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Clinical Epidemiology and Its Relevance for Public Health in Developing Countries

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Additional information is available at the end of the chapter

1. Introduction

The current medical approach must contemplate the application of clinical epidemiology in the health establishments, patients; in general, epidemiologic research with its analytical designs and clinical trials allow the progress in treatments and managements, as well as defining the quality of auxiliary exams ever more sophisticated by means of the test of tests design and its cost-benefit approach [1,2] On the other hand, the field epidemiology is applied through descriptive studies of the population's health situation with their analytical approaches to the Situational Health Analysis (SHA), the study of epidemic outbreaks and evaluation of the respective answer of the community interventions [3,4]. This way, it allows carrying out an integral management of the epidemiology, both communal and individual, which will finally result in preventive medicine and public health

Clinical epidemiology has its application peak in the solution of treatment and management of diseases, contributing the identification of risk factors to certain illnesses and being to date the fundamental part of Evidence Based Medicine, and for that it becomes important the teaching of clinical epidemiology, for it will aid in the education of professionals with judicious capacity and rational use of the best alternatives in diagnostic and treatment, by means of a critical evaluation of the literature [5], as well as helping to stimulate the training of researchers, because it's implied that the execution of the clinical epidemiology will lead to the development of research [6].

Research development makes it necessary to use tools that will make research more efficient, such as GoogleDocs, ZOGO, OneNote, which allow to write and edit online texts, or scientific

literature search engines that will let us find evidence for the sustain of our activities in the healthcare systems, and in some cases without even looking for them, like with the applications from Google Reader and the RSS/XML, or obtaining portals dedicated to Evidence Based Medicine, or programs such as the statistical calculator Epidat which can simplify our statistical analysis, without even mentioning the multiple statistical softwares available [7].

Other concepts to consider are social epidemiology, which have been gaining ground these last decades and backing up the analysis of the social determinants of health status. This approach has generated big expectation for its integration and multidisciplinary character, but it's not free of skepticism that relates it with the idealism of a politics' strategic instrument [8].

However, social epidemiology, like field of clinical epidemiology, is based on the positivist paradigm and uses the statistical methods as analysis foundation. Besides, it is important to mention that currently, it has been generated a whole new research line based on the approach of the social determinants, where it is critical the usage of multilevel statistical models and new technologies that pose a new challenge to young researchers [9].

According to what it is stated, the current medical science tendency is focused in the generation of evidence that contributed in its development and has an impact in the patients' health. This approach, of EBM, is expressed mainly in the care, in relation to drugs and medical devices, though it is admitted that community interventions through Public Health deserve to be recognized as significant events that have had an impact in the population's health [10]. In this way, it is necessary to recognize the existence of research that s directed to make evidence of the impact of Public Health's diverse activities.

Evidence Based Public Health keeps the cause-effect logic, and allows adding the determinants of health, such as lifestyles, culture and environment, to the scientific context that often is what characterizes the good or bad execution of an intervention. Evidence Based Public Health is a new tendency that is joining efforts to offer the best information for an efficient politics decision making [11]. When it is oriented to the research of a population's health issues whether in the community or the hospital sphere, it contributes remarkably to the solution of very different local and regional realities, thus making a progress in Public Health, especially in out developing countries.

2. Differences between clinical epidemiology and field epidemiology

2.1. Classic or field epidemiology

Epidemiology is an old discipline with roots on scientific and rational structures, based on experience, on what is real. It is of great importance for Public Health and its impact for clinical medicine has risen in the last decades [12].

The comparison between clinical epidemiology and field epidemiology may demonstrate similarities and differences that can result in a contribution to their final application, which is their common desire: the people's health.

Field epidemiology's primary function is to identify the cause or source of infectious diseases' outbreaks, containing its dissemination and organizing the infected patients' treatment as soon as possible [3].

Information obtaining and action are done «in the field», on the ground, namely, in the epidemic territory, there being a dominance of practice over theory. During an outbreak, the field epidemiologist works long hours until he has control over the outbreak. Another specific feature is that it is not only executed by doctors, but also by other specialties professionals, such as nurses, veterinarians, biologists, technicians, etc. [3].

The Training Programs in Epidemiology and Public Health Interventions Network (TEPHI-NET), founded in 1997 and currently located in 53 countries around the world, aims to strengthen, at an international level, the field epidemiologists' capacity for Public Health [13]. In Peru, is has been developed the Field Epidemiology Residency Program (PREC), in order to train professionals in different specialties to act in their respect jurisdictions, challenging the lack of epidemiology specialists.

This national Program had 4 stages: I Introduction to Epidemiology (2 months), II Basic Epidemiology (4 months), III Intermediate Epidemiology (6 months) and IV Specialized Epidemiology (12 months). The designated participants for each Regional Health Direction started to take the classes in their own offices, taught by specialists from the General Epidemiology Office and professors from a macro regional level University's headquarters with on line tutoring, as well as field practices. Stages II and III were carried out in the University's headquarters and the selection of the participants to continue on to the next stages were done with a pyramidal system, according to weighted averages and additional exams. The last stage was carried out only Lima-Peru, though it was still open to other provinces [14].

It is discussed that field epidemiology would tend to action without a theoretical framework. This tendency would be based on its most direct reference: the Epidemic Intelligence Service (EIS) of the Center for Disease Control and Prevention (CDC) from the USA government, administrative body of military origin related to the intelligence service, which gives them a more attractive image than a function, closer to a secret agent directed towards the action, the protection of a community against a germ invasion, the avoidance of social alarm and insecurity on the population [4]. Field epidemiology executes its intervention on a daily basis in micro spaces, generally institutional: schools, restaurants, elderly residencies, hospitals whose services can present outbreaks, and uses conventional methods [15].

Thacker SB and Buffington J., who belong to the CDC, call field epidemiology as the 21st century applied epidemiology, based on the philosophy of 'learn by doing', supervised by experienced epidemiologists on field research, database analysis, vigilance system evaluation, presenting and publishing scientific research and answering to public questions. On the other hand, it has to be directed toward action regarding the main Public Health problems, the reduction of social inequality, having a greater consideration for psychosocial elements of the illness process, the incorporation of contents and methods from social sciences and working in multidisciplinary teams [16].

In the case of field or applied epidemiology, which is also denominated general epidemiology, it has as a feature the use of epidemiologic methods for the prevention of diseases and promotion of health in the populations, to achieve in an effective way the Public Health objectives, trying to apply a primary prevention.

3. Clinical Epidemiology

In 1938, Jean Paul coined the term clinical epidemiology, and defined it as: 'a new basic science for preventive medicine'. Therefore, the practical application of clinical epidemiology is a key part of Evidence Based Medicine and clinical decision making [17]. Clinical epidemiology is a discipline that puts into practice the epidemiologic principles into the clinical environment, focusing on patients [18]. What characterizes it is the combination of epidemiologic methods with the objectives of social clinical activity, which are, a good diagnostic and treatment of the ill. The knowledge is integrated with what is obtained from a good bibliographic research and critical reading of scientific reading [1]. It is currently considered the cornerstone of Evidence Based Medicine.

Clinical epidemiology is based mainly on its clinical trials, examining the diagnostic methods, discussing the prognosis, taking part in the evolution of treatments, trying to organize a controlled and randomized study opposite to sick people getting placebos or another indicated drug [1].

Truthfully, it was difficult to distinguish this activity from what would later be called as Evidence Based Medicine (EBM), term introduced in 1992 by the same group that, years before, had founded the discipline called Clinical Epidemiology (CE) [2].

However, both disciplines: field epidemiology and clinical epidemiology share the same methodology and tool, the difference relies on the place where these are applied (Table 1).

