Epidemiology and Preventive Medicine in Times of New Technologies*

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Summary: *Epidemiology and preventive medicine are changing together with population and health and with ever expanding medical and non medical technologies.New technologies make epidemiology methodologically more sophisticated, but such advances risk overshadowing epidemiology's most important role: raising questions, providing answers, and helping the medical decision-making at all levels of prevention. Epidemiology also plays a major role in the evaluation of new and other technologies whose effectiveness is poorly known. Epidemiological approaches, methods, techniques, and interpretations are widely used in new and rapidly expanding fields of medicine: research evaluation and synthesis (meta-analysis), establishment of guidelines for clinical preventive practices, new medical technology assessment, guidelines for national and international health policies, evidence-based medicine, outcomes research and disease management ("population-based" medicine and quality of care improvement). In the nearest future, infectious and noninfectious diseases may cease to be almost the sole subjects of epidemiology and they may share their place with other mass phenomena of the next millennium, such as medical practices and care, or political, social and economic actions and their consequences. Not only will primary, secondary, and tertiary prevention will remain in the epidemiological mainstream, but health protection and health promotion will require perhaps a redefinition of epidemiology in these domains. Epidemiology and preventive medicine are both subjects of medical ethics and dilemma for right choices.*

The last hundred years of this millennium were marked by more successes of medicine and public health than ever before. Medicine and public health also affects health indirectly by influencing political, economical, managerial and other social decisions. We have been successful in providing decision-makers with solid arguments and justifications for such basic but the most effective health measures like drinking water distribution, waste management, air pollution control or immunization. With ever accelerating changes of health problems and priorities, medical and non medical technologies, communications, social structures and values, we are expected to perform even better to fulfil four traditional duties of medicine and public health:

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- to protect against harm (exposure to noxious factors),
- to prevent their consequences (disease),
- to cure ills (i.e. re-establish health), and
- to improve health and well-being (health promotion).

Epidemiology was and is one of pivotal elements of the way we deal with health problems in individuals and in groups of individuals. The future may be promising, but the journey will be bumpy and not always easy. New trends in health planning, administration and policies create a new maze through which epidemiology and medicine must find the best way possible for the maximum benefit of patients and communities. Here is why.

1. The epidemiological situation and the health of communities are changing.

2. New non medical and medical technologies appear influence the epidemiology of diseases, equally the epidemiology of diseases influences the development of technologies.

3. How we deal with both the above mentioned phenomena changes with the evolution of epidemiology as the method of objective reasoning, evaluation, and decision- making in health problem solving.

Let us overview these three important facts and draw some proposals for epidemiology and preventive medicine in the immediate future and in the forthcoming second millennium.

1. Epidemiological situation and health of communities

Our times are exciting, but also very challenging for epidemiology given the re-emergence of old diseases thought to be conquered, the emergence of new pathologies and possible problems of the future due to exposures to agents whose effect is presently poorly known.

Population aging, growth and migration, re-emergence of "forgotten" diseases (tuberculosis), emergence of the new ones (AIDS), new faces of old problems (toxic shock syndrome), new risks of modern medicine (rabies after corneal transplantation, Creutzfeldt-Jacob disease in recipients of human growth hormone), secondary effects and complications of invasive diagnostic and therapeutic methods (catheterizations, major tranquilizers), new social habits and behaviours (hot tub folliculitis, sneaker associated Pseudomonas osteomyelitis)[1], new non-infectious but contagious diseases (mass psychogenic illness), outbreaks due to environmental agents (toxic oil syndrome, polychlorinated biphenyl spills, Bhopal disaster, domoic acid contamination of shellfish), better understanding of slow infections and genetic factors (multiple sclerosis, hyperlipidemias, schizophrenia), interaction of hereditary and environmental factors (parkinsonism, amyotrophic lateral sclerosis), "First World diseases" in Third World countries (injuries, intoxications, cancers), and new epidemic and endemic challenges ("20th century disease", "total allergy syndrome", "chronic fatigue syndrome", fibromyalgia) create rich and important fields for epidemiological study.

