hr lecture/ day) total of 9 lectures
- Genetic Epidemiology (1-hr lecture/ day) total of 9 lectures
- International Health (1-hr lecture/ day) total of 9 lectures
- CVD Epidemiology (1-hr lecture/ day) total of 3 lectures
- Lecture on Medical Ethics (1-hr lecture/ day) total of 1 lecture

The workshop course content was divided into two parts; Part A for teaching the basics of various research methods lectures; and part B for individual proposal writing exercises. The first half of a day focused on teaching the basic theory of epidemiology, biostatistics, molecular epidemiology, CVD epidemiology and international health (Appendix B). In the later half, small groups were made of 8-9 students/ two facilitators for teaching practical skills needed for designing individual study projects. Participants applied the knowledge and skills taught in the lectures to develop individual study proposals. During the sessions, facilitators provided input on the individual projects with respect to study designs, selections of study sample, methods of data analysis etc. Depending upon the participant's needs, additional information was also given on statistical analysis, critical appraisal of scientific research and design.

3.5 KNOWLEDGE TESTING

3.5.1 Pre-Test Questionnaire

Prior to the course, the participants in both F2F and VTC were briefed about the pre-test questionnaire (Appendix C). The questionnaire was an objective method of testing knowledge, consisting of 20 multiple-choice questions to evaluate the students' knowledge on research methods before the workshop. Each core question was followed by five statements, only one of which was correct in regard to the core question. Correct answer had a value of 1 point; the student could gain maximum 20 points. The tested material in all was classified as “knowledge“. The questions focused on theoretical knowledge of research methods which was taught in the workshop and were not on any particular research paper. The time to complete the questionnaire was 20 minutes. The students were not given feedback about the scores until the whole study was completed.

All test questions were prepared by the workshop facilitators on topics that would be taught to both the F2F as well as VTC groups. The five basic lectures on epidemiology, molecular epidemiology, international health and CVD epidemiology were broadcast using VTC to two remote institutions. Pre-test questionnaire were administered to all students (F2F and VTC) on the first day before the start of the course. All questionnaires were reviewed manually by the principal investigator and the data was entered into a database for statistical analysis.

3.5.2 Post Test 1

This was administered on the last day of the workshop i.e. 9th day in the similar fashion as that of pre-test questionnaire. The content of post-test1 was same as that of pre-test questionnaire. All participants completed post-test 1 questionnaire within 20 minutes. Again, post test-1 scores were manually reviewed by the principal investigator and the data were entered into a database for statistical analysis.

3.6 LONG TERM EFFECTIVENESS OF THE WORKSHOP (AFTER ONE YEAR)

Long term effectiveness of the workshop has been assessed by assessment of knowledge retained after 1- year of the workshop (**post-test 2 questionnaires**)

3.6.1 Assessment of Knowledge Retention

After 1-year of the workshop, post-test 2 questionnaires were given to all students (F2F and VTC groups) who attended the workshop. The content of the post-test 2 questionnaire was same as that of pre-test & post-test1. The workshop participants did not have prior information about the post-test 2. All participants were contacted through phone calls, emails, postal mails and were asked to complete the questionnaire questionnaires.

3.7 FOLLOW-UP OF STUDY PARTICIAPNTS IN BOTH GROUPS

All participants in F2f and VTC groups were initially contacted through email. Only 4 in F2F group responded to emails. Principal investigators sent post-test2 questionnaires as an email attachment with instruction to complete the forms within 20 minute without consulting any book. The remaining participants were contacted through phone contacts (5) and by visiting their home and post-test2 were filled over the phone and in –person respectively within 20 minutes. A total of 33 participants were reached out of 38.

In VTC, no participant was reached through emails or phone contacts, therefore, home visits were made and 16 out of 18 participants were contacted and post-test2 forms were completed within 20 mins.

3.8 IMPACT OF WORKSHOP ON STUDENTS' FUTURE CAREER GOALS

To assess how this workshop helped the participants to develop further interest in research and public heath, and to demonstrate how they continue to pursue further research training, following indicators were developed and information was obtained.

1. How many papers have you written/ submitted / published in the last one year before the workshop?
2. How many papers have you written/ submitted / published after one year of the workshop
3. Are you currently enrolled in any research degree program? Yes/No
4. If yes, what kind of degree program?
5. Are you planning to enroll in any degree program Yes/ No

6. Have you participated in any research course/s after the workshop Yes/ No
7. If yes, which course/s?
8. Have you started any research project/s Yes/No
9. If yes, of what type?

3.9 COMPLETED QUESTIONAIRES

3.9.1 F2F Group (Face to Face Class room Method)

All the 40 participants attended the workshop and completed pre-test questionnaires. However, two of the participants left on the 9th day without completing post-test1 questionnaire. Therefore 38 completed pretest and post-test 1 were obtained. Similarly, after 1-year of the workshop, 33 out of 40 participants were followed and completed post-test 2 forms.

3.9.2 VTC Group

Dow University of Health Sciences (Institution 1)

An approximate 50-70 participants were expected to attend the workshop lectures through VTC during three days, however numbers varied on all three days. On the first day, 27 participants attended lecture 1 & 2, and 21 completed pre-test questionnaires. On the second day, 20 attended lecture 3 and on the last day, 26 attended lecture 4 & 5 and completed post-test 1 questionnaire. However, only 18 participants completed both pre & post-test 1 questionnaire which we included in the study for VTC group. After 1-year, participants were contacted through emails and phone contacts, and no participant was approached. We had major problem in

following these participants and at last, home visits were made and 16 out of 18 forms were completed.

Khyber Medical College (Institution 2)

The auditorium was booked for VTC expected 50-70 participants to attend the lectures on three days. The attendance on the first, second and third day was 32, 20 and 26 respectively. A total of 26 participants completed pretest and post-test 1 questionnaire. However, due to miscommunications between workshop facilitators and institutional supervisors, this activity was assumed to be a self learning exercise and all the questionnaires were returned to participants. This resulted in corrupted data which was hence not included in the study.

3.9.3 Cost Effectiveness Analysis

Cost-effectiveness analysis is a type of cost analysis that relates costs and effects, the resulting ratio is used to compare alternatives for accomplishing the same objectives.

3.9.4 Cost Effectiveness Ratio

Δ Costs / Δ effect gained = [($\sum$cost F2F/ number of students) - ($\sum$ VTC cost / number of students)] / [($\sum$ effect F2F / number of students) - ($\sum$ effect VTC / number of students)]

$\sum$ effect F2F = mean scores gained (post-test1- pretest)

$\sum$ effect VTC = mean scores gained (post-test1- pretest)

This will give incremental cost per score gained

The purpose is to provide "a method of choosing among alternatives in order to select those that are able to accomplish a given result most parsimoniously (Levin 2000).

Understanding the relationship between costs and effects is essential, especially from the developing countries point of view, if investments are to be maximized. Benefits of such an approach could include cost reduction while keeping quality constant, or expansion of existing systems and / or quality improvements, while keeping cost constant.

Two types of cost studies are usually conducted with regard to distance education. One type compares distance education with traditional class-room based education. The other examines the effects of individual media and technologies on distance education program costs. Distance education is generally reported to demonstrate distinct cost structures compared with classroom based education. Particularly with regard to the proportion of cost identified as either fixed or variable and / or investment or recurrent. Fixed costs are not dependent on the scale of the program, and variable costs are directly related to the unit of analysis e.g. students served and courses offered. Investment costs like capital costs are goods and services with an expected life of more than a year. Capital costs are annualized to determine the cost per year. Recurrent costs refer to goods and services consumed immediately such as labor cost of a teacher each time he or she teaches a course, cost of electricity consumed etc.

When compared with traditional class-room education, distance education courses typically have higher fixed costs and higher investment costs, although this generalization masks differences apparent across types of distance education programs.

The cost structure of VTC typically mimics the cost structure of traditional class room. Class room based education has relatively low development cost, which include most notably

some amount of teacher's time and office facilities. These costs are fixed regardless of class size. The bulk of costs are found in the "dissemination phase" including teacher's salary and classroom space. Given a particular class-size, costs vary with enrollment (Gold 1993). Because most costs vary with enrollment, there is little incentive to increase the enrollment beyond certain limits. Variable cost in the VTC varies according to the number of campuses/institutions/ schools linked upon rather than number of students.

3.9.5 Cost Estimation for Both Groups (F2F and VTC)

The method which will be used here for estimating and analyzing costs between F2F and VTC methods is called the ingredient approach (Levin 1999 & Routh 2004). This approach, as outlined by Levin and McEvan (2001) is used to determine the principle elements of cost analysis focusing on direct and indirect costs for course production and course dissemination for each of the two methods. The ingredients approach to cost estimation entails three distinct phases.

1. Identification of ingredients
2. Determination of the value or cost of estimation
3. Analysis of the costs

3.9.6 Identification of ingredients

Ingredients are the inputs in the program including all of the resources to run and develop the program or a course. The first step in cost analysis is to organize ingredient list into a "resource list" of relevant expense categories. List should include all of the resources required to

develop and conduct a workshop/ course/ program. Direct costs are further subdivided into three categories a) staff, b) facilities & c) equipments.

3.9.7 Determination of Cost for both the Methods

For the study, list of all ingredients for cost estimation in F2F and VTC groups is given in Appendix D.

3.10 SAMPLE SIE AND POWER CALCULATIONS

For this study, we already knew the sample size of both F2F (38 participants) as well as VTC group (18 participants). We have calculated the mean change in scores (post-test1-pretest) for both the groups.

For F2F group:

Using the equation of paired T-test

$n = \sigma^2 [(Z_{1-ß} + Z_{1-\text{alpha}/2})^2] / (U1-U2)^2$

Re-arranging the equation for U1-U2

$U_1 – U_2 = \sigma (Z_{1-ß} + Z_{1-\text{alpha}/2}) / \sqrt{n}$

Where,

U1= mean test scores of post-test 1

U2= mean test scores of pre-test

U2-U1= mean change in scores (Δ in score from post-test1-pretest)

$\hat{\sigma}^2$ = standard deviation of the difference = 1.903 (obtained from pilot data)

Z_{1-B} = 1.282 (power = 90%)

$Z_{1-alpha/2}$ = 1.96 (two-sided alpha of 0.05)

N = 38

U_1- U_2= 1.903(1.282 + 1.96) / √38

U_1-U_2 = 6.1695 / 6.16

U_1-U_2 = 1.001

Δ Score difference of 1.00 was desired to achieve statically significant results.

For VTC group

U_1–U_2 = σ ($Z_{1-ß}$ + $Z_{1-alpha/2}$) / √n

Where,

Z_{1-B} = 1.282 (power = 90%)

$Z_{1-alpha/2}$ = 1.96 (two sided alpha of 0.05)

N = 18

$\hat{\sigma}^2$ = standard deviation of the difference = 1.757 (obtained from pilot data)

U_1- U_2= 1.757 (1.282 + 1.96) /√18

U_1-U_2 = 3.087 (2.927) / 18

U_1-U_2 = 3.087 X 8.567 / 18

U1-U2= 1.34

Δ Score difference of 1.34 was desired to achieve statically significant results.

3.11 DATA ANALYSIS

All the information obtained from participants of both groups (F2F & VTC) was entered into a database. Data were entered and analyzed using SPSS 14.0 (2006 SPSS Inc, Chicago, IL)

Descriptive statistics were obtained using mean ± SD for both the groups. Histograms, kurtosis, skewness and Kolmogorov-Simrnov (K-S) tests were done for assessing normality of the data in both groups. Comparison of baseline variables between the two groups was performed using T-test for continuous and fisher exact test for categorical variables. Rank sum test was done for comparing test scores, number of publications and research related variables in two groups. We used the mean difference (Δ d) in scores (∑post-test score –∑ pretest score) as an end points for testing the hypothesis. Paired sample t-test was performed within each group for statistical difference (Δd) in mean scores for both short term (∑ post-test 1–∑ pretest) and long-term (∑post-test2 – ∑pre-test) knowledge gained from the workshop. Independent sample-test was done for test scores comparison between F2F and VTC groups. 95% Confidence Intervals (CI) were also obtained for mean test scores at all three levels (pre-test, post-test1 & post-test2) in bot5h the groups.

Two-way repeated measures ANOVA was done with time (pretest, post-test 1 and post-test2) as "within subject effect" and "groups" as between –subject effect to test whether the changes through time were the same in each group as well as in both the groups. Interaction between time and group was also performed. In addition interaction with other covariates/ predictors was also assessed. The following variables were adjusted in repeated measure

ANOVA analysis; age, gender, type of institute, type of job, educational level, previous research experience and current enrollment in research training program.