The current medical approach must contemplate the application of clinical epidemiology in health establishments, for the benefit of patients, given that epidemiologic research, with its analytical designs and clinical trials, allow the progress in treatments and managements, as well as defining the quality of auxiliary exams ever more sophisticated by means of the test of tests design and its economic approach (cost-benefit, cost-utility, cost-effectiveness), without forgetting the general population. It is in the community where field epidemiology is applied, the descriptive studies of the population's health situation with its analytical approaches to the Situational Health Analysis, the study of epidemic outbreaks and their respective intervention, as well as the posing of hygiene measurements and global prevention for a better quality of life and disease prevention. This way, an integral management is being carried out, both communal and individual, which will finally result in preventive medicine and public health.

David Sackett drew attention over the need to integrate the evidence with the clinical experience and the value of patients in the clinical decision making, referring to it as Clinical

Aspect	Field Epidemiology	Field Epidemiology
Fundamental objectives	To identify the causes or sources of outbreaks. To carry out the prevention of diseases and promotion of health in the population.	To evaluate methods and the quality of diagnostics and patient treatment.
Place of action	Community, population	Health establishments (hospitals, clinics, etc.)
Intervention or study population	General population of the community	Patients in health establishments.
Professionals in charge	Multidisciplinary: doctors, nurses, technicians, veterinarians, biologist, etc.	Multidisciplinary: with a greater emphasis in doctors for carrying out diagnostic and treatment activities.
Methods	Action without an extended theoretical background, it is practice, applied.	Bibliographic research and critical reading, applying Evidence Based Medicine.
Basic prevention	Primary	Secondary and Tertiary
Study type	Observational	Experimental : clinical trial (mostly)
Situation at work	It is dealt with unexpected problems and has to travel and work in the field, giving immediate answers in a limited time.	Hospitalized patients are evaluated; applying the validity and reliability of diagnostic tests and choosing the best alternative for the patient's treatment.

Table 1. Differences between field epidemiology and clinical epidemiology.

Epidemiology and defining it as: '*the application of epidemiologic principles and methods to the problems challenging clinical medicine. The basic aim of clinical epidemiology is to promote the clinical observation and interpretation methods, which result in valid conclusions*' [19].

Clinical epidemiology aims for the production and identification of valid tests, and to its logical extension. It is EBM, which aims for the rational use of evidence in the individual diagnosis and treatment of patients [17]. Clinical Epidemiology represents the way in which classic epidemiology, traditionally directed to general strategies in the public health of communal groups, *has been extended to include* clinical decisions in the care of individual patients (Figure 1) [20].

3.1. Evolution of clinical epidemiology

Clinical epidemiology has perform a center role in 5 recent evolutions (some say revolutions) on the healthcare area: evidence generation, critical evaluation, efficient storage and recovery, evidence based medicine and evidence synthesis (Table 2).

The effect of using epidemiologic principles has not been simply to improve the usage of clinical judgment and to eliminate the implicit element of epistemology from clinical reasoning. Arthur Elstein declared that decades of psychological research in decision making has demonstrated that: clinical judgment from experts was not as expert as we thought it was, that knowledge transference was more limited than we expected, and that judgment errors are not
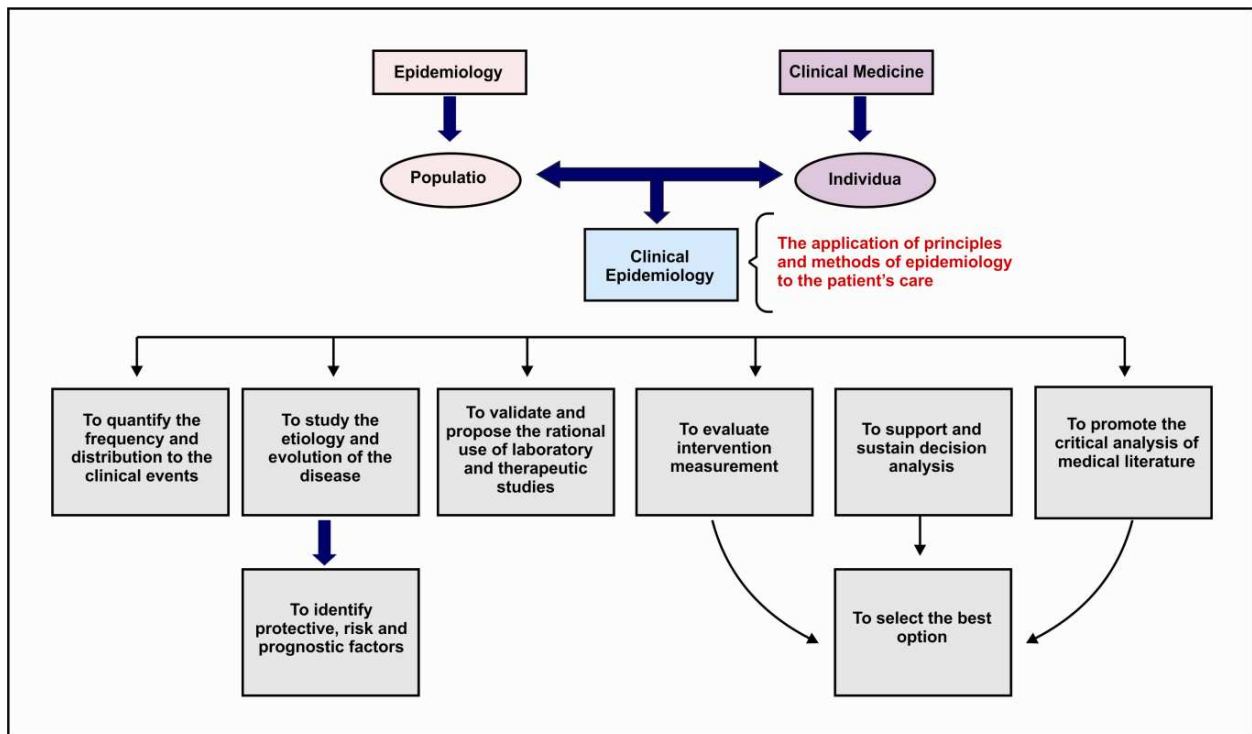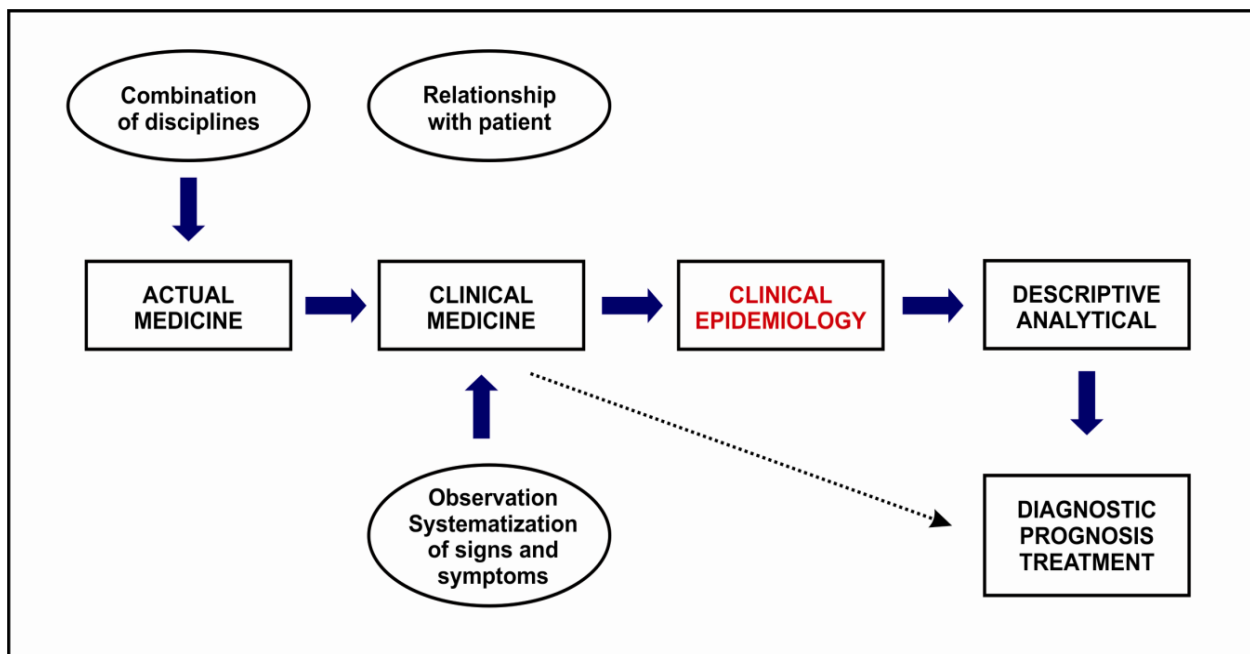
Figure 1. Uses of Clinical Epidemiology.