At the same time as these evolving problems need to be explored, it is necessary to invest resources to respond to the political pressure to deal with known problems (pollution). Elsewhere, resources must be deployed to bring solid proof of potential uselessness of new fads (many alternative medicines).

In addition to the old and new problems, there is the "paradox of health": With better community health resulting in a longer life expectancy, more individual problems, more dependency, and more dissatisfaction with medicine due to highly publicized unrealistic expectations in a medicalized daily life become apparent[2].

The health system and its financing are no longer open ended systems. Any activity in the health field is carried out at the expense of another.
Responsibility and involvement in health programs and politics are shifting from health professionals to other community groups and involved individuals. Health promotion is a classical example of this fact.

In such an increasingly complex situation, epidemiology, medicine, and public health are transforming and must adapt to tasks more diverse than the management of individual health problems and community outbreaks.

2. New technologies and epidemiology

2.1 New technologies in medicine and in general

The spectacular development of basic sciences and clinical medicine, like genetic mapping, engineering, molecular epidemiology, in vitro fertilization, immunology (monoclonal antibodies), organ transplantation, diagnostic imagery, prosthetics and post-traumatic rehabilitation, and other new technologies changed radically medicine today.

At the same time, other profound changes may be observed in epidemiology including the emergence of many new fields, such as clinical epidemiology, clinimetrics, pharmaco-epidemiology, clinical decision analysis, medical care organization, meta-analysis or evidence-based medicine.

Both new technologies listed **and** epidemiology rely on computers and communications developing a positive feedback loop.

2.2 Impact of new technologies on epidemiology

Several new medical and nonmedical technologies contributed to the current situation, which might be defined as "brilliance and poverty of epidemiology".

- Large data banks were made available for surveillance, record linkage, and inductive research
- Computers made possible the study of a considerable number of potential risk and prognostic factors and markers and of multiple health related problems by multivariate and multivariable statistical methods
- Computer facilities such as Medline and CD ROM made retrieval of medical information easier, speedier and within the reach of many practising clinicians and practitioners of preventive medicine and public health
- The easily retrievable ,literature encourages the formation of new data sets for systematic reviews[3,4] and meta-analysis
- The easier access to literature speeds up the process of the development of research protocols thus easing the process of applying for research grants

2.2.1 The result

2.2.1.1 "The methodological brilliance of epidemiology"

As a consequence and result of the above, epidemiology succeeds better than ever before in

- identifying clusters of health problems
- predicting trends of disease by sophisticated surveillance of infectious and noninfectious health phenomena
- identifying the most important potential risk and prognostic markers and factors
- describing these factors in space and time
- assessing the impact of interventions

For example, the etiology and the transmission of AIDS having been elucidated, primary prevention remains, for the moment, the sole means to control this threat to humanity. Epidemiologically sound clinical trials are now a golden standard of evaluation of medical interventions. That is how the effectiveness of new vaccines was demonstrated beyond doubt.

2.2.1.2 " The intellectual poverty of epidemiology"

The main problem with the use of epidemiology occurs when health professionals, caught up in the excitement of applying the advances in quantitative epidemiology, lose sight of the ultimate goal - meaningful decisions in health care. In such a situation, innovative thinking remains relatively dormant [5,6]. The unattributed saying is true: "Do not seek truth, be happy with $p < 0.05$."

Let us quote Schlesselman[7]: *" Applications of probability and statistics to epidemiology are based on a remarkable fact: one can rarely predict the specific persons who develop the disease or die within some interval of time, but in relative large groups, defined by demographic, biological, or medical conditions, statistical methods can often predict quite accurately the* percentage *of individuals who will succumb. Statistics and its methods, however, do not offer, nor do they aspire to provide, a scientific explanation for the development of disease or the occurrence of death, either in general terms, or for any particular person. I say this because scientific explanation in the biological sciences is given in terms of a collective body of facts that describe the biological world.".* And this is said by a biostatistician, not by a physician!