The test scores were obtained from pre-test (first day of the workshop), post-test1 (9^{th} day of the workshop) and post-test2 (after 1-year of the workshop) questionnaires. There were total of 20 multiple-choice questions in each questionnaire and the correct answer carried a value of 1 point. The student could gain maximum 20 points (Appendix C).

The cost-effectiveness analysis was centered on the cost-effectiveness (CE) ratio. This is the ratio of incremental costs per unit effect gained. For this study, effect is the knowledge gained (in terms of mean scores gained) in short term (∑ post-test1–∑ pretest) and long term (∑ post-test2–∑ pretest). The cost for both methods (VTC and F2F) was obtained using the ingredient method (table1 &2). The analysis was based on the CE ratio given below.

For short term workshop cost- effectiveness

Δ Costs / Δ effect gained = [(∑cost F2F/ number of students) - (∑ VTC cost / number of students)] / [(∑ effect F2F / number of students) - (∑ effect VTC / number of students)]

∑ effect F2F = mean scores gained (post-test1- pretest)

∑ effect VTC = mean scores gained (post-test1- pretest)

This gave incremental cost per score gained

For long-term workshop cost effectiveness

Δ Costs / Δ effect gained = [(∑cost F2F/ number of students) - (∑ VTC cost / number of students)] / [(∑ effect F2F / number of students) - (∑ effect VTC / number of students)]

∑ effect F2F = mean scores gained (post-test2- pretest)

∑ effect VTC = mean scores gained (post-test2- pretest)

This gave incremental cost per score gained

4.0 STUDY RESULTS

The total study sample included 56 participants (F2F= 38 & VTC = 18) for the short-term workshop assessment. One year after the workshop, information on post-test2 scores were obtained on 33 in F2F and 16 in VTC group (a total sample of 49 participants).

The age distribution of F2F and VTC groups was found to be normally distributed based on histograms (figure 3 & 4), kurtosis, skewness and 1-sample Kolmogorov-Simimov Z test (table 2).

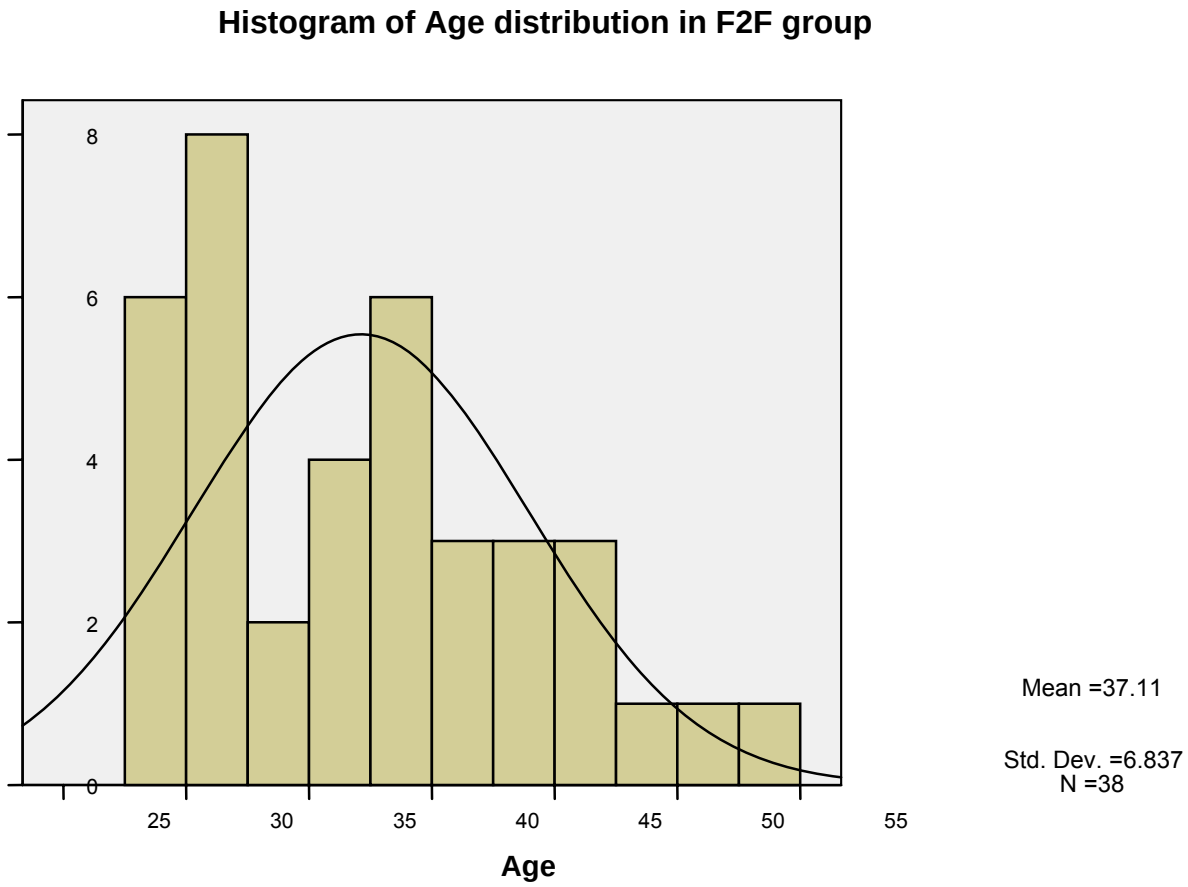


Figure 3. Histogram of Age distribution in F2F group

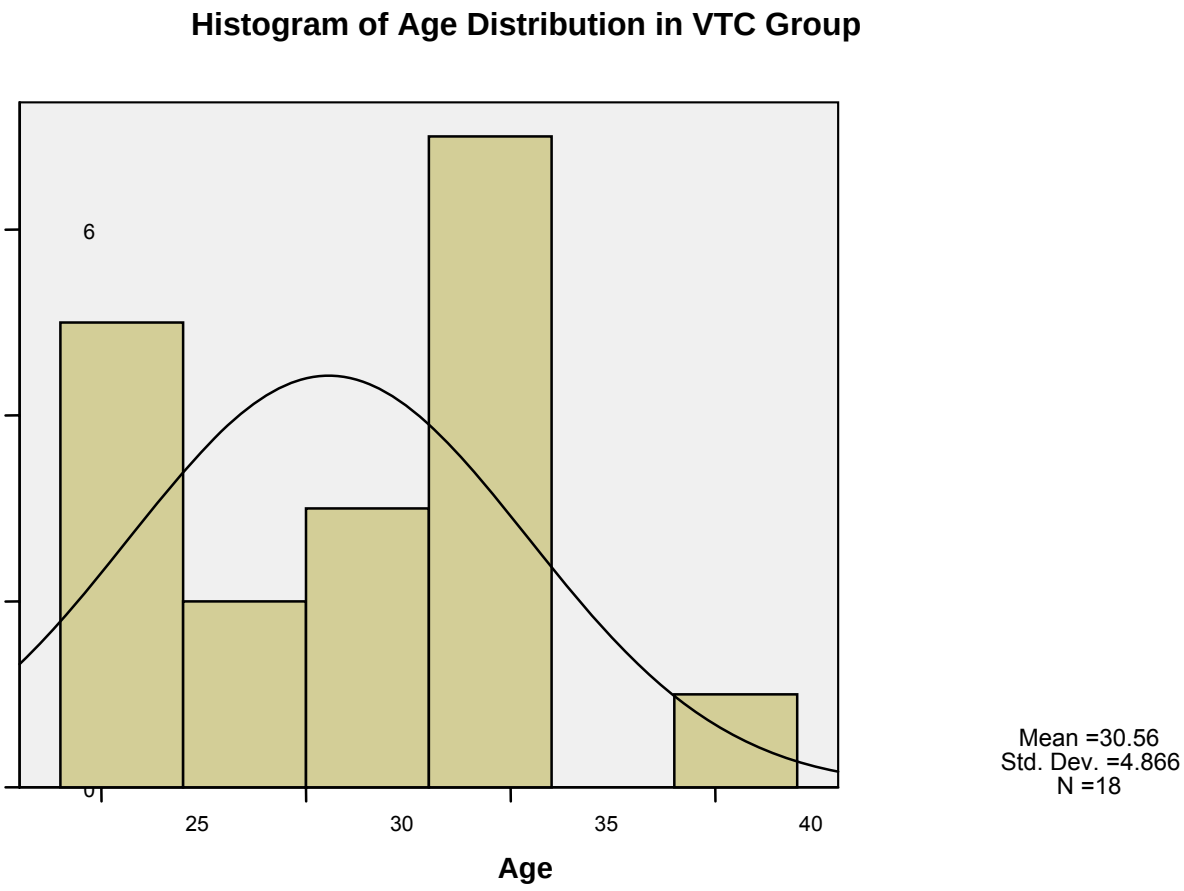


Figure 4. Histogram of Age distribution in VTC group

Table 2. Tests of normality for F2F and VTC group

Test	F2F (n=38)	VTC (n=18)
Skewness	0.652	0.143
Kurtosis	-.232	-0.515
Kolmogorov-Smirnov Z	0.868	0.641
Asymp. Sig. (2-tailed)	0.438	0.806
Exact Sig. (2-tailed)	0.401	0.752

Table 3. Baseline demographic information of F2F and VTC participants

Characteristics	F2F group		VTC group (n=18)		P values(2-sided)
	Count	%	Count	%	
Age	*37.11	**6.83	*30.56	**4.86	†0.001
Gender					
Male	27	71.1	9	50	‡0.146
Female	11	28.9	9	50	
Current job					
(a) research faculty / fellow	8	21.1	7	38.9	‡0.202
(b) clinical faculty / fellow	30	78.9	11	61.1	
Working institute					
Private	17	44.7	0	0	
Government	19	50	18	100	‡<0.001
NGO	2	5.3	0	0	
Level of Education					
MD & research degree	3	7.9	3	16.7	
MBBS plus fellow	12	31.6	6	33.3	
MBBS & research degree	6	15.8	2	11.1	0.435
§MBBS	17	44.7	7	38.9	
Previous research experience					
Yes	33	86.8	18	55.6	‡0.017
No	5	13.2	8	44.8	
Type of research experience					
(a) MS in Epi or MPH	17	39.5	6	14	
(b) workshops/courses/ research projects	8	18.6	2	20	1.00
(c) research projects / publish papers	8	18.6	2	20	
Research training after the workshop	8	24.2	5	31.3	‡0.73
Yes	25	75.8	11	68.8	
No					
Type of research training					
MS in Epi or MPH	3	37.5	1	20	
MS in Health Management	2	25	2	40	
MS in International Health	2	25	2	40	‡1.00
PhD in Epi	1	12.5	0	0	
Future plan					
(a) PhD	3	7.9	0	0	
(b) MPH	0	0	1	5.6	
(c) MS in Epi	1	2.6	0	0	
(d) MS in health management	1	2.6	0	0	
(e) MS in biostatistics	0	0	1	5.6	
(f) research projects	19	50	4	22.1	
(g) publish papers	10	26.3	10	55.6	‡0.015
(h) CVD research	1	2.6	0	0	
(i) develop research unit	3	7.9	0	0	
(j) clinical trials	0	0	2	11.1	

§ MBBS= bachelor of medicine & bachelor of surgery (5 year undergraduate medical training)
* mean ** Std. deviation
† 2-sample T-test with equal variance not assumed ‡ Fisher's exact test

Baseline characteristics of F2F and VTC groups are presented in table 3. The participants in F2F group were older than VTC group (2-sample T-test P value < 0.001). The mean age was 37.11(± 6.83) and 30.56 (± 4.86) in F2F and VTC respectively. However, there was not a significant gender difference between two groups (Fisher's exact test P value= 0.14). Similarly, significant differences were noted between the two groups in the type of institute where participants were working at the time of the workshop (Fisher's exact test P-value < 0.001), previous research experience (Fisher's exact test P-value= 0.017) and future research plans (Fisher's exact test P-value= 0.015) between two groups. We did not find significant difference in the level of education (Fisher's exact test P-value = 0.43) and type of previous research experience (Fisher's exact test P-value = 1.00) in the two groups. One year after the workshop, 8(24%) in F2F and 5(31%) in VTC group were enrolled in research related training programs (table 3) but there was no statistical difference between the two groups (Fisher's exact test P-value =0.73)

It was interesting to see the number of publications in both groups (table 4). The total number of publications by the end of the study period (February 2006) were more in F2F (3.18 ±1.68) group than what was observed in VTC group (1.63±1.25), but was not statistically significant (2-sample T-test P- value= 0.08). When total publications were compared 1-year before and 1-year after the workshop in both groups together, there were 1.14 and 1.06 papers published 1-year before and 1-year after the workshop respectively.