Evolution	Change	Description
1º Evolution	Evidence generation	Increase of reports, especially clinical trials, followed by prognostic and diagnostic studies.
2º Evolution	Critical evaluation	Critical evaluation of the validity of medical literature.
3º Evolution	Efficient storage and recovery	Implementation of databases and scientific literature search engines.
4º Evolution	Evidence Based Medicine	Number Needed to Harm (NNH)
5º Evolution	Evidence synthesis	Start of the Cochrane Collaboration (http://www.cochrane.org)

Table 2. Evolution of the Clinical Epidemiology (Sackett DL. 2000).

limited to medicine students nor are eradicated by experience, so that, them being the cognitive errors inherent to clinical reasoning, they can be aggravated through the dependency called 'experts opinion' [21].

In 1992, Sackett DL. and Col. decided to substitute the term 'Clinical Epidemiology' for 'Evidence Based Medicine', meaning that every medical action of diagnosis, prognosis and therapy must be sustained in quantitative, solid proofs, based on the best epidemiologic and clinical research [21]. Thereby, Sacket DL., in one of the first definitions of EBM, he mentioned:

**Figure 2.** Actual medicine, clinical medicine and clinical epidemiology

'conscious, explicit and reasonable use of the best current evidence to make decisions regarding the care of individual patients' [5].

Sackett DL. mentions the dichotomous existence between the science of epidemiologic reasoning and the art of intuitive judgments of clinical epidemiology. He realized that the application of these epidemiologic principles (plus a bit more of biostatistics) to the beliefs, judgments and intuitions that make up for the art of medicine can considerably improve the accuracy and effectiveness of diagnosis and prognosis [21]. The practice of EBM means to integrate the individual clinical experience with the best external clinical evidence available from systematic research, and recently, in a paper published on 2000, it is described as: 'the integration of the best research evidence, of clinical experience and the patients' values' [5]. Meanwhile, Cuestas E. defines it as 'the discipline that takes care of the study of the happening of medical decisions regarding its determinants' [22].

Broadly, clinical epidemiology takes care of the event of patients', which range from the appearance of the disease to its result in the form of healing, sequels or death. Therefore, the study subjects are ill people who are normally found in health establishments, and their contribution is relevant, especially for diagnosis and secondary and third prevention of the disease.

Clinical epidemiology can be divided into descriptive and analytical. The descriptive part is focused on the variation of clinical prognosis, whereas the analytical is focused on the reasons for this variation, that is to say, the main predictors for the prognosis, diagnosis and treatment, which are key concepts in the clinical epidemiology and the practice of clinical medicine (Figure 2). Also, demographic epidemiology is largely directed to the general population, whereas clinical epidemiology is more focused on the individual [23] (Figure 1).
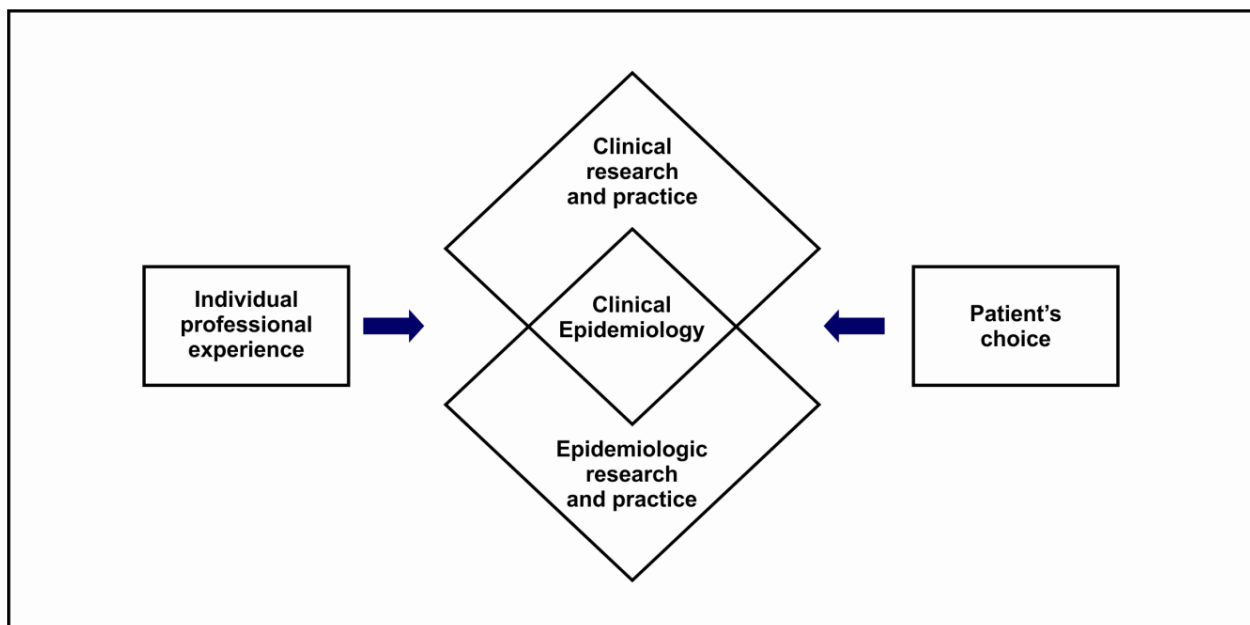
Figure 3. Interactions of the Clinical Epidemiology.

The EBM is driven by the need of confront the surplus of information and the medical practice, the patient's demand for the best diagnosis and treatment, y by the cost control, being known that the world tendency is the rise of costs in healthcare, leading to a stimulus of the critical evaluation of laboratory tests as an attempt for the best use of the limited resources. That means to realize a cost-benefit analysis [5]. In the last years, clinical epidemiology has become 'very important' for the health system, due to the need to perform evaluations in the quality of care, patient's security, health economy and resource usage areas. All these aspects are based on clinical epidemiology's thinking [23].

Nowadays, there have been many misunderstandings about EBM, which arise because it has been adopted by functionaries and academicians in Public Health, and by health managers, who for better or for worse, are 'too far from patients', giving interpretations like 'they remain sitting comfortably in their desks', 'they manage abusively and without a criteria, telling clinical doctors how to treat the patients in cost-effective ways'…; points of view far from what was originally planned for the integral approach of clinical practice and clinical epidemiology [24].

But we also need to bear in mind that the EBM is not a 'cookbook', like some think, for it requires the integration of the best external evidence with the individual professional experience and the patient's choice; the clinical evidence may inform but cannot substitute the individual clinical experience. This knowledge is necessary to evaluate if the external evidence can be applied to the individual subject to decide how to improve the patient's clinical results (Figure 3). In the same manner, the use of EBM as a 'cost reducing' medicine is a misunderstanding, because doctors who practice the EBM, identify and apply the more efficient interventions to achieve the best in terms of patient's quality of life, might increase the cost of healthcare instead of reducing it [5].