Many researchers multiply etiological research and clinical trials to increase the body of evidence, hoping ultimately that the whole will bring the true answer. Biostatisticans in clinical research make a plea for larger and larger clinical trials, since the increased statistical power of larger numbers will increase the likelihood of finding statistical significance. However, clinical significance cannot be changed increased by changing the methodology and it is the clinical significance (endorsed by the statistical and epidemiological one) which is of prime importance in medical decision-making. Are there enough convincing arguments to change medical decisions about the health problem under scrutiny?

According to Skrabanek[8], multiplying etiological research and trials in the case of weak relationships and effects only confirms an Irish saying that "you cannot make a pig grow by weighing him."

Better epidemiology today is mainly due to three improvements. The first is sources of data, such as registers and systems of epidemiological surveillance at various levels in the community. The second is the improvement of analysis and interpretation of data. The third is the epidemiological approach to interventions in addition to the description and analysis of observational data.

If valuable and effective health programs are to be implemented, the causes of problems must be known before hand. The knowledge of causes comes from two types of etiological research:

- In **inductive research**, data are collected and analyzed and hypotheses are formulated as a result of this scientific procedure.

- In **deductive research**, hypotheses are formulated first (by intuition or from previous experience and observations). Then, material is gathered with such a hypothesis in mind, data are analysed and the hypothesis of interest is accepted or rejected after that.

The deductive approach is more reliable in proving the effect of a factor on outcome. However, in the field of health protection, many practical decisions rely on epidemiological surveillance, an activity which is most often inductive in nature. This is probably the only situation, besides first steps in the investigation of outbreaks, where "milking" or "dredging of data" is justified. Both approaches have their virtues and limitations, both are interactive and complementary.

One of the great challenges is to decide how far to go in gathering epidemiological information by induction while keeping the information system practical, informative and financially affordable.

The blind temptation to "feed the computer" should be controlled as much as possible not only for the sake of economy but also for the sake of the mind.

Statistically significant or close associations are sometimes used as sole arguments in health policies in community health, the pharmaceutical industry and elsewhere. Epidemiology expands and strengthens the establishment of causality by using multiple measures of risk such as relative risks or etiological fractions. In such a way, criteria of strength and specificity of causal relationship may be better quantified and clarified. The present status of epidemiological research is characterized by a considerable reliance on such evaluation of cause-effect relations. However, much less discussion takes place around such criteria of causality as temporal precedence, consistency of findings or biological plausibility. Unfortunately "*Post hoc ergo propter hoc*" is still just enough to make many people happy. Biostatistical methods are brilliant, precise, and necessary. However, their brilliance must not be allowed to obfuscate medical thinking and biological interpretation of observations which have been marvellously observed, measured, and computed beforehand.

Right now, it appears that we live in a rather paradoxical situation. On the one hand, we have succeeded in refining and structuring a conceptual basis, logical reasoning and quantitative methods in epidemiology, On the other hand, "old sins" are still often perpetrated in practice, like the still frequent ecological fallacy in the interpretation of findings or an excessive reliance on biostatistics while assessing the relevance of results.

If methodological tools are not to become their own "raison d'être", health professionals must become intellectual partners in clinical research and practice and collaborate closely with their partners from the field of quantitative methodology.

One may argue that nobody can teach or learn how to have ideas. However, one must provide the space and the opportunity to have them.

2.3. Influence of epidemiology on the acceptance and uses of new technologies in medicine

Epidemiology established itself as a crucial and often decisive tool in original medical research and its synthesis by:

- Defining criteria for the assessment of the quality of original research (occurrence, observational etiological, and intervention studies)

- Developing methodology of systematic reviews, research synthesis and meta-analysis in terms of the "epidemiology of results"[3,8] where original studies themselves and their results are becoming an additional unit of observation, analysis, interpretation and translation into practical decisions. Medical literature overviews are becoming clearer and as well structured as papers based on original laboratory, bedside or community research.