Table 4. Comparison of publications information in F2F and VTC group

Characteristics	F2F (n= 38)		VTC (n = 18)		P value(2-sided)
	Freq	%	Freq	%	
Total Publication till Feb,2006	*3.18	**4.68	*1.63	**1.25	†0.08
Publication 1-year before workshop	1.14[a]				
Yes	24	63.2	9	50	
No	14	36.8	9	50	‡0.394
Number of publications 1-year before the workshop	***1.34**	****1.43**	***0.72**	****0.89**	†0.054
Publication 1-year after workshop¥	1.06[b]				
Yes	19	57.6	12	75	‡0.346
No	14	42.4	4	25	
Number of publications 1-year after the workshop	***1.09**	****1.33**	***1**	****0.81**	†0.803
Net Publication (1year after- 1year before workshop)	*-0.15	**1.30	*0.38	**1.14	† 0.15
-3	1	3	0	0	
-2	4	12.1	1	6.3	
-1	7	21.2	2	12.5	
0	12	36.4	6	37.5	§0.154
1	6	18.2	4	25.0	
2	2	6.1	3	18.8	
3	1	3.0	0	0	

* mean ** Std. deviation ‡fisher's exact test
†2-sample T-test with equal variance not assumed ¥f2f sample is 33 and VTC is 16
§ Two-sample rank-sum test with P- values from exact test
[a] Mean publication 1-year before the workshop in both groups
[b] Mean publication 1-year after the workshop in both groups

We expected to see the workshop result in motivating the participants to publish more papers. However, taking the number of publications as an indicator of the success of the workshop, we were unable to find the supporting evidence.

When total publications 1-year before the workshop were compared between the groups, it was interesting to note that the participants in F2F group had significantly more publications (1.34 ± 1.43) than the VTC group (0.72±0.89; 2-sample T-test P value= 0.054). However, 1-year after the workshop, F2F group published 1.09 (± 1.33) papers as compared to 1.00 (± 0.81) papers in VTC and was not found to be statistically significant (table 4). There were 14(36.8%)

in F2F and 9 (50%) participants in VTC group who had no publication 1-year before the workshop (Fisher's exact test P-value= 0.153) and 14(42.4%) in F2F and 4(25%) in VTC group who had no publications 1-year after the workshop (Fisher's exact test P-value= 0.651). In other words, more participants in VTC group published papers after the workshop than F2F; however figures were not statistically significant.

4.1 TEST SCORES IN F2F AND VTC GROUPS

Figure 5 & 6 are histograms for all test scores in both groups with normal curve showing normal distribution of scores. Table 5 shows the descriptive statistics of test scores in both F2F and VTC groups. The mean pre-test scores (table 5) on day 1 of the workshop were 11.13 ±1.96 in F2F and 10.67 ±2.35in VTC group. After the end of the workshop (9^{th} day), mean post-test1 scores showed improvement in both the groups (15.08±1.75 in F2F Vs 13.122± 1.87 in VTC). Mean scores after 1-year of the workshop (post-test2) were lower than mean post-test1 scores in both groups (13.42±2.61 in F2F Vs 12.31±2.08 in VTC), however, were higher than the baseline pretest scores (table5). When knowledge gained was assessed from the baseline pre-test scores, the workshop was found to be very effective with increase in knowledge up to 36% in F2F and 24% in VTC in short-term evaluation (table 6). Long-term workshop assessment also showed knowledge increase and sustained after one year in both F2F (19%) and VTC (15%).

Table 5. Descriptive statistics of test scores in two groups

Scores	Mean	Std Deviation (SD)	95% Confidence Interval	
			Lower	Upper
Pre test on day 1				
F2F	11.13	1.961	10.56	11.99
VTC	10.67	2.351	9.358	12.02
Post test1 on day 9				
F2F	15.08	1.75	14.41	15.65
VTC	13.22	1.87	12.37	14.38
†Post test2 after a year				
F2F	13.42	2.61	12.49	14.35
VTC	12.31	2.08	11.20	13.42

† F2F had 33 and VTC had 16 participants

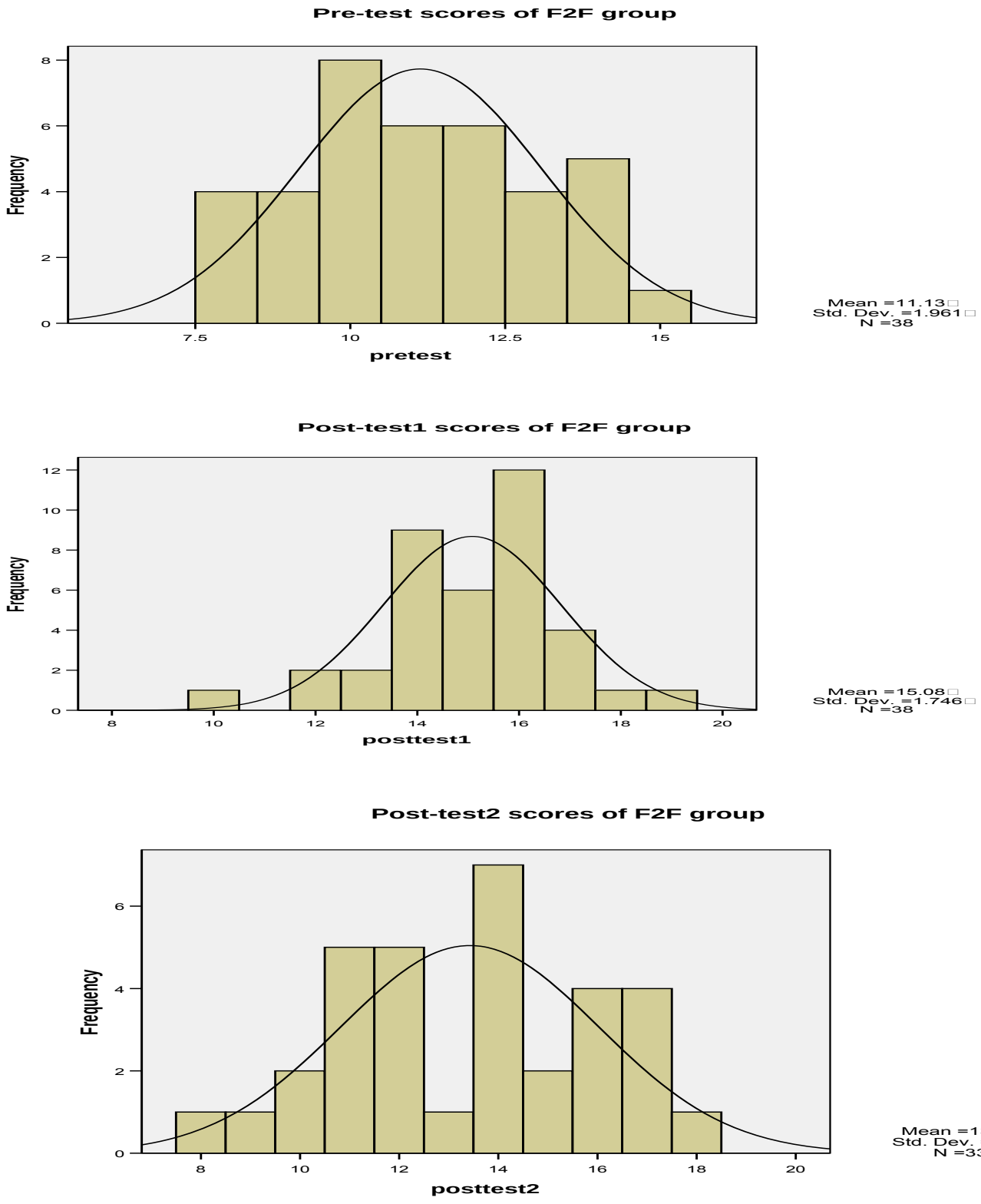


Figure 5. Test scores of F2F group

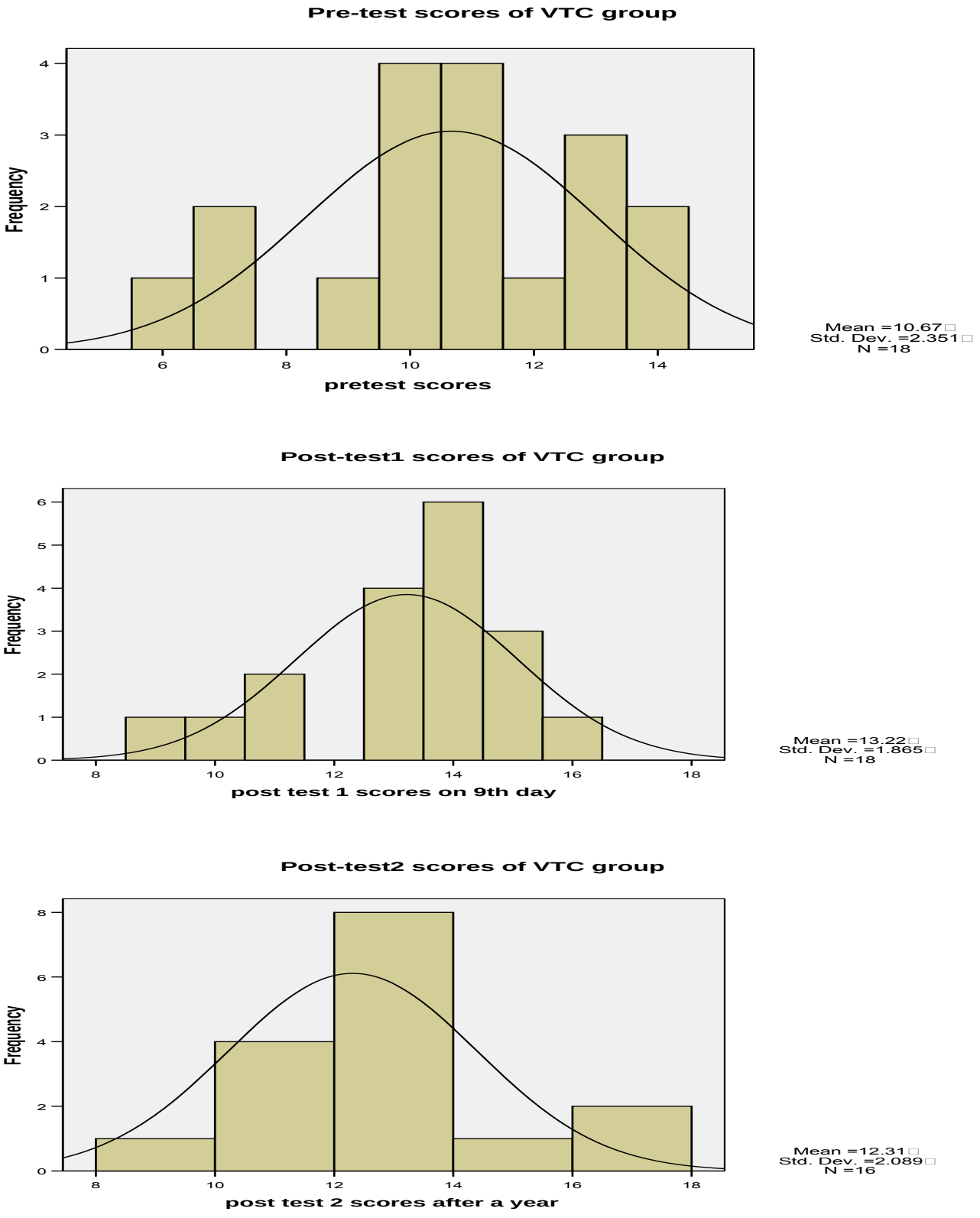


Figure 6. Test scores of VTC group

Table 6. Percent knowledge increase in two groups from pre-test scores

Groups	Post-test1- Pre-test	Post-test2- Pre-test
F2F	35.46 %	19.33 %
VTC	23.95 %	15.22 %

The 95% confidence intervals (CI) for mean scores are shown in figure7. For VTC group, wide 95% CI are seen, attributable to small sample size.