3.2. From epidemiology teaching and practice to research

Clinical Medicine, Clinical Epidemiology and EBM have been widely promoted as an improvement in patient's healthcare [25]. For that, doctors must be capable of showing the patient the therapeutic options for a shared decision making [26], using the results obtained in clinical studies [27]. Then it becomes important to correctly interpret the results of a study, to transmit appropriately this information to the patients, and to take the best diagnostic and therapeutic decisions.

Through systematic reviews and meta-analysis, as well as clinical practice guidelines, important progress has been made in the search of scientific literature, evaluation and synthesis. Terms such as 'likelihood ratio' or 'number needed to harm' are used commonly in medical journals [28]. In medical literature it is also used many epidemiologic risk indicators to present the results on the effectiveness of a therapeutic intervention. Between the most used are: relative risk (RR), relative risk reduction (RRR), absolute risk reduction (ARR), hazard ratio (HR) and number needed to harm (NNH). These entire indicators represent different ways to express the same result [29].

Studies done at the beginning of the decade showed that practicing doctors had a limited comprehension of numerical data given by the research results [5,30]. In Estellat C's study, the highest proportions of correct answers were the questions about relative risk reduction (87.7%), sensibility (84.6%) and specificity (80%), whereas the lowest proportions were for the calculus and use of likelihood ratio (16.9% and 9.2% respectively), and the interpretation of the kappa coefficient (19.2%). Though more than 80% of the respondents were able to calculate the sensibility or the specificity of a diagnostic test, only 32% was capable of using it in a clinical context. In the same way, the 30% correctly defined the likelihood ratio, but a percentage lower than 10% was able to use it to approximate the post-test probability of a disease [31].

In the same study, the subjects that had had previous training in statistics, epidemiology or critical evaluation of medical literature scored significantly higher than those who did not have this training. The average score (highest score being 7) was of 5.9 (IC95% 5.3-6.5) and 4.5 (IC95% 4.0-5.0), respectively (p<0.01). Therefore, their capacity to interpret quantitative data from medical scientific literature may be limited, which can deplete the information given to the patient for the decision making [31]

The practice of EBM requires the comprehension of five tasks: (1) building of a clinical question, structured on the patient's problem, (2) the acquisition of skills o search in medical literature and obtain the best evidence available, (3) critical evaluation of the evidence, (4) the application and integration of evidence to the patient's healthcare and (5) the evaluation (how to evaluate the process of helping the patient?) [32,33], which have taken EBM to be now part of the undergraduate teaching and the graduate activities of continuous medical education in various countries all over the world [34].

For example, in France, the critical evaluation of a medical article is part of the national residence exam, and for that, most the schools of medicine have incorporated it in their curricula as a formal training in clinical epidemiology. However, in the teaching hospitals most doctors tend to ignore clinical epidemiology and EBM, mainly because it requires the knowl-

edge and comprehension of epidemiology and statistics technical terms, which makes its understanding complex to some, whether for self-sufficiency or lack of interest [34].

This way, when the risk indicators used to inform the results of clinical trials were evaluated in students and residents, it was found that 19.4% didn't recognize any of the indicators and 81.4% wasn't able to calculate them. The relative risk reduction was the most recognized indicator (55.2%), followed by 'number need to harm' (51.6%), absolute risk reduction (26.6%) and hazard ratio (9.5%), concluding that medicine students and residents do not recognize and are incapable of correctly calculating the risk indicators used in clinical trials [35].

In a similar study carried out in faculties of a northern city of Peru (unpublished data), with 139 medicine students, among them a group that had finished a the Clinical Epidemiology course and another group that was finishing Classic Epidemiology; it was found that the most recognized indicator was NNH (number needed to harm) with 58.9%, followed by RRR (relative risk reduction) with 56.8%. Besides, 30.9% of the students recognized at least one indicator and 13.7% didn't recognize anyone. However, this changed when they were asked to calculate the indicators, finding that ARR (35.9%) and RR (30.9%) were the ones with the most correct calculation. Likewise, 11.5% did adequately the calculation of at least one of them, and 56.1% didn't do one of them correctly. A little more than 10% was able to recognize and calculate the risk indicators. Comparing both groups, there was a significant difference ($p<0.05$) at recognizing and calculating the indicators (Table 3)

Indicators	Clinical Epidemiology	Classic Epidemiology	p
Recognizes*	3.12 ± 0.89	0.79 ± 1.19	p<0,05
Calculates&	2.94 ± 0.96	1.45 ± 0.79	p<0,05
Total§	6.06 ± 1.43	2.21 ± 1.53	p<0,05

*Maximum score: 4. &Maximum score: 4. §maximum score: 8.

Table 3. Comparison of mean scores obtained

The medicine students usually start their courses enthusiastically, curious and willing to improve the human condition, but soon find themselves surrounded by a long and passive curriculum, where they have a small direct role in patient healthcare. There are courses that are hard for students to learn and the results tend to have an immediate effect on patient healthcare. Evidently, this goes beyond the fact that students apply the theory to artificial circumstances, situation that would improve if students used the EBM for the choosing of patient's clinical problems, so that then they can locate and evaluate the appropriate articles that will help in the healthcare patients get. These activities might improve their critical skills and experiential approach as a real teamwork [36].

Dunn K. and Col. in the last decade they were already channeling the teaching of EBM, looking to create competences in students such as (1) elaboration of researchable clinical questions, (2) access to the best and most recent literature, (3) evaluation and scoring of the literature for its validity and pertinence, and (4) cost-performance-benefit analysis and the interpretation of meta-analysis [37]. Rucker L also mentions the 'EBM recipe' [38] as a useful tool to bring EBM closer to healthcare, which consisted in posing clinical questions relevant during rounds at hospitals, which would later be solved by the students with the help of teachers. A similar progress occurs at the Canadian Institute of Health Research (http://www.cihr-irsc.gc.ca/), implementing a 'teaching recipe', which allows the resident to take note of the doubts from a concrete clinical case, and answer them following a methodology based on the PICO model (problem/pacient, intervention, comparison and result) and finally designate a date and a person in charge to deliver the answer.

As it has been mentioned, evolution of clinical epidemiology started with the creation of scientific research, which has led to critical reading, database creation and its search engines, EBM and finally, information synthesis (Table 2). That means, in the beginning and in all of its evolution it is surrounded by research. But, what stands out is that, in 2005, in a study we realized in 1484 medicine students from 13 Peruvian faculties, we found that 53.7% had a good knowledge and 71.9% an adequate attitude towards research, as well as a relation between belonging to a research group and having a good knowledge (Díaz-Velez C et al) [39]. This suffered a reduction of 7% and 34.2% respectively in a later study by Cabrera-Enríquez JA et al, where also 68% did not do any extracurricular courses, and those who did, only 3.28% and 6.24% could do critical reading and statistics respectively, finding an association between the level of knowledge and attitude towards research (p<0.05) and only 51% had taken part, or was taking part, of a research. [6]

While the Latinamerican context is not the most adequate to train researchers, there are students societies that can help promote research even if one is undergraduate. The research lines in universities institutions are not always adequately developed. Moreover, they are not even clearly stipulated and the primary healthcare research is poorly developed, while hospital research gains more support, especially from pharmaceutical industries. If we add to this that publications at a local level are scarce (as a consequence of what's stated before) and that 75% are done regarding topics which are not a regional or national priority, and knowing the social, ethnic and cultural differences that exist between communities, then what evidence do we have to answer our clinical doubts? [40]

In this context, a good researcher's attitude, with an integral approach of research, represents, in undergraduates and graduates as well, an alternative to build a solid researcher's intelligence and attitude, in terms of capability for scientific work [41]. Besides, we must promote some activities, as the graduation by publication in undergraduate students as an alternative to increase the universities' scientific production, an aspect we have been promoting as university teachers.