- Making a fundamental contribution to the establishment of guidelines for clinical preventive health practices

- Contributing to the choice, implementation and evaluation of national and international health

2.3.1 The results

2.3.1.1 Meta-analysis

Classical epidemiology contributed significantly to the establishment of criteria related to the necessary components and the architecture of original medical and public health research[9-19].

These criteria were used in the establishment of the qualitative assessment of original studies in meta-analytical research, falling under the term of "qualitative meta-analysis"[3,20].

The assessment and interpretation of heterogeneity of original studies is becoming often more important than a simple quantitative research synthesis[20].

However, in the domain of new technologies, original studies often do not respect even the basic quality criteria. For example, the use and acceptance of magnetic resonance was originally supported by an array of studies, assessing the clinimetric value of this new technology. Cooper et al.[21] looked at the first 54 studies with surprising results, given the cost and sophistication of this diagnostic tool. They found no evidence of research planning in 78% of these studies, 33% of studies misused basic terms like sensitivity, specificity, predictive values, or accuracy, calculations were incorrectly done in 98% of cases, there was no randomization of tests in studies comparing magnetic resonance with other procedures, interpreters were not blinded with regard to clinical history or other test results, and appropriate statistical analysis was lacking in 91% of studies.

Today, being now so well methodologically equipped, we have no excuse for not putting our knowledge of tools into practice.

2.3.1.2 Guidelines for clinical preventive practices

To optimize effectiveness of care and to direct it toward those who need it the most, various national and international bodies are attempting to offer to practitioners general guidelines on the practice of preventive medicine. These guidelines include effective practices to be encouraged and ineffective practices to be abandoned[22,23].

Guidelines are most often based on a sort of structured consensus[23], grading practices according to two axes: quality of evidence for adoption and proof of effectiveness (Table 1).

Table 1
Categorization of clinical practices for inclusion or exclusion from preventive practices and health programs[21,23]

Quality of Evidence	
I.	Evidence obtained from at least one properly randomized controlled trial.
II-I	Evidence obtained from well-designed controlled trials without randomization.
II-2	Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.
II-3	Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of treatment with penicillin in the 1940's) could also be included in this category.
III	Opinions of respected authorities, based on clinical experience, descriptive studies or reports of expert committees.
Classification of Recommendations	
A	There is good evidence to support the recommendation that the condition be specifically considered in a periodic health examination.
B	There is fair evidence to support the recommendation that the condition be specifically considered in a periodic health examination.
C	There is poor evidence regarding the inclusion or exclusion of the condition in a periodic health examination, but recommendations may be made on other grounds.
D	There is fair evidence to support the recommendation that the condition be excluded from consideration in a periodic health examination.
E	There is good evidence to support the recommendation that the condition be excluded from consideration in a periodic health examination.

For example, according to such guidelines[21], some well established or preferred practices such as urine dipstick search for urinary infections in children, adolescents and the elderly must be deleted (C or D recommendation, from Table 1). At the other extreme lie smoking cessation in pregnant women to improve newborns' birthweight and later cognitive abilities or influenza immunization of the elderly (recommendations A), which merit wide use given the body and the quality of evidence of effectiveness.

Overall, primary and secondary prevention guidelines are currently based on more solid grounds. Tertiary prevention requires a better practice of clinimetrics (measurement and mensuration of clinical phenomena)[24,25] without which a study of variation of clinical gradient and spectrum of diseases is unreliable.

These guidelines, once put into practice should themselves become a subject of field and community trials, to assess their effectiveness in practice. This is an immediate challenge for an equally immediate future.

2.3.1.3 Guidelines for national and international health policies

Recently published general methodological guidelines[26,27] and specific pathology oriented ones[28] demonstrate an increasing acceptance, application, and use of the epidemiological and meta-analytical argumentation in health policies choices.