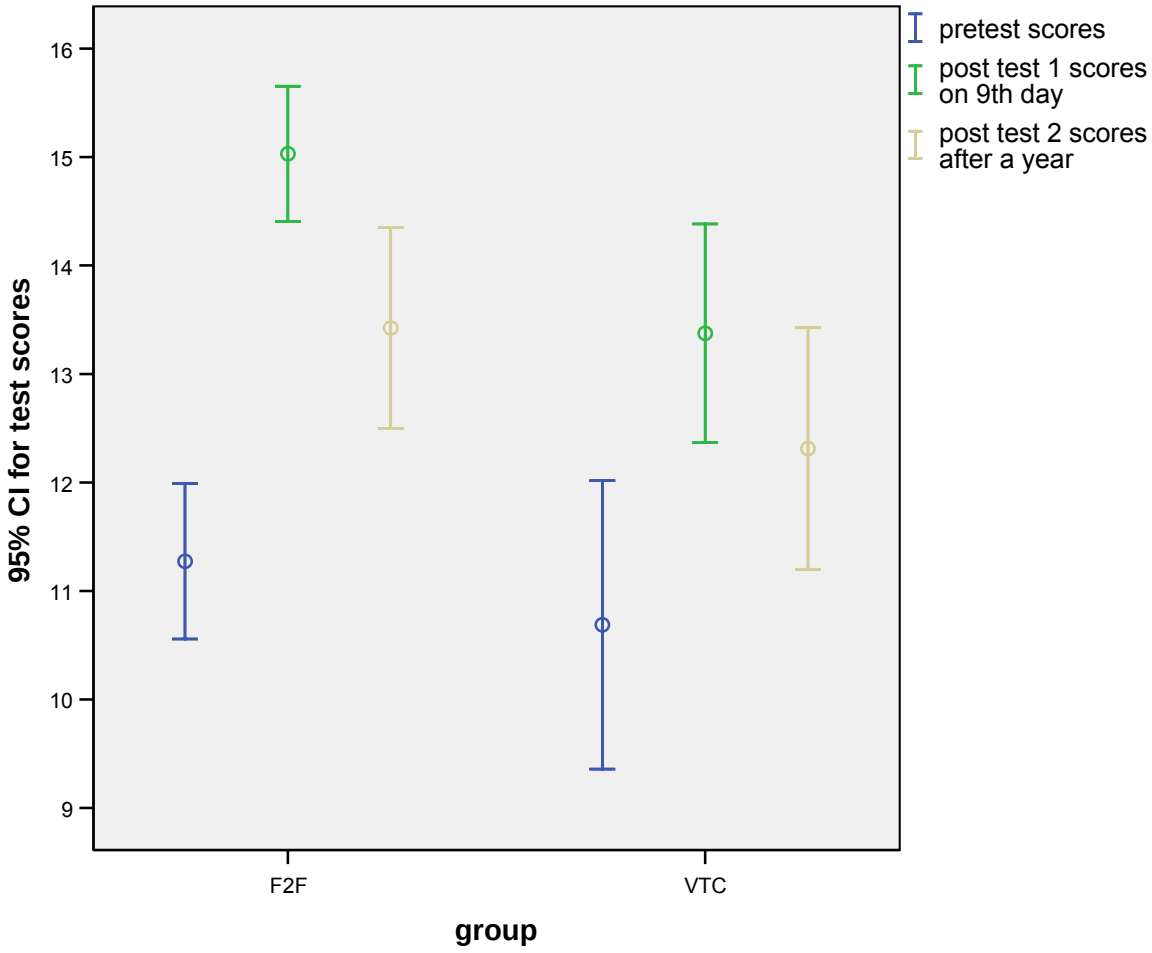


Figure 7. 95% CI of test two groups

When mean scores were compared between the two groups (table 7), the difference in the pre-test scores of the two groups was not statistically significant and were not different (2-sample T-test P-value= 0.47). However, mean post-test1 scores after completion of the workshop on day 9 were significantly improved in both the groups. However the mean post-test1 scores were significantly higher in F2F (15.08 ±1.74) as compare to VTC group (13.22±1.86; 2-sample T test P-value= 0.001). When assessed the long-term effectiveness of the workshop, mean post-test 2 scores obtained after one year of the workshop, were not statistically different between two groups (13.42 ±2.61 Vs 12.31± 2.08). Furthermore, post-test2 scores in both the groups, although were lower than post-test1 scores, but are higher than the pre-test scores. This shows that the workshop was useful in both the groups and knowledge was retained not only short-term but also after one year of the workshop (long-term knowledge retention)

Table 7. Comparison of test scores between F2F and VTC groups

Scores (out of 20 points)	F2F (n=38)		VTC (n=18)		P-value
	Freq	**%**	**Freq**	**%**	
Pre-test (1st day)	*11.13	**1.96	*10.67	**2.35	†0.473
< 10 points	16	42.1	8	44.4	
10-15 points	22	57.9	10	55.6	‡0.625
>16 points	0	0	0	0	
Post-test 1 (9th day)	*15.08	**1.74	13.22	**1.86	†0.001
< 10 points	1	2.6	2	11.1	
10-15 points	19	50	15	83.3	‡0.001
>16 points	18	47.4	1	5.6	
$Post-test 2 (after 1-year)	*13.42	**2.61	*12.31	** 2.08	†0.117
< 10 points	4	12.1	2	12.5	
10-15 points	20	60.6	12	75	‡0.157
>16 points	9	27.3	2	12.5	

* mean ** Std. deviation

‡ fisher's exact test †2-sample T-test with equal variance not assumed

$F2F n=33 & VTC n=16

When scores were compared within each group, the short-term and long-term effect of the in terms of knowledge gained was found statistically significant in both groups (table 8). In F2F, statistically significant difference was seen in mean scores between post-test1 –pretest (3.947±1.88; P<0.001) and post-test2-pretest (2.152±2.30; P<0.001). Similar results were also seen in VTC group (Δpost-test1-pretest of 2.556 ±1.75; P<0.001 & Δpost-test2 – pretest of 1.625 ±2.306; P=0.013).

Table 8. Paired sample T-Test in F2F and VTC groups

Test scores	Mean Δ scores	SD	95% CI levels		P-vale (2-sided)
			Lower	Upper	
F2F group					
Posttest1- pretest	3.947	1.88	3.32	4.56	<0.0001
Posttest 2- pretest	2.152	2.30	1.33	2.96	<0.0001
VTC group					
Posttest1- pretest	2.556	1.75	1.68	3.42	<0.0001
Posttest 2- pretest	1.625	2.30	0.39	2.85	0.013

On one-way repeated measure ANOVA analysis (within each group), there was a significant time effect seen in both groups (table 9 & 10). Both F2F (P<0.001) & VTC (P <0.001) groups showed significant changes in mean test scores with time. The mean test scores followed linear as well as quadratic pattern in both groups. We can conclude that with time changes were seen in test scores at both short-term as well as long-tern workshop effectiveness was concerned with respect to knowledge gain and knowledge sustained.

Table 9. Repeated measure ANOVA for F2F group

Effect (Time)	F	Df	P-value
Maulchy's test for sphericity	*0.824	2	0.05
Within subjects effect	41.494	1.700	*<0.001
Within subjects contrast			
Linear	28.713	1	< 0.001
Quadratic	53.332	1	< 0.001

* Maulchys test for sphericity **Green-house Geisser statistics

Table 10. Repeated measure ANOVA for VTC group

Effect (Time)	F	Df	P-value
Maulchys test for Sphericity	*0.913	2	0.530
Within subjects effect	12.555	2	**<0.001
Within subjects contrast			
Linear	21,125	1	0.013
Quadratic	53.332	1	0.001

* Maulchys test for sphericity **Sphericity assumed statistics

When mean scores were plotted for both the groups (Figure 8), changes in scores with time are seen following a pattern which is same for both the groups. In other words, plots of mean test scores in both groups showed similar trend with both lines parallel to each other.

The results of 2-way repeated measure ANOVA analysis is shown in table 11. Mean score changes (within subject effect) were significant. Both the groups showed significant changes in mean scores over time ($P<0.001$), which was also seen in score plots. However, no interaction was seen between time and groups ($P=0.31$). To explain this further, changes in mean test scores were seen at all levels in both groups with time, changes were not different in two groups. Both the groups followed a similar trend with increasing scores at post-test1 level followed by reduction in scores at post-test 2 after 1-year of the workshop. This is also depicted

in plots where both line followed an upward slop with highest scores on the 9th day of the workshop and than scores showed a downward trend in scores with time in both the groups (figure9). The between subject-effect showed that group was a significant factor (p=0.013) and mean test scores lines are not close to each other (figure 8).

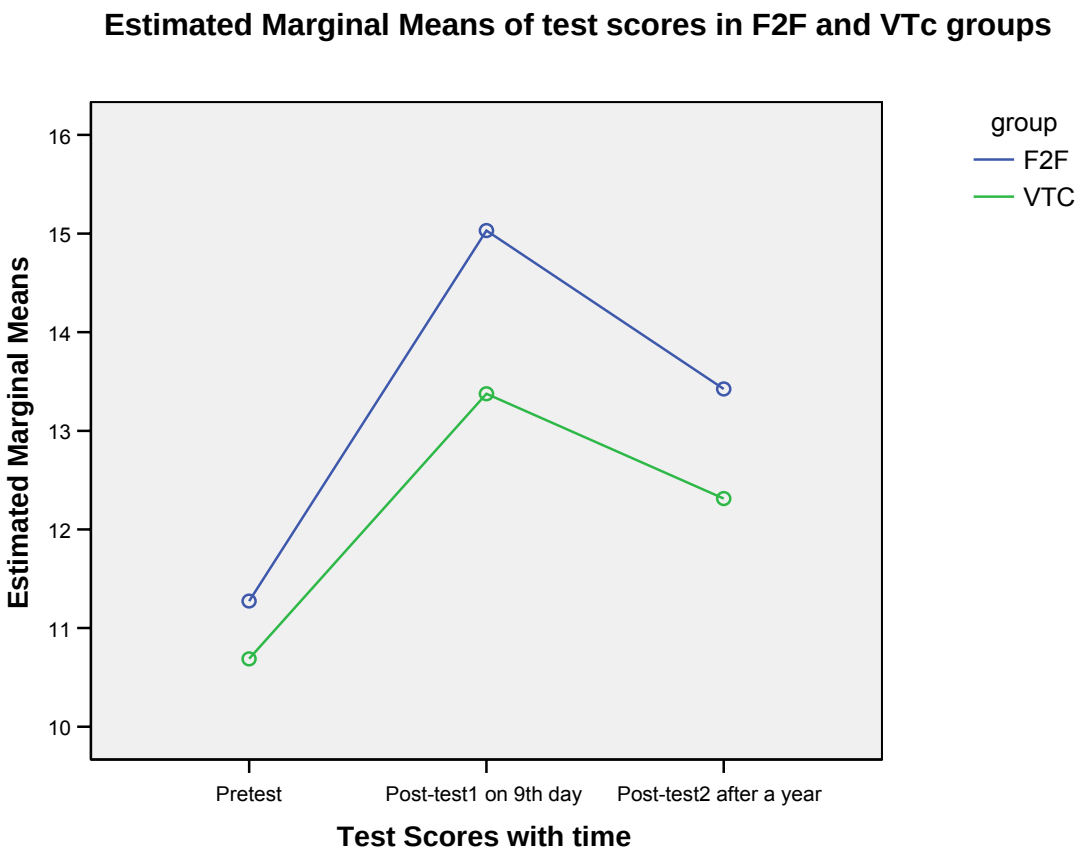


Figure 8. Test scores plots for F2F and VTC

Table 11. 2-way Repeated measure ANOVA between F2F& VTC

Effect (Time)	F	Df	P-value
Maulchy's test for sphericity	*0.861	2	0.032
Within subjects effect			
Time	42.272	1.75	<0.001
Time*group	42.272	1.75	0.318
Within subjects contrast			
Time			
Linear	28.893	1	<0.001
Quadratic	56.039	1	<0.001
Time*group			
Linear	0.562	1	0.457
Quadratic	1.757	1	0.191
Between subjects effect			
Intercept	2384.084	1	<0.001
Group	4.626	1	0.037

* Maulchys test for sphericity **Green-house Geisser statistics

To adjust the effects of covariates on time , we performed univariate repeated measure analysis (table12). Owing to the small sample size and loss of power, multi-variate analysis was not done and each covariate was entered into the model one at a time. We found three-way interactions between time*job type*group (P=0.02) and time* education level*group (P=0.02). In addition interaction was also seen between time* type of institute (P=0.01). We can conclude that time*group interactions differ according to the job type of participants as well with the level of education of participants in both the groups. Moreover, mean test scores with time also differ with the type of institute to which participants belonged at the time of the workshop (government, private or NGO). Age , gender, previous research experience and further research training after the workshop did not have any effect on scores in two groups and were not found to be confounders.

Table 12. Adjusted 2-way repeated measure ANOVA between two groups.