Examples of teaching EBM and research exist all around the world. We have the Accreditation Council for Graduate Medical Education, from the University of California, San Francisco, which includes EBM and practice based learning, among other basic competences. For that,

the development of the 'PRIME curriculum' program (EBM/clinical research program) which uses didactic lectures, journal club, progress evaluation sessions and active tutoring that allows the residents to carry out a clinical research project during their residence [42].

The first component of the 'PRIME curriculum' program (didactic lectures) motivates the development of topics such as: statistic power calculation, qualitative research methods, survey research, decision analysis and treatment threshold, cost-effectiveness analysis, ethical use of patients in research, community research and research process evaluation with international support, use of administrative data and spreadsheet management. The second component has weekly evening meetings of small journal clubs (diagnostic test evaluation, case-control studies, cohort studies, controlled randomized clinical trials, meta-analysis, decision analysis, cost-effectiveness analysis, clinical practice guidelines, etc.), which are made by students with a 15 minute duration, with a later debate moderated by the tutor. The third component consists on the trimestral presentation of interactive seminars (used to improve the ideas of the project's author) of the projects done by the residents. So far, these experiences have been successful, perhaps due to the fact that residents that take part of the program have the explicit expectative that the results of their research will be published, and with that, teachers are more willing to spend their time as mentors. However, we believe that the exit relays greatly on the structured curricula, the willingness of the mentors and, above all, the enthusiasm of the residents [42].

There are also other experiences in which the student is assigned to a team with a mentor (research team leader), a methodology tutor, expert clinicians and even biostatistics experts; in a research that coincides with the formation interest of the student, in which he learns about the research process. The mentor and the student meet weekly to develop and review the participant's curricula, apart from analyzing the research thesis and clarifying doubts that are generated in the sessions, so that, at the end, the student can have the thesis manuscript ready in the form of an article journal and can be presented [43].

The satisfactory fulfillment of the program gives the student the knowledge of the basic types of research design, including randomized clinical trials, cohort and case-control studies, quasi-experimental studies, concepts of health measurement and evaluation in the epidemiologic studies, capacity to critically evaluate medical literature and to use and interpret the various statistical programs for the data analysis [43].

However, there are limits to the EBM that, according to Cuestas E., might be: a) the frequently conflictive results of randomized and controlled trials (RCT); b) the inexistence of evidence in an enormity of topics; c) the questionable quality of many RCT and meta-analysis; and d) many time the RCT are not easy to conduct due to practical reasons, or impossible to do because of ethical reasons. Besides, it is necessary to integrate the best scientific evidence available with the preferences of the patient, with limits such as economic, social, ethnic, moral, cultural and health organization of the system [24].

In the USA, the Internal Medicine Residence and Postgraduate Curriculum Working Group suggests that the EBM concepts should be an integral part of the undergraduate and residency curriculum, given that medicine students do not necessarily acquire these skills in classrooms or during medical or teaching rounds [44].

3.3. Clinical epidemiology competences [44]

- Understanding of how bias and chance can affect the accuracy of observations in individual patients.

- Evaluation of the validity of original articles over diagnosis, prognosis, treatment and prevention.

- Knowing the strengths and weaknesses of randomized clinical trials, case-control studies, cohort studies (prospective and retrospective) and meta-analysis.

- Using practical strategies to judge the validity of clinical evidence synthesis (i.e. reviews).

- Comprehension of the meaning, uses and limits of the statistic power, the values of 'p' and the confidence interval, relative risk, attributable risk and NNH (number needed to harm).

- Knowing how to measure the patients' preferences.

- Comprehension and usage of the sensibility analysis and the cost-effectiveness analysis.

3.4. Competences for quantitative clinical reasoning [44]

- Comprehension of the way to calculate the pre-test disease probability and how to use the Bayes theorem to calculate the post-test probability.

- Defining and using sensibility, specificity and likelihood ratio of the diagnostic information.

- Knowing and being capable of detecting possible bias in calculations of sensibility and specificity.

- Comprehension of the value of decision trees and decision making.

Opportunities for health professionals to obtain the education and training in clinical epidemiology have extended gradually. In South America, there is a group that promotes its development, LatinCLEN (Latinamerican Clinical Epidemiology Network), regional member of the International Clinical Epidemiology Network (INCLEN Trust http://www.inclen.org/), that is formed by research and Clinical Epidemiology training centers, as well as Clinical Epidemiology units around the world. (Table 4) [45].

With all these things mentioned we can see that both disciplines (field epidemiology and clinical epidemiology) share the same methodology and tools, just that the application of them is done in different locations and the current medical approach must contemplate the application of clinical epidemiology in health establishments, patients, in those who research epidemiology, with its analytical designs and clinical trials allow the progress in treatment and management, as well as defining the quality of the auxiliary exams ever more sophisticated by means of the test of tests and its economic approach (cost-benefit, cost-utility, cost-effectiveness)

One cannot forget the general population, for it is in the community where field epidemiology is applied, the descriptive study of the health situation with the analytical approach of the

Network	Country members	Website
LatinCLEN	South American countries	www.latinclen.org
INCLEN-África	African countries	www.inclenafrica.org
CanUSACLEN	Canada and the USA	www.canusaclen.org
ChinaCLEN	China	www.chinaclen.org.cn
INCLEN – Euro-Med	Europe countries	www.recif.univ-lyon1.fr
IndiaCLEN	India	www.indiaclen.org
INCLEN – Southeast Asia	Asian countries	www.cim.edu.ph

Table 4. Clinical Epidemiology World Network.

Situational Health Analysis, the study of epidemic outbreaks and the respective intervention, as well as the planning of hygiene and global prevention measurements for a better life quality and disease prevention.

Finally, we can say that the importance of clinical epidemiology in clinical research is recognized in ways that the classic epidemiology hasn't been able to achieve, but is prone to the knowledge of health professionals and its constant evolution makes it stay valid, this way an integral manage of the epidemiology will be carried out, both communal and individual, thus resulting in preventive medicine and public health.

4. Informatics tools for health research

During health professionals' daily practice, the need to keep informed about the new scientific evidence comes up as a responsibility towards patients and, of course, to oneself. It is not strange to see yourself in front of a patient with a specific pathology to which certain treatments haven't had effect, and asking yourself: what is new to treat this condition? Or, on the other hand, in front of a research, lecture or speech about any topic, trying to have the most updated information about the topic. Considering its etymologic origin, the word 'investigation' comes from the Latin word *invenio*, *invenire*, which means 'to find'. By association and as a logical consequence, to find you must first search. And for that, we must know how to and where to search. This searching implies knowing the principal sources of information to which, as professionals, we must access. However, the task does not end there, for, once we find the information, we must do a critical reading of it and select the most relevant, which in the context of a research must be adequately cited [7].