These guidelines focus on all three levels of prevention in epidemiological terms:

- In terms of **primary prevention** as reduction of disease incidence,
- of **secondary prevention** focusing on the reduction of disease prevalence by controlling disease duration (restoration of health), and
- of **tertiary prevention** as the control of disease severity and spectrum.

To succeed at these different levels of prevention, a considerable amount of the best epidemiological evidence is necessary, either provided by classical epidemiology or clinical epidemiology. Priority setting for prevention programs and for health intervention is a good example of the crucial value of epidemiological information, such as disease occurrence, severity, controllability, and the population within the reach. Table 2 resumes the approach to health program priority setting.

Table 2
Epidemiological prerequisites for setting priorities in health programs[25]

Priority =	Occurrence x	Clinical importance	x Controllability x (in proportional terms)	Operational consideration (Target population)
Level of prevention				
PRIMARY (control of disease incidence)	Incidence	Disease severity (case fatality rate, severity score, etc.)	Etiological (attributable) fraction of risk	General population proportion reached by the disease prevention program
SECONDARY (control of disease pre valence by controlling the duration of cases)	Prevalence	Disease severity (case fatality rate, severity score, etc.)	Etiological (attributable) fraction of prognosis (survival, or duration of disease)*	Group of patients reached by the health care program
TERTIARY (control of disease spectrum and/or gradient without affecting its duration)	Clinical events	Disease severity (case fatality rate, severity score, etc.)	Etiological (attributable) fraction of prognosis (out comes' occurrence timing, and duration in terms of disease spectrum and/or gradient)**	Group of patients reached by the health care program

All components may be considered in terms of absolute frequencies, rates, or proportional rates, depending on the view of importance.
* From observational analytical studies, more desirable from clinical and community trials
** Mostly from clinical trials

Cost-effectiveness considerations and analysis are necessary to complete this fundamental epidemiological step.

Original evaluative studies and meta-analysis of medical and other practices, conducted by various teams around the world are coordinated by the way of the International Cochrane Collaboration[29,30]. Through this organization, to which the Canadian Cochrane Collaboration Network adheres, results of systematic reviews are better disseminated and wasteful duplication of efforts is avoided.

Various coordinating national and local bodies add to the effort by carrying out and coordinating assessment of new medical technologies: The Canadian Coordinating Office for Health Technology Assessment (CCOHTA), the "Conseil d'évaluation des technologies de la santé du Québec" (Quebec Council for Evaluation of Health Technologies), the French "Agence nationale d'évaluation médicale" (ANDEM, National Agency for Medical Evaluation) or the U.S. Congress' Office of Technology Assessment and others.

2.3.1.4 Evidence-based medicine

New technologies of the computer age contribute to improving access to the most recent medical evidence. They are relatively easy to use in clinical practice, either for acquiring information on general diagnostic or therapeutic strategies, or for tailoring the available information for the benefit of the individual patient. Tufts University clinicians develop the use of decision analysis while caring of individual cardiac patients. Clinical epidemiologists based in McMaster University and elsewhere speak in favour of using the best and the most recent evidence based on computer search in clinical care for individuals, and of the new evidence-base paradigm of clinical practice[31-35].

Evidence-based medicine proposes that intuition, unsystematic clinical experience, and knowledge of pathophysiology are insufficient grounds on which to base clinical decision making. Clinical decisions, the choice of diagnostic procedure or the choice of treatment, must be based on the best available evidence. This evidence is found through a computerized literature search. Original studies must be subject of a critical appraisal of their quality and adequateness in face of the patient's problem to be solved[31]. Guidelines for such a critical appraisal of original studies are already published[9-19,25]. Results of the search are synthesized through meta-analysis, other forms of systematic review or by a structured consensus.

There are five steps in evidence-based medicine[33,34]:

- Formulate a question concerning the patient's problem
- Search the literature for relevant clinical articles
- Evaluate (critically appraise) the evidence for the validity and usefulness of the options for solution.
- Implement the best solution in clinical practice
- Evaluate the outcome

The American College of Physicians (AC) Journal Club or Evidence Based Medicine are new periodicals devoted to the coverage of this field[36].