Effect (Time)	Within subjects effect			Between subjects effect		
	F	Df	P-value	F	Df	P-value
Age						
Time*Age	1.154	30	0.34			
Time*Group*Age						
Group*Age‡						
Sex						
Time*sex	*1.381	2	0.257			
Time*sex*group	*0.467	2	0.628			
Group*sex‡				0.124	1	0.726
Type of job						
Time *job type	†1.292	2	0.280			
Time *job type*group	†4.00	2	0.022			
				0.523	1	0.473
Group*job type						
Type of institute						
Time *institute type	*3.118	4	0.019			
Group* institute type‡						
Level of education						
Time *education	†0.484	2	0.618			
Time*group*education	†4.089	2	0.020			
Group *education				1.260	1	0.268
Previous Research Exp						
Time*ReshExp	†1.193	2	0.308			
Time*ReshExp*group	†1.443	2	0.242			
Group*ReshExp				0.571	1	0.454
Research program enroll						
Time*Reshprog	*0.032	2	0.968			
Time*Reshprog*group	*2.916	2	0.059			
Group*Reshprog				0.190	1	0.665

*Green-house Geisser statistics are used as Maulchys test for sphericity is significant
† Sphericity assumed statistics used as Maulchys test for sphericity was not significant
‡ not enough power to conduct analysis

4.2 COST EFFECTIVENESS ANALYSIS BETWEEN TWO GROUPS

The total institutional costs for F2F and VTC groups are given in Table 13 & 14. When main cost ingredients were compared between the two groups, the workshop development cost

was found to be higher in F2F group as compared to VTC. However, the workshop dissemination cost was higher in VTC group compared to F2F.

Table 13. Costs estimates of research method course for F2F group (n= 40)

Cost category	Item Description	total cost/day	cost/9 days	cost/stud/day
Development cost		In US$	In US $	In US $
Faculty salary (5)	Faculty time/ day including lecture preparation cost	120 X 5= 600	5,400	15
Facilities	*Faculty offices (5)	27.27	245.43	0.68
Equipment				
Furniture	With office cost	-	-	
**Computers	8 for faculty and participants	9.69	87.2	0.24
Internet connection	(2 DSL)	6.5	58.5	0.16
Office supplies		8.08	72.72	0.20
Total Development cost		**651.54**	**5863.85**	**16.28**
Dissemination Cost				
Teaching	1-2 lecture /day	95 X 5=475	4,275	11.8
Local faculty & staff salary	2 co-facilitators	18X2=36	324	0.90
	4 staff	19.39	174.5	0.48
Facilities	Classroom space			
Equipment				
Multi-media, screen & projectors	2 each	12.12	109	0.673
Classrooms	5	27.27	245.43	0.68
Video recorder and related equipments	1	30	270	0.75
Total Dissemination Cost		**599.78**	**5398.00**	**14.99**
Other related cost				
Travel from Pittsburgh-Karachi and return (business class)	5 faculty	2600X 5=13,000	13,000	
Lodging	5 faculty	200	1800	5
Food		35	315	0.87
Total other related cost		**13,235**	**15,115**	**330.87**
Total institutional cost per course		**14,486.32**	**26,376.85**	**362.158**

* Cost is estimated on the basis of rent / day (exchange currency rate 1 US$ = 60 Pak Rupee)

** Computers cost is based rent of 8 computers/ day

Table 14. Cost estimation for VTC at two institutes for 3 days teaching course (n=18)

Cost category	Item Description	cost/ day	cost per 3 days	cost/day/student
Development cost		In US $	In US $	In US $
Faculty salary (5)	Teaching cost/day including lecture preparation cost	120 X 5= 600	1,800	55
Supervisor	Manager (1)	6.06	18.18	0.336
Technical support	1	3.63	10.8	0.202
Instructional staff	1	3.63	10.8	0.202
Telecom personnel	1	4.85	14.5	0.269
*Conference room	for meetings	9.09	27.27	0.505
Total development cost		**627.26**	**1881.78**	**33.38**
Dissemination Cost				
Faculty teaching time	1 lecture/day	40 X5= 200	600	11.11
Equipment setting cost				
Overhead projector	2	1.212	3.63	0.067
Video Camera	Toshiba (2)	2.424	7.27	0.13
Internet	512 Kb DSL	12.12	36.36	0.673
TV	Toshiba (2)	1.212	3.636	0.067
AV mikes	4	3.636	10.90	0.202
Screen	2	0.66	1.98	0.009
Staff salary	2	5.45	16.3	0.30
Supervisor	1	6.06	18.18	
*Facilities	Auditorium (2) (one at each institute)	45	135	2.5
Internet connection with phone	3 ISDN lines	65	195	3.6
Stationary and other items		12.12	36.36	0.67
Total dissemination cost		**354.894**	**1064.682**	**19.71**
Other related cost				
Travel from Pittsburgh-Karachi and return (business class)	5 faculty	2600X 5=13,000	13,000	722.22
Lodging	5 faculty	200	600	5
Food		35	105	1.94
Total related cost		**13235**	**13705**	**735.277**
Total Institutional cost for VTC		**14216.154**	**16651.462**	**789.786**

* Cost is estimated on the basis of rent / day (exchange currency rate 1 US$ = 60 Pak Rupee)

The cost effectiveness ratios (CE ratio) in two groups for both short and long-term workshop effectiveness are shown in table 15. The total incremental cost per score gained was higher for VTC group with for both short-term (VTC incremental cost was $166/score gained) and long-term workshop effectiveness (VTC incremental cost was $458/ score gained).

Table 15. Cost effectiveness ratios in both groups

Δ Costs / Δ effect gained = **[(∑cost F2F/ number of students) - (∑ VTC cost / number of students)] / (∑ effect F2F-∑ effect VTC)**	
Short term Workshop Effect **Where as,** ∑ effect F2F = Δ mean post-test1- Δ mean pretest (3.947) ∑ effect VTC = Δ mean post-test1- Δ mean pretest (2.556) N for F2F= 38 N for VTC=18	**Long Term Workshop Effect** **Where as,** ∑ effect F2F = Δ mean post-test2- Δ mean pretest (2.152) ∑ effect VTC = Δ mean post-test2- Δ mean pretest (1.625) N for F2F= 33 N for VTC=16
= (26,377/38)–(16,652/18)/(3.947– 2.556) = (694.13) – (925) / 1.391 = **-166** incremental cost per score gained	26,377/33) – (16,652/16) / 2.152 – 1.625 = 799.30- 1040.75/ 0.527 = **- 458** incremental cost per score gained

A hypothetical model of cost was created where cost of faculty travel to a developing country, boarding and lodging was eliminated by considering delivering lectures from university of Pittsburgh using video teleconferencing to both the institutes (table16 & 17),. In this model, there was no cost for teachers travel or lodging, and cost at both the institute dramatically reduced to $57 incremental cost per score gained in short-term workshop effect and $183 incremental cost per score gained in long-term workshop effect. The cost was higher for AKU than for DUHS due to 9 day course as compare to 3 days lecture telecast in DUHS.

Table 16. Cost estimation for VTC at AKU from University of Pittsburgh (n=40)

Cost category	Item Description	cost/ day	cost/9 days	cost/student
Development cost		In US $	In US $	In US $
Faculty salary (5)	Faculty teaching cost/ day including lecture preparation cost	120 X 5= 600	5,400	15
Supervisor	Manager (1) at AKU	27.27	245.43	0.68
Technical support	1 at AKU	3.63	32.67	0.09
Telecom personnel	1	4.85	43.65	0.121
Total development cost		**635.75**	**5721.75**	**15.894**
Dissemination Cost				
Faculty teaching time	1 lecture/day	40 X5= 200	1800	5
Equipment setting cost				
Overhead projectors	1	20	180	0.5
Video Camera	Toshiba (2)	18	162	0.45
DSL connection	512 Kb DSL	5.50	49.5	0.1375
TV	Samsung or Toshiba (1)	12	108	0.3
AV mikes	4	5	45	0.125
Screen	2	8	72	0.2
Technician	2 (one at Uni of Pitt and one at AKU)	50	450	1.25
Supervisor	1	70	630	1.75
*Facilities at remote site and at Uni of Pitt	Auditorium (2)	45	405	1.125
Internet connection with phone	3 ISDN lines	65	585	1.625
Total dissemination cost		**498.50**	**4486.5**	**12.4625**
Total Institutional cost for VTC		**1134.25**	**10,208.25**	**28.356**

* Cost is estimated on the basis of rent / day (exchange currency rate 1 US$ = 60 Pak Rupee)

Table 17. Cost estimation for VTC at DUHS from University of Pittsburgh (n=18)

Cost category	Item Description	cost/ day	cost/3 days	cost/student
Development cost		In US $	In US $	In US $
Faculty salary (5)	Faculty teaching cost/ day including lecture preparation cost	120 X 5= 600	1800	33.33
Supervisor	Manager (1)	27.27	81.81	1.515
Technical support	1 at DUHS	3.63	10.89	0.201
Telecom personnel	1 at DUHS	4.85	14.55	0.2694
Total development cost		**635.75**	**1907.25**	**35.319**
Dissemination Cost				
Faculty teaching time	1 lecture/day	40 X5= 200	600	11.11
Equipment setting cost				
Overhead projectors	2	20	60	1.111
Video Camera	Toshiba (2)	18	54	1
DSL connection	512 Kb DSL	5.50	16.5	0.305
TV	Samsung or Toshiba (1)	12	36	0.667
AV mikes	4	5	15	0.278
Screen	2	8	24	0.444
Technician	2 one at Uni of Pitt and one at DUHS	50	150	2.78
Supervisor	1 at DUHS	70	210	3.89
*Facilities	2 Auditorium (one at Uni of Pitt and one at DUHS)	45	135	2.5
Internet connection with phone	3 ISDN lines	65	195	3.61
Total dissemination cost		**498.50**	**1495.5**	**27.694**
Total Institutional cost for VTC		**1134.25**	**3402.75**	**63.013**

* Cost is estimated on the basis of rent / day (exchange currency rate 1 US$ = 60 Pak Rupee)

Table 18. Cost effectiveness ratios for lectures delivered from University of Pittsburgh

Δ Costs / Δ effect gained = **[(∑cost F2F/ number of students) - (∑ VTC cost / number of students)] / [(∑ effect F2F / number of students) - (∑ effect VTC / number of students)]**	
Short term Workshop Effect **Where as,** ∑ effect F2F = Δ mean post-test1- Δ mean pretest (3.947) ∑ effect VTC = Δ mean post-test1- Δ mean pretest (2.556) N for F2F= 38 N for VTC=18	**Long Term Workshop Effect** **Where as,** ∑ effect F2F = Δ mean post-test2- Δ mean pretest (2.152) ∑ effect VTC = Δ mean post-test2- Δ mean pretest (1.625) N for F2F= 33 N for VTC=16
= (10,208/38)–(3402/18)/(3.947– 2.556) = 268.23) – (189) / 1.391 = **56.95** incremental cost per score gained	(10208/33) – (3402/16) / 2.152 – 1.625 = 309.33-212.62/ 0.527 = **183.00** incremental cost per score gained

5.0 DISCUSSION

Knowledge has untapped power of development. The purpose of new knowledge is an action for health, and new knowledge is acquired through research. Building research capacity in epidemiology and health services has been recognized internationally as important in order to produce a sound evidence base for decision-making in policy and practice. Research capacity development is a broad concept covering the planning, development, implementation, evaluation and sustainability of programs tailored to building and strengthening local research capacity. The developing countries are currently facing an increasing epidemic of non-communicable diseases in addition to the non-resolving familiar problems of infections, malnutrition and reproductive health problems of mothers. Clinical research is the link between advances in research and innovations in medical practice. Physician–scientists, trained in patient care and epidemiological research, are crucial in developing and performing cutting-edge clinical research in developing countries. Owing to the lack of local research capacity, these challenges have not been matched by the ability and capability of developing countries to carry out appropriate studies the results of which will enable them to deal with health problems in their national contexts. There has been increasing attention paid in the literature to the problem of translating research findings (even those of appropriate research) in such a way as to have effect into clinical practices and policies. Health care professionals often lack the skills to use research-based evidence. Furthermore, they

are under such time constraints that they have little opportunity to reflect on the value of research.

From the developing countries point of view, local research capacity building has been the focus of several recent reviews and conceptual pieces (Nchinda 2001; Pang 2002). Specific issues such as training, retention of scientists within a country and issues of brain drain have been discussed (Nchinda 2002). Recent efforts initiated by the World Health Organization (WHO) are defining and assessing national health research systems, and will be developing tools for evaluation of research capacity development as well (Pang 2002). However, there is a relative dearth in the literature on evaluation of such efforts and programs. Similarly, distance education teaching has increased access to education and democratized educational opportunities in many countries, but questions regarding at what cost and degree of effectiveness have arisen.