To do research there are informatics tools, mainly through internet, that ease up the daily work of a researcher, from sources of information to friendly interfaces, of easy access and naviga-
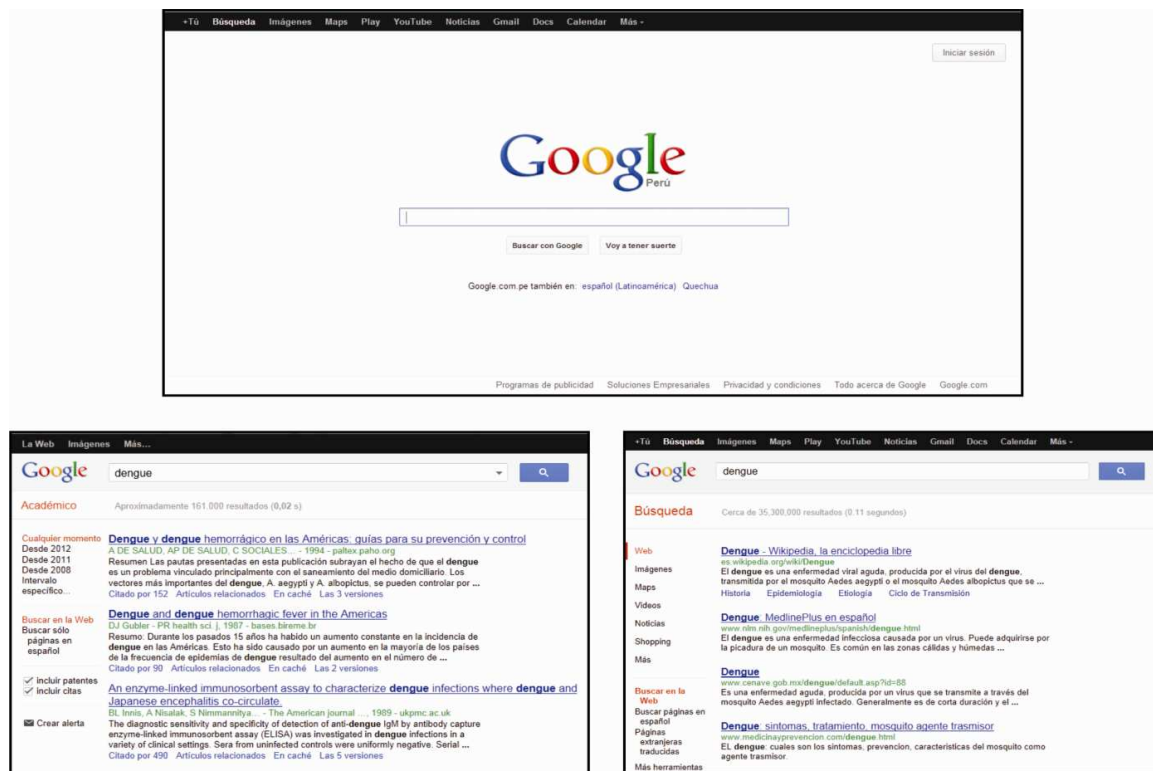
Figure 4. Google y Google Scholar.

tion, bibliographic references managers and statistic applications that allow us to do calculations that would turn very complex if we did it the conventional way.

4.1. Information sources

Search resources to which we normally turn to are general search engines (Google, Yahoo, Altavista, Metacrawler, etc.) Google (http://www.google.com) has the biggest demand, but the health information available in this engines may come from a non-reliable source, so it is important to distinguish which are the most adequate websites to find the health related information, which implies to evaluate the quality of these websites, an activity that sometimes is quite tedious for the researcher [46–49].

Given the wealth of information it retrieves the conventional search engine Google, and considering the existence of dubious sources, Google implemented Google Scholar (Google Scholar) oriented search scientific references (http://scholar.google.es), which are listed in order of relevance, and provide information about the source, year of publication, authors, times the number that have been cited and other versions of the publication, and also, you can access related articles (mentioning or are cited by the text), the content in HTML, PDF, DOC or other format, it is recommended to do the advanced search preference (Figure 4).

Among the great online Medicine bibliographic databases we have MEDLINE, produced since 1966 by the National Library of Medicine (NLM) [50] in the USA. MEDLINE is the largest article bibliographic source in biomedical sciences we have at hand. The database is made up

by cited articles by three indexes: Index Medicus, Index to Dental Literature and International Nursing Index. Currently it is the most consulted database by global researchers. A study applied to Spanish speaking biomedical professional researchers referred us to a 34.1% [51].

MEDLINE includes general topics, such as microbiology, health prevention, nutrition, pharmacology and environmental health. However, the covered categories by the database include anatomy, organisms, diseases, drugs, techniques, equipment, psychiatry, biologic sciences, physical sciences, social sciences and education, technology, food, industry, humanities, and communication sciences. All of these related to health. The search is done via PUBMED: http://www.pubmed.gov (Figure 5). Here, the searches are in English base on Boolean operators: AND, intersection, automatic term mapping; OR, conjunction and isolation; NOT, excludes the final term; uses a MeSH (Medical Subject Headings) controlled vocabulary and the subheadings described by the Index Medicus, where most of the abstracts have the link to the editorial where the full text article can be found [52].
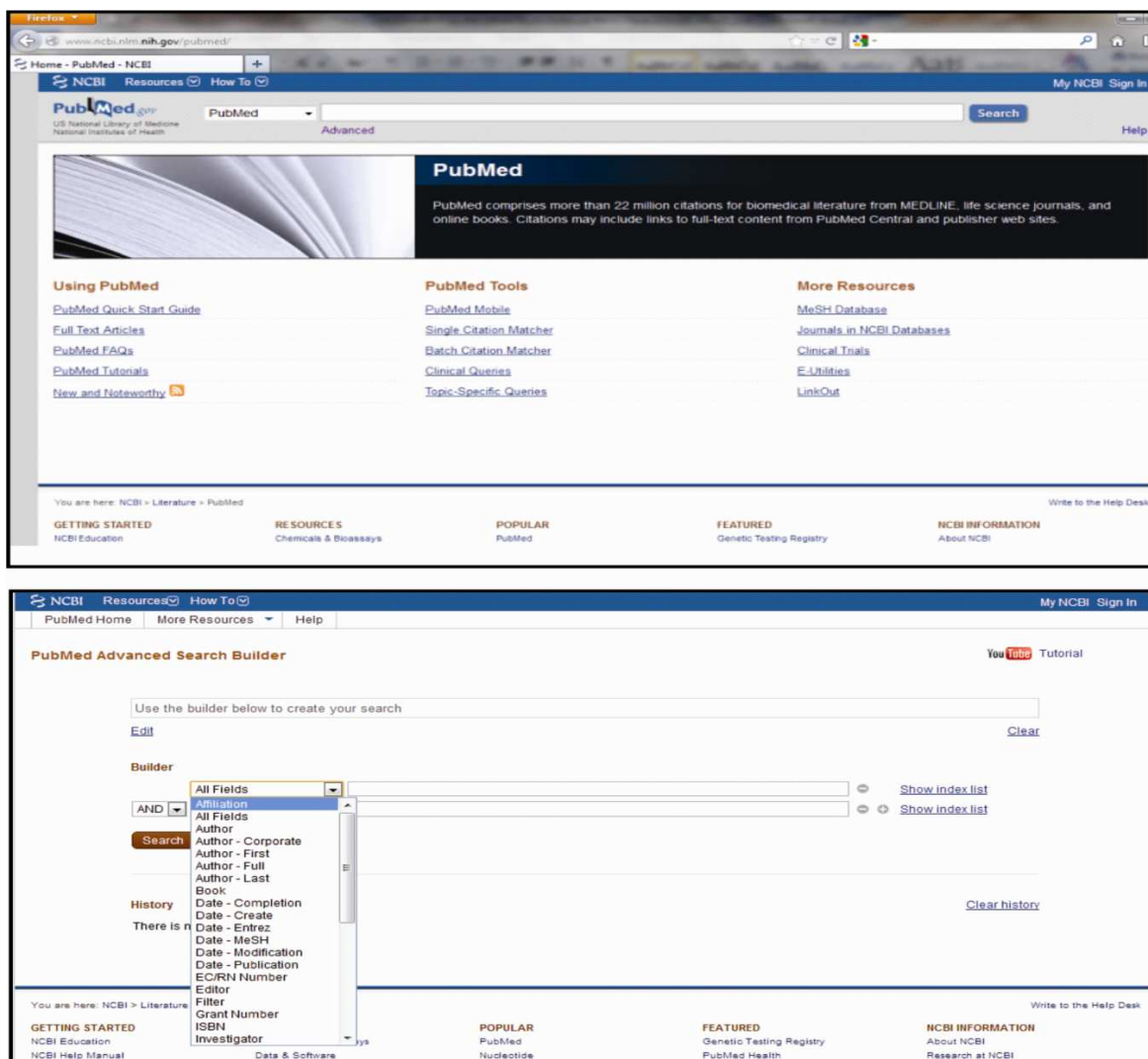
Figure 5. Pubmed specialized search engine of the National Library of Medicine (MEDLINE).