Implementability and usefulness of evidence-based medicine in various domains has already been evaluated in the literature. Areas examined are: oncology[37], psychiatry[38], critical care surgery[39], obstetrics and gynaecology[40] and other domains of inhouse practice[41].

Many journal articles on evidence-based medicine are favourable[42-45], other call for appropriate training for professionals[46-48]. Several critiques of the concept and practice of evidence-based medicine also appeared[49-54]. In summary, it appears from the discussion, that evidence-based medicine is a new and complementary tool in medicine and not an all encompassing approach which should replace other forms of clinical experience. It cannot be expected to solve all the problems facing practising physicians.

Medicine will and must also work in situations, where there is little or no evidence, while trying to cure or, at least alleviate and comfort.

Evidence-based medicine does not represent a significant intellectual enrichment of medicine, clinical epidemiology does. Evidence-based medicine structures and organizes medical work according to the best available evidence, no more, no less.

We must realize now, that evidence-based medicine is, in itself, a new practice and must be evaluated such as. Clinical trials and other forms of evaluation will show, in the future, the benefits to patients and doctors of this new concept of the practice of medicine.

How do we fare in preventive medicine and public health programs in view of evidence-based medicine? Fairly well, it may be said. To a variable extent, the practice of evidence-based medicine is already inherent to community based health programs. The concept is now brought at patient bedside.

In terms of community health programs, should we envision "evidence-based public health and preventive medicine"?

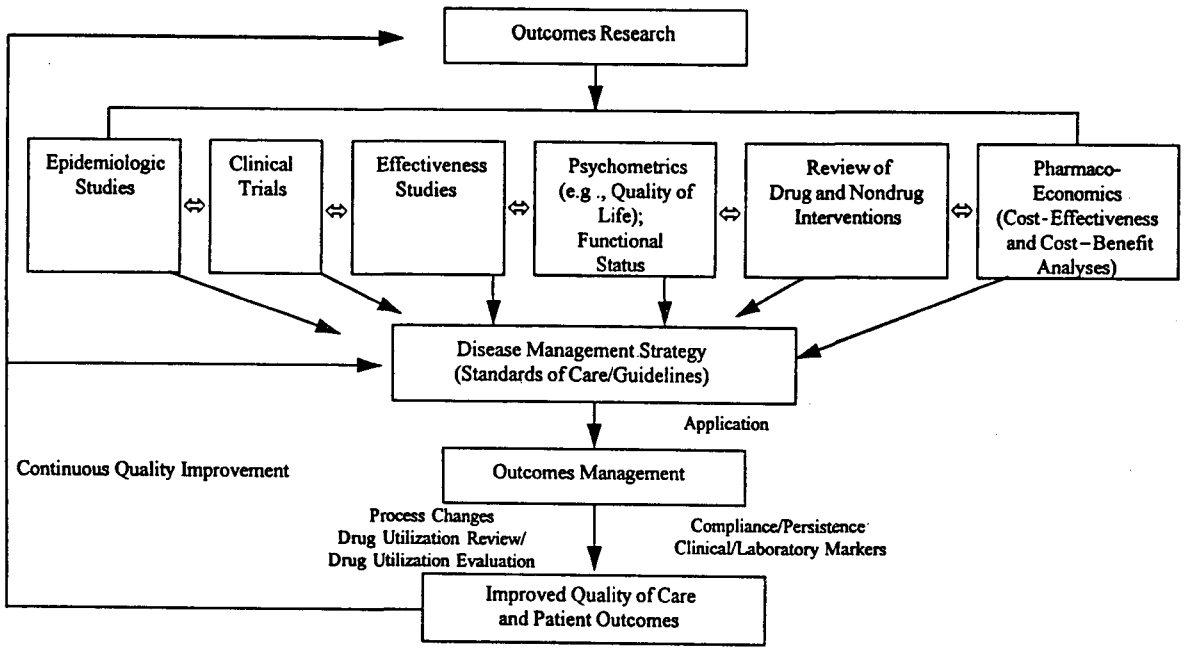
2.3.1.5 Outcomes research and disease management

New health problems, new technologies, and an increasing accessibility to modern health care generated a galloping increase of its cost. Care must be as cost-effective as possible. Instead of traditional treatments carried out by physicians, disease management programmes are proposed.