Though several attempts have been made in the past by several organizations, WHO, INCLEN, UNO, and many more to develop and strengthen research capacity in Pakistan, effectiveness of theses trainings programs are yet to be analyzed. This research training workshop to build local research capacity in Pakistan is the first of its kind. Furthermore, we attempted to maximize its yield by increasing health care professions audience through VTC. We also evaluated its effectiveness, both short and long-term knowledge gained from the workshop. This is the first kind of training course in a developing country, in which we have experimented teaching research methods using VTC technique, a modern method of distance education. The choice of VTC over other common methods of distance education like, online training using www, i-pod, web cast, audio telecast was made because (a) VTC mimics traditional class-room

teaching, (b) is considered as virtual class-room, (c) interaction with teachers is possible and students can ask questions from the teachers conducting lectures at the same time, (d) students can actively participate in discussion with traditional class room participants and the most important (e) high speed internet services are not widely available in making courses access available online a problem. Although VTC is expensive mode of teaching as compare to other cheap methods of distance education like online courses, web cast etc, the effectiveness of VTC training is far greater than other methods of distance education (Debourgh 2003).

Teaching epidemiological research was not only a new experience for the participants but also for all teachers, especially the main workshop faculty from University of Pittsburgh. According to faculty feedback, although they have conducted similar kinds of workshops in the past in many developed countries with participations from developing countries, most of the experiences were with a specific workshop/ course on a "disease". This workshop however, was designed to teach epidemiological research methods and to encourage and provide the tools to conduct best quality research in the country. This was a first experience for the teachers to train and build local research capacity to do research in Pakistan which has been rarely done. Further more, it was learning experience for the workshop facilitators to teach and train doctors in a remote setting using information technology (IT) to expanding the reach of the classroom teaching. The knowledge gained form the workshop was not beneficial to the participant but also to the workshop faculty.

This study demonstrates that the workshop was effectives in short-term as well as long-term knowledge gained and sustained respectively. According to a recent audit done in Pakistan (Aslam & Waheed, 2005), though there a limited number of original papers with the majority

being reviewed articles, however 90% of the amount of publications high contribution rate were from two private institutes with less than 7% coming from government medical institutions . Furthermore, it was also observed that most of the private institutions were involved in providing some kind of research training. In many of the private institutions, research experts either local scientists or expatriates are available providing research training to medical institution. The Aga Khan University (AKU) is the only private university where research is an integral part of undergraduate teaching and 10% of the 5-year medical curriculum is allocated to research and community medicine. This is not seen in other private or government institutes.

It was interesting to note that though 48% of participants in F2F group came from private institutions as compare to all VTC participants from government medical university, both the groups had a similar pre-test scores (baseline knowledge about epidemiological research methods) before the start of workshop. Though participants in F2F group had more previous research experiences (table 4) and had more publications before the workshop (table 5), the pretest scores were not confounded by confounders and did not affect pre-test scores in F2F group (table 19).

Table 19. Effect of Previous research experience on pre-test scores in F2F after adjusting other predictors Dependent Variable: pretest

Source	Type III Sum of Squares	f	Mean Square	F	Sig.
Corrected Model	15.204(a)		3.041	.700	.628
Intercept	142.434		1 42.434	3 2.774	.0 00
Previous research experience	10.072		10.072	2.318	.140
Type of job	1.371		1.371	.315	.579
Institute	2.189		2.189	.504	.484
Education level	1.481		1.481	.341	.564
Publications 1-year before workshop	1.164		1.164	.268	.609
Error	117.341		4.346		
Total	4326.000				
Corrected Total	132.545				

a R Squared = .115 (Adjusted R Squared = -.049)

In other words though proper research training was not evident in VTC group and participants did not have wide previous research experience, they still did well in pre-test scores, equivalent to F2F. The VTC group also showed strong interest towards learning research methods. This became more obvious after the workshop with significant improvement in post-test1 scores in both groups with increase in 3.94 mean scores in F2F and 2.55 mean scores in VTC group. It is important to note that VTC group only learnt from five basic lectures of epidemiology research methods as compare to 40 lectures delivered to F2F group along with hand on-experiences of writing research proposals. The difference in the number of lectures delivered to the two groups was because of financial constraints and technical problems with VTC telecast. We can clearly conclude from these results that despite only 5 lectures were taught to VTC group and test questions were from these five lectures in both the group, VTC group did extremely well. Had the whole workshop was telecast to VTC groups, we perhaps could have seen more score improvements in VTC group, same as for F2F group if not more. This small study has laid down the importance of research training courses in developing countries and its

effectiveness with respect to training medical doctors using IT technology to expand the reach of the classroom teaching. Due to paucity of literature available, we cannot compare these results with other studies.

Hermann Ebbinnghaus (1850-1909) was the first psychologist who investigated the process of forgetting. He tested memory by syllables of no sense; his findings were published in 1885 (Plucker 2003). The results showed steep decrease of knowledge after a short time after study. His "curve of forgetting" showed that the original knowledge decreases already the first day to the level of about 40% and on the 30th day it is on about 20% of the original level. Despite of a criticism of his method his findings are broadly recognized and his curve of forgetting remains a part of modern textbooks of psychology (Glietman et al 2003). The experiments were repeated with similar results by other authors. Several researchers (Semb 1994 & Conway et al 1991) studied retention of knowledge over longer period of time for traditional class-room teaching. They stated knowledge retention after one year is given approximately in the range of 35-75%.

The values above stated are valid in case the studied topics are not revised in the meantime. If the topics are repeated in the time between the original study period and the final test, the retention of knowledge is approximately 75% even after several months (Lynch 2003)

In addition to the apparent effectiveness in terms of short-term workshop effectiveness, long-term effectiveness with respect to knowledge retained and sustained showed improvements in scores from pre-test. Even though mean test scores of post-test 2 dropped from post-test 1

scores but were above the baseline scores. The topics of the course were not repeated during the one year period and to reduce the bias, the participants were not aware of their knowledge being tested after 1 year. When compared with post-test1 scores, the retention of knowledge was 89% in F2F group and 93% in VTC group. In one study (Naidr 2994) using online training course as a way of distance education, the retention of knowledge after one year of teaching without any revision showed knowledge retention of 67% for students using web-based teaching course. Moreover, the retention of knowledge in F2F group is greater in comparison with those courses which are revised before the test is conducted. It is interesting to note that VTC participants retained workshop knowledge better than F2F. The VTC group did not revise the material, and did not know they would be tested once again. Yet, the result of knowledge retention (93% after 12 months) is comparable with the scores gained in ordinary teaching even with theme revision. We would not be wrong to conclude that the workshop effectiveness and impact was huge even after one year when no additional teaching was offered to both the groups by workshop faculty. There could be several reasons for these results. The first point is the technique of training used in our workshop, and the second one is the level of activation of the student in the distance way of learning. The role of the student is even more important; in the distance learning the student's role changes from passive consumption of studied material as it is carried out in the classroom to an active approach when the student becomes an active manager of his/her own study. This role in comparison with the situation in a group of students during an ordinary teaching is much more active. The structure of the teaching process in a traditional face-to face way of education is based on the dominance of a teacher; on the contrary, in the distance education the student is a central key point (Wisher 2001). This activation surely increases long-term retention of knowledge.

When evaluated all test scores for incomplete test survey, there was one post-test2 in F2F and two in VTC group which were incomplete. When these participants were contacted again for test completion, we learnt that they left some questions because they did not know the answers. All the incomplete questions in test questionnaires were scored zero. The workshop was evaluated by the F2F students which will be analyzed for publication.

Though there were 8 participants in F2F and 5 in VTC group who were currently enrolled in higher research training programs like, MPH, MS or PhD, however, further research training had no effect on post-test2 scores after adjusting in multivariate analysis (table 20 &21). Mehrabi et al. in his trial (2000) showed that the effectiveness of computer-based learning is 15-20% better than that of the classical traditional teaching when measured immediately after the course. Wisher et al (2001) showed 15% decrease in knowledge retention after 2 distance video courses (air traffic control, military activity) and stressed the importance of measuring knowledge retention after the training focused on security. Yildrim et al (2001) found through pretest-posttest method a better knowledge retention after teaching supported with multimedia means. Calabro et al. (2000) found null knowledge retention 2 years after a course focused on control of infectious diseases conducted through classical technique (lecture, practical exercises and case report) despite the fact that immediately after the course there was knowledge increase. All of these studies, however, significantly differ from our research, especially in methodological approach; the comparison is therefore difficult. Owing to lack of other published data, the comparison of these results with that of other researchers, who investigated have teaching in medical education, is rather difficult.

For any country, certain indicators are used to assess the research growth; for instance number of research projects, publications in national and international peer-review journals etc. For any health care professional, publication is an important factor in academic career building. Publications can serve as an indicator of the research productivity, crucial for monitoring and surveying, development and evaluation of prevention programs, and clinical practice. There are some previous studies consisting of small and unrepresentative samples, yielding conflicting results on publication by health care professionals in Pakistan. A recent study by Hyder et al (2003) conducted bibliometric analysis in Pakistan for health care professionals with research qualifications like PhD or equivalent. The study revealed that the average number of papers (international and national) published by Pakistani researchers was 15, and a significant positive association with age ($P < 0.001$) was observed. Fifty percent of the respondents have an average of seven publications; while one-third have no international publications. The average numbers of publications per year were 0.89.

In this study, though we were not able to find the extend of the research projects conducted by in both the groups was not assessed, information was obtained on the manuscript published, written and submitted, 1-year before and after the workshop. In addition total number of publications till the end of study in February 2006 was also obtained. Comparing results with Hyder et al study, the total number of publication were 3.18 in F2F and 1.63 in VTC group which is very low compared to 15 publications by Pakistani scientists (Hyder et al 2003). The main reason for this discrepancy could be level of research experience. In our study there were no PhD level participants and most of research degrees were master level or MPH. (table3). There was significant association with level of education in F2F; for total publications P= 0.01

and for publications 1-year after the workshop P= 0.015 (table 20 & 22). Where as in VTC group, total publications were associated with type of current job (table 23; P= 0.033) and previous research experience was found to be the predictor of publications 1-year before the workshop (table 24; P <0.001). Furthermore, the total mean publication one year before the workshop in both groups together were 1.14 which reduced slightly to 1.06 one year after the workshop. There were significantly more publications in F2F one year before the workshop (1.34) as compared to VTC group (0.89). In F2F, publications 1-year before the workshop was not associated with age, job type, level of education or previous research experience (table 21). Though VTC group was not an explicit group of researchers with significant research qualifications, however the research output in terms of publications is same as that of a Pakistani researcher with PhD or equivalent degree. In short, the VTC group selected was most motivated group and wanted to learn research methods despite no previous research experience and research qualifications.

Table 20: Effect of predictors on log Total Publication in F2F group

Dependent Variable: tot pub (log)

Source	Type III Sum of Squares	df	Mean Square	F	P value
Corrected Model	1.881[a]	5	.376	3.177	.027
Intercept	.388	1	.388	3.279	.084
Age	.132	1	.132	1.112	.304
Job	.000	1	.000	.003	.958
Institute	.001	1	.001	.009	.924
Education level	.959	1	.959	8.097	.010
Reshexp	.145	1	.145	1.226	.281
Error	2.487	21	.118		
Total	8.401	27			
Corrected Total	4.368	26			

a. R Squared = .431 (Adjusted R Squared = .295)

Table 21. Effect of predictors on log Publications 1-year before the workshop in F2F group

Dependent Variable: log pub before1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.152[a]	5	.030	1.502	.217
Intercept	.005	1	.005	.262	.612
Age	.001	1	.001	.064	.802
Job	.001	1	.001	.027	.872
Institute	.009	1	.009	.429	.517
Education level	.034	1	.034	1.695	.202
Reshexp	.051	1	.051	2.530	.122
Error	.649	32	.020		
Total	1.269	38			
Corrected Total	.801	37			

a. R Squared = .190 (Adjusted R Squared = .063)

On the contrary, F2F group had more publications per year than a PhD or equivalent level Pakistani researcher and this can be regarded as one of the strengths of this training workshop by bringing the most research talent on one platform. We could not find significant publication after the workshop and the main reason could be (a) participants were enroll in further research training program after the workshop and could not get time to publish papers and (b) one year is a short period to reflect upon the effectiveness of any training course with respect to writing papers. Significant association remained between publication 1-year after the workshop and educational level in F2F group (table 20).