Another large database, not as extensive as MEDLINE, is 'Literatura Latinoamericana y del Caribe en Ciencias de la Salud' (Latinamerican and the Caribbean Literature on Health Sciences - LILACS)[53]. It can be accessed through the Virtual Health Library (Regional Medicine Library – BIREME)[54]: http://www.bireme.br, the same that includes other sources of information in biomedical sciences. One of them is the catalogue of the Library hosting the Panamerican Health Organization (PAHO) and the World Health Organization (WHO). Here you can access full text articles that are included in the Scientific Electronic Library Online (SciELO)[55]: http://www.scielo.org, which includes Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Spain, Mexico, Portugal, Venezuela, Public Health, Social Sciences and developing initiatives like Bolivia, Paraguay, Peru, South Africa and Uruguay (Figure 6).
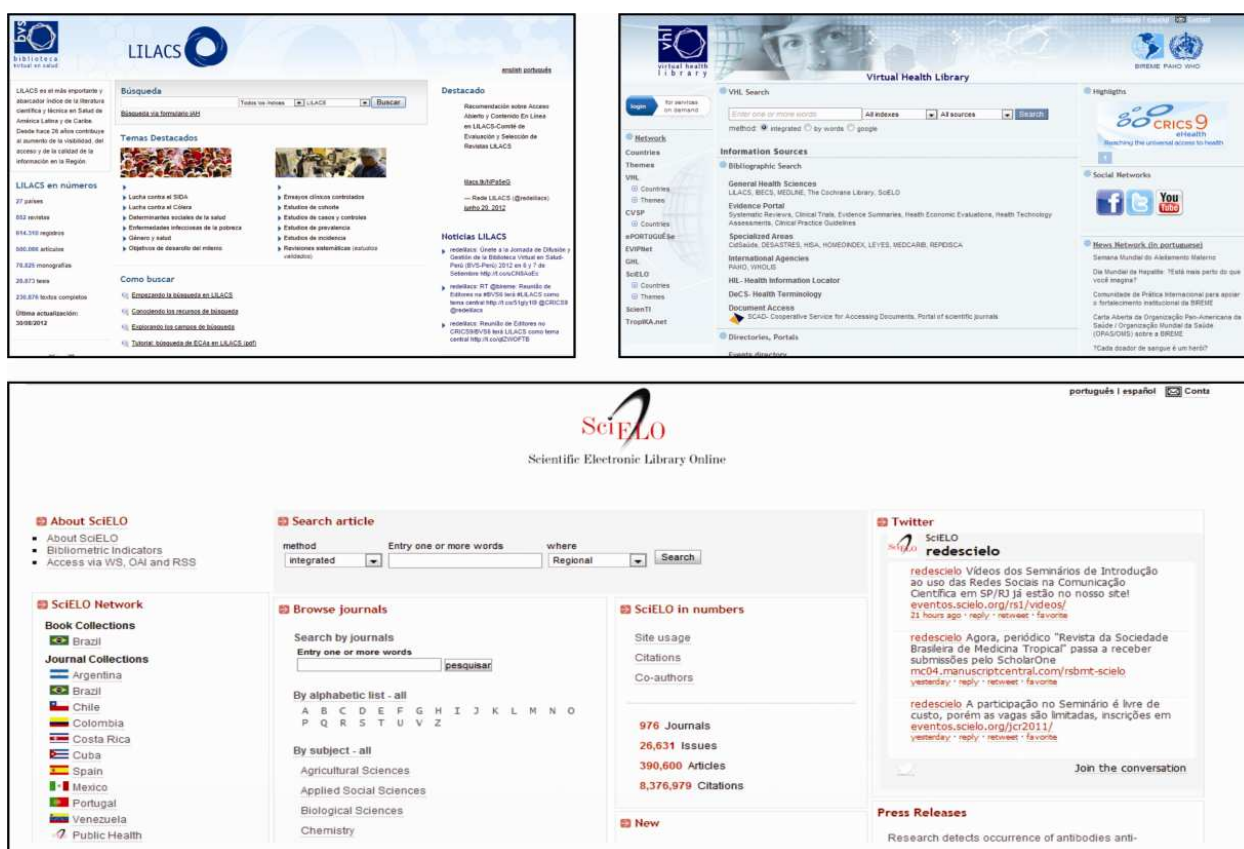
Figure 6. Latinamerican and the Caribbean Literature on Health Sciences (LILACS), Virtual Health Library and Scientific Electronic Library Online (SCIELO).

An important resource is the Cochrane Library: (http://www.bibliotecacochrane.org/) (Figure 7), whose aim is to prepare, keep and spread systematic reviews regarding the effects of healthcare, mostly base on controlled clinical trials, and are highly structured and systematized, for they include the evidence according specific quality criteria.

Figure 7. Cochrane Library

Health Inter Network Access to Research Initiative (HINARI) in: http://extranet.who.int/
hinari/en/journals.php (Figure 8) is a program established by the WHO, in partnership with
publisher, and gives an easier access to one of the most extensive biomedical and health
literature collections. It contains more than 8 500 information resources, in 30 different
languages, which are available for health institutions in more than 100 countries [56].
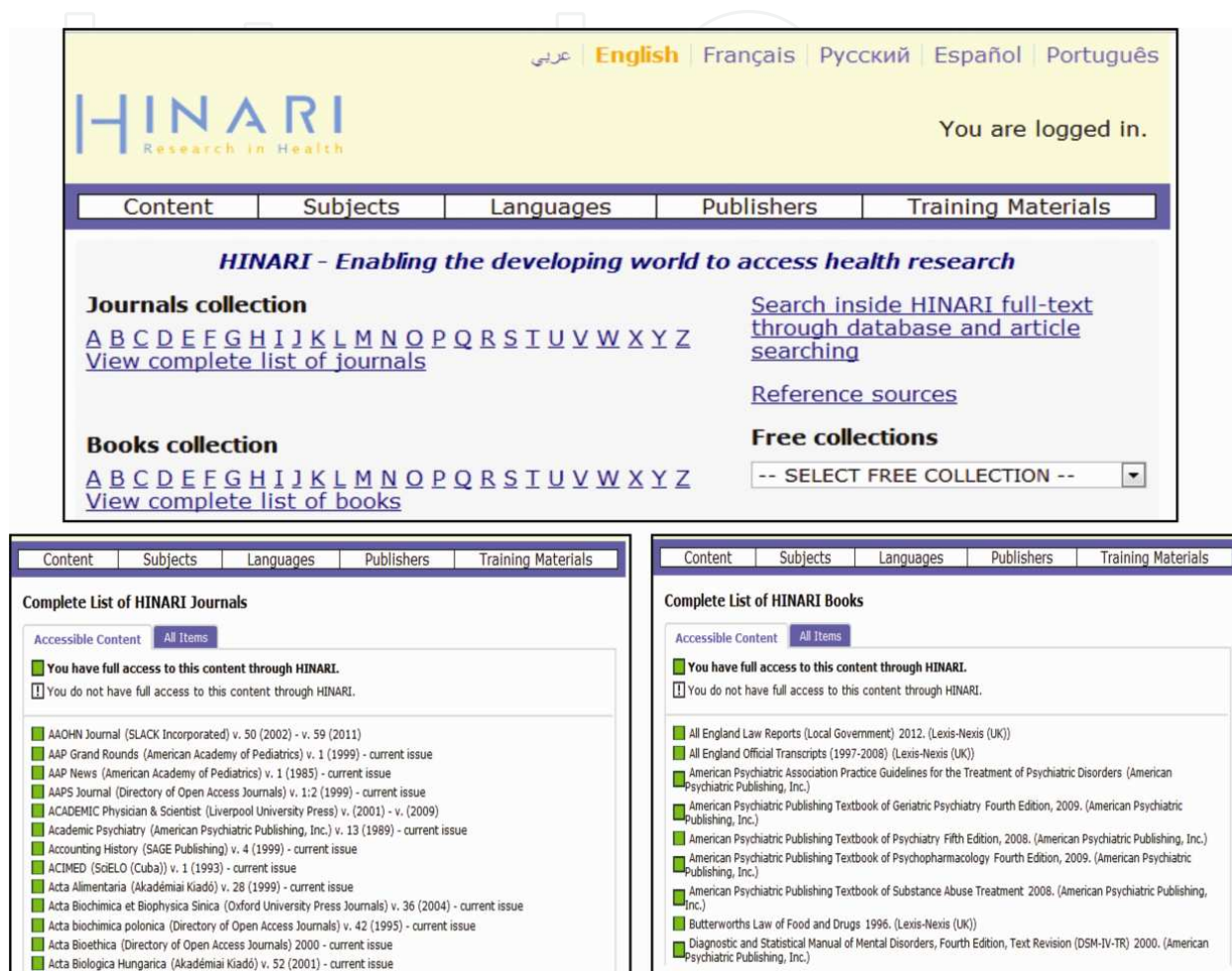
**Figure 8.** Health Internetwork Access to Research Initiative (HINARI).