For Epstein and Sherwood[55], disease management refers to " *...the use of explicit systematic population-based approach to identify persons at risk, intervene with specific programs of care, and measure clinical and other outcomes... It is a systematic information driven approach in which clinical encounters are computerized, summarized, and shared; opportunities for intervention are not always detected solely at the bedside, but sometimes from a central data-base; practice guidelines may be implemented by computer screens in the practice setting; and initiatives are measured and compared in terms of health outcomes.*"

From the evaluation quatuor of "soundness-structure-process-outcome" the emphasis is on the last, be it healing, death (clinical), quality of life (humanistic), or economic (medical and non medical costs). Outcome research encompasses epidemiologic studies, clinical trials, effectiveness studies, psychometrics and functional status evaluation, pharmacoepidemiology and pharmacoeconomics (Figure 1). From this ensemble, disease management strategy is chosen to maximize the quality of care and provide the best possible patient outcome.

Figure 1
Place of epidemiology in outcomes research and quality of case improvement



Source: Ref.55

In these new approaches, epidemiology becomes more and more an integrated part of medical decision making at all levels of prevention. It no longer stands apart as a self-sustaining domain with its own objectives and goals.

Reliance of outcomes research on computer technology, linked databases and collaborative research is obvious. It is expected, that " ... health care providers will need to be hands-on computer users when clinical decision making occurs with data on individual patients..."[55].

The future of disease management and outcome evaluation approach is not without risks. Its critics[56] fear the industrialization or the corporatization of the delivery system.

Epidemiology will find itself torn between community-based fundamental public health principles and those, where the unit of observation is expenditure for any kind of care. In such an approach, resource allocation should be a better means of controlling health costs (thus disease and other health problems) than any other traditional epidemiological intervention.

Harris[56] stresses several potential pitfalls of such a population-based medicine:

- most efforts are restricted to persons whose health care, mostly medical and not public health, is being financed by particular payers,
- present lack of evaluation of impact compared to traditional health practices and services,
- disease management programs should not be accepted on faith,
- their indirect effects may outweigh their direct effects (increased demands),
- overestimation of their likely benefit, and
- fragmentation of care.

For this price, potential benefit may include

- improved efficiency of care,
- opportunity to find system solutions to health care problems,
- reduction of pressure for perfection currently felt by physicians,
- improvement of medical decision making.

Only the future and careful evaluation will show, whether the pitfalls or benefits will prevail.

3. Conclusions. Epidemiology is making its way through the maze of current and foreseeable changes of preventive medicine and public health.

What may we expect as a forthcoming scenario for epidemiology?

The focus of epidemiology will change,

- new directions and strategies will be challenging,
- denominators will change,
- societal pressures and expectations from epidemiology will increase,
- pressures to develop pragmatic research will increase, and
- attention will become focused on all levels of prevention.

3.1 The focus of epidemiology

While breathing the same air, drinking the same water and eating the food from the same earth, other mass exposures occur. More people will have more diagnostic or preventive interventions than will have serious illness. "High tech" interventions will remain costlier than "low tech" ones. The growing population of the elderly and the problems of the elderly particularly in regard to medication use and abuse, dependence and illness will move epidemiology into gerontology and geriatrics.

In psychiatry and mental health, relying heavily on soft data, the challenge of redefining diagnoses, treatments and outcomes in order to make measurement more reliable will further increase the value of clinical epidemiology.