Table 22. Effect of predictors on log Publications 1-year after the workshop in F2F group

Dependent Variable: log pub1-af

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.236[a]	5	.047	2.580	.049
Intercept	.005	1	.005	.293	.592
Age	.052	1	.052	2.834	.104
Job	.003	1	.003	.190	.666
Institute	.005	1	.005	.269	.608
Education level	.122	1	.122	6.681	.015
Reshexp	9.24E-006	1	9.24E-006	.001	.982
Error	.494	27	.018		
Total	1.269	33			
Corrected Total	.730	32			

a. R Squared = .323 (Adjusted R Squared = .198)

Table 23. Effect of predictors on log Total Publication in VTC group

Dependent Variable: logtotpub

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.372[a]	4	.093	2.950	.090
Intercept	.000	0	.	.	.
Age	.018	1	.018	.566	.473
Job	.209	1	.209	6.631	.033
Institute	.000	0	.	.	.
Education level	.061	1	.061	1.940	.201
Reshexp	.005	1	.005	.171	.690
Error	.252	8	.032		
Total	1.406	13			
Corrected Total	.625	12			

a. R Squared = .596 (Adjusted R Squared = .394)

Table 24. Effect of predictors on log Publications1-year before the workshop in VTC group

Dependent Variable: log pubbf 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.347[a]	4	.087	18.562	.000
Intercept	.000	0	.	.	.
Age	.001	1	.001	.275	.609
Job	.014	1	.014	3.079	.103
Institute	.000	0	.	.	.
Education level	.004	1	.004	.870	.368
Reshexp	.130	1	.130	27.749	.000
Error	.061	13	.005		
Total	.816	18			
Corrected Total	.408	17			

a. R Squared = .851 (Adjusted R Squared = .805)

Table 25. Effect of predictors on Publications 1-year after the workshop in VTC group

Dependent Variable: log pubaf1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.108[a]	4	.027	1.820	.195
Intercept	.000	0	.	.	.
Age	.038	1	.038	2.587	.136
Job	.029	1	.029	1.973	.188
Institute	.000	0	.	.	.
Education level	.057	1	.057	3.838	.076
Reshexp	.004	1	.004	.275	.610
Error	.164	11	.015		
Total	.362	16			
Corrected Total	.272	15			

a. R Squared = .398 (Adjusted R Squared = .179)

Last, but not the least we want to throw some light about the cost effectiveness of the workshop. The secondary objective of this study was to assess the cost-effectiveness of workshop in two different groups and to see if our results complimented the main results of the study. According to study results, VTC method of teaching was found to be expensive with only 18 participants in short-term and 16 participants in long-term effectiveness. The major problem

was follow-up of the VTC participants and retention in the lecture auditorium. The total cost of VTC was spent on two institutes but information was obtained from only one institute (we lost 26 test scores due to miscommunication and administrative problems). From a developing country stand point, on surface, even the cost of F2F ($26,377) for a 9-day research training course in a private institute may appear high. Translating this amount in Pakistani currency turns out to Rs 1,582,620.00 (current exchange rate 1$= Rs 60) for a 9-day training workshop for F2F and Rs 1,083,699.00 for a 3-day training workshop. This may present a huge cost for a country like Pakistan which spent <1% of total health budget on research. However, when considered the long-term effect of the workshop and amount of trainers trained, the cost can be trivial and this workshop can be very cost-effective. The participants in both F2F and VTC group were not only post-graduate level students but also teachers. This workshop was based on the concept of "training the trainers". After this workshop, many of the teachers were and are involved in training and higher education. These teachers will be training many other teachers and trainers. Faculty at University of Pittsburgh will be supporting and helping these teachers by providing course material. In this way each participant will roughly teach and train 100 other participants. Looking into the broader picture and considering the example of F2F participants for the time being, these 40 participants will eventually teach and train thousands of trainers, of whom many will again teach several thousands producing ripple effect. In such a way the cost of both F2F and VTC from the training point of view is trivial with a huge impact on country's economy by training and retaining country's asset of scientists and researchers.

If we consider the hypothetical model of lecture delivery from University of Pittsburgh, the cost can be reduced to Rs 612,495 for F2F (9-day training)and Rs 204,165 (3-day training)

with cost of Rs 3,417 per incremental score gained per student in F2F (short-term)and Rs 10,980 per incremental score gained per student in F2f (long-term). The cost of VTC group can further be reduced by increasing the participants in the workshop telecast. This kind of training if planned needs to be evaluated for knowledge gain and knowledge retention.

5.1 STUDY STRENGTH

- This is first study of its kind done in a developing country to train and build local research capacity in Pakistan by training health care professionals in Epidemiological research methods.
- To expand the reach of the classroom teaching of Epidemiological research training, this is the first workshop conducted in a developing country which experimented the effectiveness of a video-teleconference a synchronous method of distance education from the knowledge and cost-effectiveness point of view.
- Unlike many other training courses and workshop, this unique epidemiological research training workshop evaluated the effectiveness not only for short term knowledge gained but also long-term (after 1-year) knowledge sustained and retained by both traditional (F2F) as well as remote class-room (VTC) participants.
- This is first study conducted in a developing country which has tried to apply indicators for assessing the research performance of health professionals and their contributions to the development of health research in Pakistan. In this study, universally accepted indicators for evaluating the performance of individual researchers were assessed (number of publications) on which there is no literature available in Pakistan.

- First kind of training course which looked into the cost-effectiveness ratio of VTC teaching relative to F2F group which carries policy implication for considering VTC as a

model of teaching for greater number of participants. VTC is an expensive way of training if numbers of participants are small.

- This study provided researchers and teachers with some basic data which can be used as pilot data for developing studies on a larger scale.

5.2 STUDY LIMITATION

Although the results of this investigation are encouraging regarding the effectiveness so an epidemiological research training workshop using traditional as well as video conferencing methods, there were several study limitations that are worth mentioning.

1. **Selection Bias:** The selection of F2F group for the workshop was done using strict eligibility criteria (given in methods sections), however due to late arrangements for VTC and last minute announcements, the VTC group was randomly selected without any eligibility criteria. All participants learnt about the workshop through institutional announcements, flyers and notices on the notice boards. Participants who had interest in research attended the lectures. However, after study results were analyzed, age and previous research experience were the only differences that were seen between the two groups. We can conclude that there was a selection bias but this did not result in a major difference in results.

2. **The study design**: This was a prospective study and was more like a quasi type experiment. These types of designs have the major advantage of being easy to perform and relatively simple. However the major disadvantage is that these type of experiments lack temporal relationship i.e. cause and effect relationship. The score changes from pre-test to post-test showed improvements, but we cannot ascertain that these changes may not have occurred with time and there were not other attributable factors which were not considered in the study. For example, with time learning changes occur, so some of scores changes could be because of other factor or improvement with time Changes can be confounded by "regression to mean". This refers to changes due to pure luck that students were lucky to score high. Considering the design of the study especially its effectiveness after one year, regression to mean could not be considered interfering with study results.
3. **Time trends:** The study design did not consider time trends. Factors that can distort the results, unless they are adjusted.
4. **Time management:** Owing to the lack of communication and improper time management, we lost complete information and test scores from one VTC institution which resulted in a small sample size and loss of power. This was a major limitation and results of this small study cannot be generalized.
5. **Follow-up of participants**: Owing to information and being at distance, we were not able to follow all participants of both groups after one year.

6.0 CONCLUSION

6.1 PUBLIC HEALTH SIGNIFICANCE

More than a decade ago the Commission on Health Research for Development called for essential national health research in developing countries, with at least 2% of the national health budget to be spent on health research vital to developing countries This was in recognition of the severe lack of research building capacity and experts in research in the developing world, and a growing concern regarding the 10–90 gap between the developed and the developing world in health research. Capacity development efforts in the field of health research have been ongoing for decades by international, bilateral and private organizations. Usually such programs call for the provision of funds for training of scientists from the developing world, in centers of excellence in developed countries. Over the years attempts have been made to ensure that such trained scientists return to their home countries and contribute to national health. However, the reality is that the large amount of money is spent on defense (80-90%) and on scientists to receive research training aboard, and less than 10% return to their home country resulting in brain drain. There is need for flexible training programs within country which are effective and useful in training and retaining the country's human resources.

The current epidemiological research training workshop was an attempt to build and strengthen local research capacity in Pakistan by teaching epidemiological research methods to

health care professionals from all over Pakistan. To increase the yield and broaden its impact of teaching, this is the first workshop which in addition to F2F also attempted to train doctors in a remote setting the technology of video conferencing. The training workshop proved to be very effective and useful to both the group participants. The study also demonstrates the application of quantitative estimates for assessing the performance of individual researchers, with respect to research productivity and research progress. Selecting the right set of doctors who are interested and keen in taking on research as their career. These kinds of workshops conducted within the country prove to be an effective way of building capacity and reducing the major problem of brain drain.

The study has major public health significance. The major policy issue in a country like Pakistan is the balancing of limited resources. On one hand, Pakistan spends large amount of funds on research level training abroad, indicating the national commitment and interest in the development of a scientific base in the country. The government of Pakistan has been readily allocating substantial amounts from its international aid and chronically constrained budget to the training of scientists. This must be encouraging for those who return (10%) and are helpful towards the development of scientific and technological capacity in the country. On the other hand, country has a major loss, not only of resources but also the local strength and country's product when 90% of researcher do not return and stay aboard for better future career. With the current economic situation, financial constraints and increasing international loans, Pakistan is very vulnerable in epidemiologic transition to the double burden of diseases. Current medical training and medical practices have resulted in production of specialists with no training in research. Both the Pakistan government as well as common man is stretched financially by

spending huge amount of the budget in tertiary curative services. Country with limited resources cannot cope with increasing CVD mortality and morbidity esp. when CVD targets younger age group who are sole earner. There is urgent and immediate need of prevention programs and researchers who can provide the country its own data of disease burden. Prevention and public health programs can not only focus on prevention strategies for e.g. prevention of CVD by controlling CVD risk factors, but can also help the country to conduct national health surveys. To build prevention programs, training in public health and research is of prime important so research capacity can be built and strengthened in the country. The current study results from a 9-day training workshop have shown the effectiveness in terms of knowledge gained and retained. So far, to our knowledge only 2 out of 40 participants have left the country. These numbers are small if compared with results of previous training programs which provided training to health care professionals abroad of which only 10% returned to their native country. Though on surface, the total cost spent on the current training workshop may appear high, however, in the long run and when compared with country's loss of billions of funding by sending scientists aboard, the cost of this workshop is trivial.

It is time for country like Pakistan to best use such investments for the country and there are ways of developing research capacity and at the same time retaining local experts. The findings of this study indicate that new and innovative models of training and building research capacity not only in Pakistan but in other developing countries. It is time for the developing world to both enhance national capacities for postgraduate training, and also be selective in training investments outside the country. Such evidence is required by policy planners to

redefine existing human resource development programs and build future cost-effective programs.

6.2 FUTURE DIRECTIONS

The findings of this research were quite intriguing. This initial study provides a foundation from which larger studies may be developed. Given the small sample size, problems with follow-up and administrative problems, caution is advised with respect to generalizing impressions to the population. Although training course with special emphasis on research training courses like these, by its own definition, mandates a small number of students in each class, to increase interaction and impact of a course. The results of this study can be used to develop large trials in future. Distance education in general and video teleconferencing in particular may or may not be the educational "savior", but much of the literature on this subject lacks good research methodology, objective outcome measures, and valid and reliable instruments. Our investigation is one of the few studies that examined the effectiveness of an Internet instructional delivery method by minimizing most of the intervening factors that could influence study outcomes: instructor, content, text, syllabus, time, and travel. However, valid and reliable instruments need to be developed and tested to evaluate important outcomes, such as knowledge, satisfaction, technical support requirements, and lecture attendance. With these instruments, future studies should examine other educational content areas (research projects) the efficacy of the various forms of internet and traditional teaching methods, as well as the evaluation of the type of courses and content which is best delivered via these instructional techniques.

In addition, we need to identify the optimal student learning style type that could benefit most from Internet instructional methods. For country like Pakistan and other developing nations where there is scarcity of research capacity, IT -mediated distance learning has great potential to expand access to high quality research training to trainers across the lifespan and around the globe

APPENDIX A: Paper on Brain Drain in developing Countries.

Brain drain from developing countries: how can brain drain be converted into wisdom gain?

Sunita Dodani Ronald E LaPorte

J R Soc Med 2005;98:487–491

SUMMARY

Brain drain is defined as the migration of health personnel in search of the better standard of living and quality of life, higher salaries, access to advanced technology and more stable political conditions in different places worldwide. This migration of health professionals for better opportunities, both within countries and across international borders, is of growing concern worldwide because of its impact on health systems in developing countries. Why do talented people leave their countries and go abroad? What are the consequences of such migrations especially on the educational sector? What policies can be adopted to stem such movements from developing countries to developed countries?

This article seeks to raise questions, identify key issues and provide solutions which would enable immigrant health professionals to share their knowledge, skills and innovative capacities and thereby enhancing the economic development of their countries.

INTRODUCTION

Brain drain is the migration of skilled human resources for trade, education, etc.[1] Trained health professionals are needed in every part of the world. However, better standards of living and quality of life, higher salaries, access to advanced technology and more stable political conditions in the developed countries attract talent from less developed areas. The majority of migration is from developing to developed countries. This is of growing concern worldwide because of its impact on the health systems in developing countries. These countries have invested in the education and training of young health professionals. This translates into a loss of considerable resources when these people migrate, with the direct benefit accruing to the recipient states who have not forked out the cost of educating them. The intellectuals of any country are some of the most expensive resources because of their training in terms of material cost and time, and most importantly, because of lost opportunity.

In 2000 almost 175 million people, or 2.9% of the world's population, were living outside their country of birth for more than a year. Of these, about 65 million were economically active.[2] This form of migration has in the past involved many health professionals[3]: nurses and physicians have sought employment abroad for many reasons including high unemployment in their home country.

International migration first emerged as a major public health concern in the 1940s when many European professionals emigrated to the UK and USA.[4] In the 1970s, the World Health Organization (WHO) published a detailed 40-country study on the magnitude and flow of the health professionals.[5] According to this report, close to 90% of all migrating physicians, were moving to just five countries: Australia, Canada, Germany, UK and USA.[5]

In 1972, about 6% of the world's physicians (140 000) were located outside their countries of origin. Over three-quarters were found in only three countries: in order of magnitude, the USA, UK and Canada.[6] The main donor countries reflected colonial and linguistic ties, with a dominance of Asian countries: India, Pakistan and Sri Lanka. By linking the number of physicians per 10 000 population to gross domestic product (GDP) *per capita*, the countries that produced more physicians than they had the capacity to absorb were identified[7] as Egypt, India, Pakistan, Philippines and South Korea. However, the lack of reliable data and the difficulties of defining whether a migrant is 'permanent' or 'temporary' still exist.

One may claim that this migration from developing countries is both useful and unavoidable. There are definite advantages—enabling the migrant to spend time in other countries—but at the same time, the very low emigration rate of professionals *from* USA or UK may be as disturbing a sign as the high rates of immigration *to* these countries.

Young, well-educated, healthy individuals are most likely to migrate, especially in pursuit of higher education and economic improvement.[8,9] The distinction between 'push' and 'pull' factors has been recognized.[10] Continuing disparities in working conditions between richer and poorer countries offer a greater 'pull' towards the more developed countries. The role of governments and recruitment

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APPENDIX B: Workshop Registration Form

(a) Epidemiology Research workshop: Aga Khan University, Karachi, Pakistan. *February 1-9, 2005*

REGISTRATION FORM

Name: _____

(surname) (first)

Sex: M F **Date of Birth:** _____

day month year

Address: _____

Organization:

Job Title: _____

Educational Background:

_____

_____

Research Experience (also any current research): _____

_____

Previous exposure to Epidemiology and Biostatistics courses: _____

Why do you want to take this course? _____

_____

Future plan (with respect to research):

How did you learn about this workshop:

Email or any contact:

(b) **AKU Workshop Program, Feb. 1-9, 2005**

Date	Basic Epi (Thomas Songer)	Mol: Epi (Jan Dorman)	Biostatistics(M Rahbar)	Ronald E LaPorte	CVD Epi (Sunita Dodani)
Feb. 1 Tuesday	Introduction to the Fundamentals of Epidemiology	Scientific Basis of Genetics	Introduction to Biostatistics & Descriptive statistics	What is Clinical research? (REL) & Significance of preventive cardiology programs in Pakistan	
Feb. 2 Wed's day	Web Causation; Exposure and Disease Outcomes	Human Genome Project	Estimation of various opulation parameters	Epidemiologic transition	Health transition and emerging CVD in developing countries
Feb. 3 Thursday	Assessing Disease Frequency (surveillance, incidence, revalence)	Integrating Genomics into Clinical Practice	Basic Elements of Hypothesis Testing including P-value	Super course and its application in developing countries	Preventive cardiology Programs: strategies for prevention
Feb. 4 Friday	Measures of Association	Health Benefits of Genomics	Comparing population parameters using t-tests and Chi-square test.	Publication writing: how to get into nature	Meta analysis (Arin Basu)
Feb. 5 Saturday	Study Designs in Epidemiologic Research	HDL cholesterol no longer is good cholesterol: emerging genetic theories (JD & SD)	Sample size determination and power analysis	Reviewing/ avoiding the evil reviewer knives	Dysfunctional HDL: grant proposal
Feb. 7 Monday	Screening and its Useful Tools	Genomics, Health Care and Society	Regression & Correlation	Developing and joining international Research	Bioethics from developing world perspective – by Sisira Siribandana
Feb. 8 Tuesday	Economics and health	Genetics and Diabetes	Introduction to Survival Analysis	Grants and obtaining funding	Successful Research in Pakistan
Feb 9 Wed' day Day 8	Group presentations, and certificate distribution / Research Seminar				

APPENDIX C: Sample of Test Questionnaire(Pre, Post tests)

آغا خان یونیورسٹی
THE AGA KHAN UNIVERSITY

South Asian Cardiovascular Research Methodology Workshop

Student Name_____ **Name of the institute** _____

Email address_____ **Mailing Address** _____

_____

Please circle one best answer for each question and hand in your questionnaire to the instructor. This questionnaire should be returned back before the first lecture starts to Dr Sunita Dodani.

Q1. Which of the following statement is correct regarding Prospective Studies?

(a) These kind of studies address how exposure is related to disease at one point in time
(b) These kinds of studies require long term follow-up to examine future events.
(c) It is important to have an intervention arm for these studies
(d) These kind of studies require little resources to conduct
(e) These kind of studies are best to generate hypothesis

Q2. Case series

(a) Are useful for hypothesis generation
(b) Are useful for hypothesis testing
(c) Are useful to report on well known diseases or conditions
(d) Can assess the cause and effect relationship
(e) Allows one to calculate disease incidence in a population

Q3. Cross-sectional study

(a) Are useful for studying rare diseases
(b) The exposure under study requires follow-up until the event occurs
(c) Assess the disease and exposure relationship at one point in time
(d) Temporal association can be easily made
(e) Measure the incidence of disease

Q4. Case-control Studies

(a) Exposure data are collected prospectively
(b) Outcome data are known before the study begins
(c) Most feasible design for common diseases
(d) These studies require follow-up of patients
(e) Intervention arm (e.g. drug) is given to one group

Q5. Experimental studies

(a) These studies are best suited to generate hypotheses
(b) Investigators have no control on the measurement of the exposure variable
(c) Involves random assignment to groups
(d) No follow-up is required to study the outcome
(e) A very cost-effective study method

Q6. For publishing articles which is the correct statement about impact factor

(a) It has very less importance for granting agencies
(b) Is actually total number of articles over number of citations
(c) Is an indicator of judging quality of research work
(d) Is least important for publication in an international journal
(e) Is number of citations divided by number of articles published

Q7. Which of the following factor is important to keep in mind before selecting a journal for article submission?

(a) Does your paper contain new knowledge or a new interpretation?
(b) Does your paper is of interest to journal's editor
(c) Does your paper is long enough to be considered for submission
(d) Do you have good contacts with the editorial board
(e) Did you inform the journal editor that you will make a submission

Q8. What is the requirement of a publisher to consider an article for submission?

(a) You should be a well known researcher
(b) You should at least have more than 50 publications in other journals
(c) You should have good terms with the publisher
(d) You must provide advance and new knowledge in your manuscript
(e) Your manuscript should be on the same topic as other articles for that specific journal edition.

Q9. What are the key features of a well written article?

(a) Authors background with at least PhD in research
(b) A clear, concise and meaningful title which creates interest
(c) Manuscript should be at least of five A4 size pages
(d) Manuscript title should be match with journal editorial
(e) Material and methods section should be short and brief

Q10. The following statement regarding writing a manuscript is correct

(a) Actively seek out critical readers (co-authors or peers) to provide comments on your drafts
(b) Always keep your manuscript secret so that there is less chance of it being hijacked
(c) IT is not important to set a time for completing a manuscript
(d) Always give your manuscript to your friends to avoid criticism on the manuscript

Q11. Which of the following statements applies to somatic cells?

a. They are germ cells.
b. They contain homologous chromosomes.
c. They divide by meiosis.
d. They are haploid.

Q12. What are the monomers which compose nucleic acids?

a. Amino acids
b. Pyrimidines
c. Purines
d. Nucleotides

Q13. What are the monomers which compose proteins?

a. Amino acids

b. Pyrimidines
c. Purines
d. Nucleotides

Q14. Are all the products of transcription translated into protein?

a. No
b. Yes
c. Yes, but this is tissue-specific
d. Yes, but only during interphase

Q15. You recently completed a molecular epidemiology study of cardiovascular disease where 1000 cases and 1000 controls were typed for 3 alleles at the Apo E locus (E2, E3, E4), a candidate gene for atherosclerosis. Which group(s) would you think may be in Hardy Weinberg equilibrium?

a Cases
b Controls
c Cases and controls
d Neither

Q16. Epidemiologic transition is defined as

(a) A characteristic shift in the disease pattern of a population as mortality increases during demographic transition
(b) A characteristic shift in the disease pattern of a population as mortality increases due to increasing respiratory tract infections in developing countries.
(c) A characteristic shift in the disease pattern of a population as mortality falls during the demographic transition, causing a gradual shift in the age pattern of mortality from younger to older ages
(d) A characteristic shift in the disease pattern of a population as mortality increases, causing a gradual shift in the age pattern of mortality from younger to older ages
(e) A characteristic shift in the disease pattern of a population as mortality falls during the demographic transition, causing a gradual shift in the age pattern of mortality from older to younger ages

Q17. Regarding Demographic transition

(a) in UK, demographic transition resulted in increasing mortality, increasing fertility and reducing life expectancy
(b) Japan had accelerated demographic transition with reducing fertility increasing mortality and increasing life expectancies

(c) Demographic transition in developing countries is same as that of developed countries
(d) In Sri Lanka, demographic transition was delayed till 1980s
(e) CVD epidemic is same in both developed and developing world.

Q18. Factors responsible for Epidemiologic transition in developing countries are

(a) Insufficient medical care in tertiary care hospital
(b) Deteriorating living standards
(c) Improving living standards
(d) Improved public health & research
(e) Available modern technology

Q19 Which statement regarding epidemic of cardiovascular disease in developing countries is correct

(a) the rise is insufficient than what is seen in developed nations
(b) contribute more than 80% of all deaths in developing countries
(c) cannot be measured due to increasing population
(d) is more than developed countries in absolute numbers
(e) is rising slowly due to improved life standards

Q20 What is the best way to prevent cardiovascular diseases in developing countries

(a) By having improved secondary and tertiary care services
(b) By improving preventive care and research skills
(c) By obtaining more funds from developed nations
(d) By providing specialized training in bypass surgeries and angiographies
(e) By improving education system in medical colleges towards specialized care

APPENDIX D: Cost Estimation Charts for F2F & VTC Group

(a) **Costs estimates of Research Method course for F2F group (n= 40)**

Cost category	**Item Description**	**cost/day**	**cost/9 days**	**cost/stud/day**
Development cost		In US$	In US $	In US $
Faculty salary (5)	Faculty time/ day including lecture preparation cost			
Facilities	*Faculty offices (5)			
Equipment				
Furniture	With office cost			
**Computers	8 for faculty and participants			
Internet connection	(2 DSL)			
Office supplies				
Total Development cost				
Dissemination Cost				
Teaching	1-2 lecture /day			
Local faculty & staff salary	2 co-facilitators			
	4 staff			
Facilities	Classroom space			
Equipment				
Multi-media, screen & projectors	2 each			
Classrooms	5			
Video recorder and related equipments	1			
Total Dissemination Cost				
Other related cost				
Travel from Pittsburgh-Karachi and return (business class)	5 faculty			
Lodging	5 faculty			
Food				
Total other related cost				
Total institutional cost				

* Cost is estimated on the basis of rent / day (exchange currency rate 1 US$ = 55 Pak Rupee)
** computers cost is based on rent of 8 computers/ day

(b) Cost estimation for VTC at two institutes for 9 days teaching course (n=18)

Cost category	Item Description	cost/ day	cost/3 days	cost/student
Development cost		In US $	In US $	In US $
Faculty salary (5)	Faculty teaching cost/ day including lecture preparation cost			
Supervisor	Manager (1)			
Technical support	1			
Instructional staff	1			
Telecom personnel	1			
*Conference room	for meetings			
Total development cost				
Dissemination Cost				
Faculty teaching time	1 lecture/day			
Equipment setting cost				
Overhead projector	2			
Video Camera	Toshiba (2)			
Internet	512 Kb DSL			
TV	Toshiba (2)			
AV mikes	4			
Screen	2			
Staff salary	2			
Supervisor	1			
*Facilities	Auditorium (2) (one at each institute)			
Internet connection with phone	3 ISDN lines			
Stationary and other items				
Total dissemination cost				
Other related cost				
Travel from Pittsburgh-Karachi and return (business class)	5 faculty			
Lodging	5 faculty			
Food				
Total related cost				
Total institutional cost				

*** Cost is estimated on the basis of rent / day (exchange currency rate 1 US$ = 55 Pak Rupee)**

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