3.2 Strategies of epidemiology

Information and computer facilities will provide epidemiologists with an increasing volume of information to organize, link, analyze, and explain, hence providing and increasing opportunity for inductive research, noting associations and generalizing hypotheses. This will provide, in the conjunction with basic and clinical sciences, increasing opportunity for deductive research. However, results of inductive research must not be overemphasized.

Both inductive and deductive research are possible, desirable, and needed, but their results are different.

3.3 Change of denominators

Traditionally, epidemiologists like cities, rural regions, workforce, and other communities. Such entities provide denominators for occurrence, etiological, and intervention studies. However, focus on other groups may be increasingly expected: Persons on the payroll of governments, national and multinational companies, insured individuals, high technology industry employees, professional (computer screens) and leisure users of new technological offerings (virtual reality, computer simulations).

3.4 Societal pressures on epidemiology

Epidemiology as logic of modern medicine and health sciences has gained such credibility that it is used increasingly in tort and other legal litigations[57]. Proofs of causality or proofs of impact

of various environmental, medical, or social factors depend, in the eye of courts, more and more on epidemiological reasoning and rigor. Epidemiology must be ready to answer satisfactorily to such calls.

3.5 Increasing expectations of pragmatic results

There will always be two objectives of epidemiology:

- to seek the general, all encompassing truth in absolute terms, and
- to determine what is going on in particular situations, conditions of work, and in specific groups of people.

In the former case, epidemiology will always play a major role in etiological research or in the assessment of efficiency of medical and other sanitary interventions.

However, chances of generalizable, absolute and all-encompassing results are smaller than the need for answers concerning problems, challenges, and needs of specific communities, outpatient services, family medicine, high technology based specialties (orthopaedic and prosthetic surgery, invasive diagnostic methods, new imagery techniques, genetic manipulation, fertilization, production of genetically engineered vaccines, immunosuppression and enhancement, etc.). Clinical epidemiology is a cornerstone of such evaluations.

The other field for epidemiology will be represented by frequent medical practices, less glamorous than the newest gadgets in medical technology, but more important in overall impact on the health of communities and on the budget of medical care providers: Breasts examinations, prostate function and morphology assessment, mental adequacy and social functioning evaluation, dependency assessment, assessment of need, physiological, professional and social, rehabilitation after injury and other acute events, to name just a few. Epidemiology will be called to help to answer such needs.

3.6 Levels of prevention

Health professionals must become accustomed to the fact that, by way of clinical epidemiology, the epidemiological approach will improve and be more used in the field of secondary and tertiary prevention. It has already been said (unattributed), that by definition of tertiary prevention, every surgeon, physiotherapist or psychiatrist is a specialist of preventive medicine.

However, the practice and the assessment of secondary and tertiary prevention must be as rigorous as the one of the primary prevention.

In conclusion, some may argue, that epidemiology is essential, but not sufficient to solve health problems in individuals and that of communities. Even so, it remains the cornerstone and its position is strengthening in the ever expanding and refocusing domain of preventive medicine and public health.

Changing paradigms of medicine and public health in terms of evidence-based medicine, outcome research, population-based medicine will force epidemiology to adapt itself to work and provide results in a multidisciplinary work and framework.

It will be probably beyond the realm and possibility of epidemiology to influence implementation of health program based on epidemiological findings. That's where the challenge of ethics in preventive medicine lie. Will it be a well argued offer of choices or will it be a coercive implementation by force of anything that is "healthy" for the individual and for the community [58,59]? Should we equip everybody in the community with personal smoke detectors, helmets for cycling, knee and elbow protectors for skating, masks for respiratory infection, medical accessories, blood pressure and lipid monitors, stress and anxiety gauges, and criminal record on request?

In today's demanding times, the most important task for epidemiology will be to provide the best possible facts, proofs, evidence, and arguments for decision making in health and disease fields. An equally important task for preventive medicine is to implement decisions properly. It should be done resolutely in a forceful prescriptive way, rather than in a restrictive ordering and/or imposing way. Imposition should remain the last recourse. Both tasks are ethically challenging and the future will show, how shall we succeed.

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