Global representative health organizations, such as the PAHO, offer in their website important links, as well as free access to their publications (http://new.paho.org/) [57] (Figure 9). The WHO allows us to access important articles on disease control, vigilance systems and public health. The information is in three languages, including Spanish (http://www.who.int/en/) (Figure 9) [58].

The Center for Disease Control and Prevention (CDC), whose objective is to promote health and wuality of life, gives updated information on the control of disease, lesions and disabilities (http://www.cdc.gov/) (Figure 9)[59].

Figure 9. Panamerican Health Organization, World Health Organization, The Center for Disease Control and Prevention (CDC).

To access a consensus, the National Guideline Clearinghouse (http://www.guideline.gov/) (Figure 10) contains evidence-based clinical guidelines of the main medical societies in the USA and Canada, National Institute of Clinical Studies, National Institute of Health and Medical Research Council (NHMRC) which collects the CLG developed in Australia (http://www.clinicalguidelines.gov.au/) (Figure 10), National Institute for Health and Clinical Excellence (NICE), an independent agency of the UK's NHS in England and Wales (http://www.nice.org.uk) (Figure 10) or the Scottish Intercollegiate Guidelines Network (SIGN) which develops these products for the UK's NHS in Scotland (http://www.sign.ac.uk/) (Figure 10) [60].
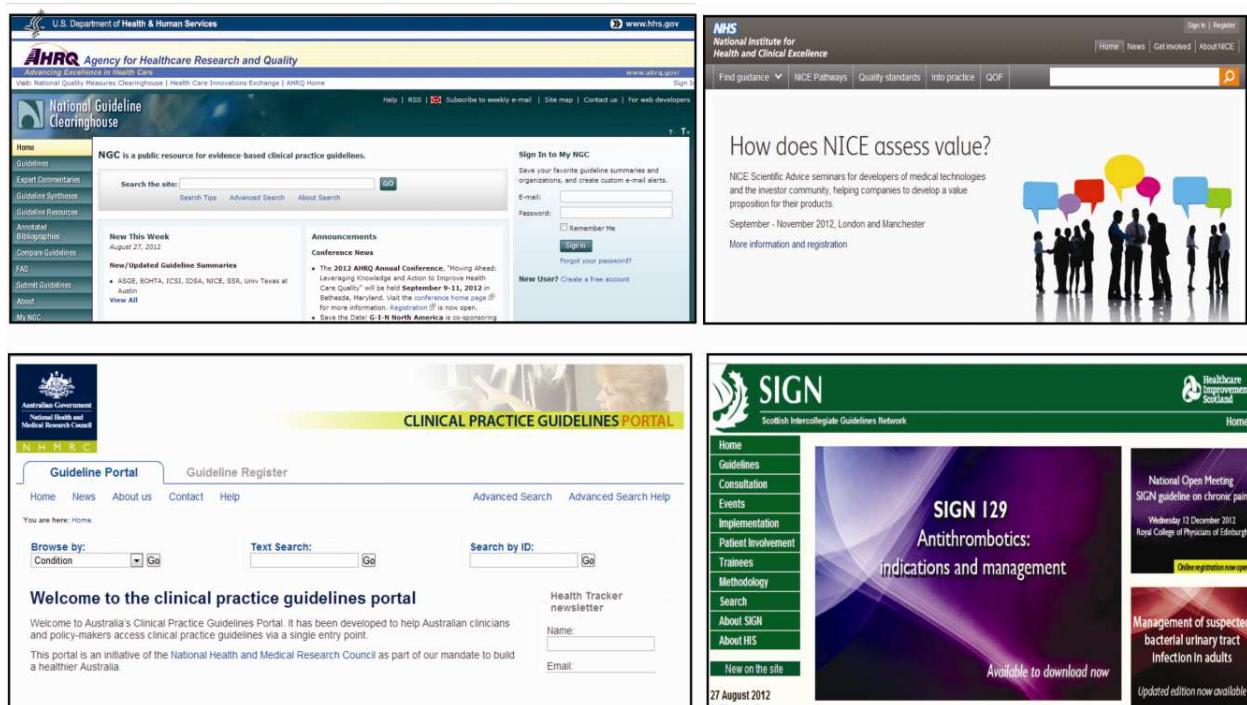
Figure 10. The Nacional Guideline Clearinghouse (AHRQ), National Institute of Clinical Studies (NHMRC), National Institute for Health and Clinical Excellence (NHS) y el Scottish Intercollegiate Guidelines Network (SIGN).

Other informatic applications for access to information on health, are represented by social networks, like Twitter, to promote research, disseminating scientific knowledge and funding opportunities, and being very useful for students, researchers and health professionals. [61,62]

4.2. Bibliographic reference managers

A bibliographic reference (BR) is a minimal group of data that allows the identification of a publication or a part of the same. There are as many types of BR as information sources. Among them, journal articles, electronic articles, books, chapters of books, thesis, norms, technical documents, videos, etc.

In turn, every BR is made up of diverse fields, some compulsory and other optional, which structure changes according to the BR format. However, in practice, every journal chooses its own format of citing and BR, being the most used: American Psychological Association (APA), Modern Language Association (MLA), National Library of Medicine (NLM), Vancouver style, among others.

Aiming to standardize the great diversity of formats available, in 1978, the Vancouver Group, later International Committee of Medical Journal Editors (ICMJE), requested the National Library of Medicine to estipulate the rules to write the BR [63], and in 1991, the NIH published

the *NLM Recommended Formats for Bibliographic*, based on the *American National Standard for Bibliographic References* [64].

Taking into account the need to manage the BR in a more efficient and agile way, endless softwares have been made available for the management of BR, being the most socialized in the world the Endnote [65]. It is commercial software for references and images, whose main function is to store, manage and search bibliographic references in a personal reference library. Besides, it allows organizing images including graphics, tables, pictures and equations, assigning each image its own caption and keywords. However, there are other free access resources, like Zotero [66], which is a Firefox-Mozilla Add-on, created by the University of Washington as an improved and free version. This software will let us automatically store our search results from Pubmed, build our BR library, and cite everyone in direct communication with Microsoft Word, Outlook, etc.
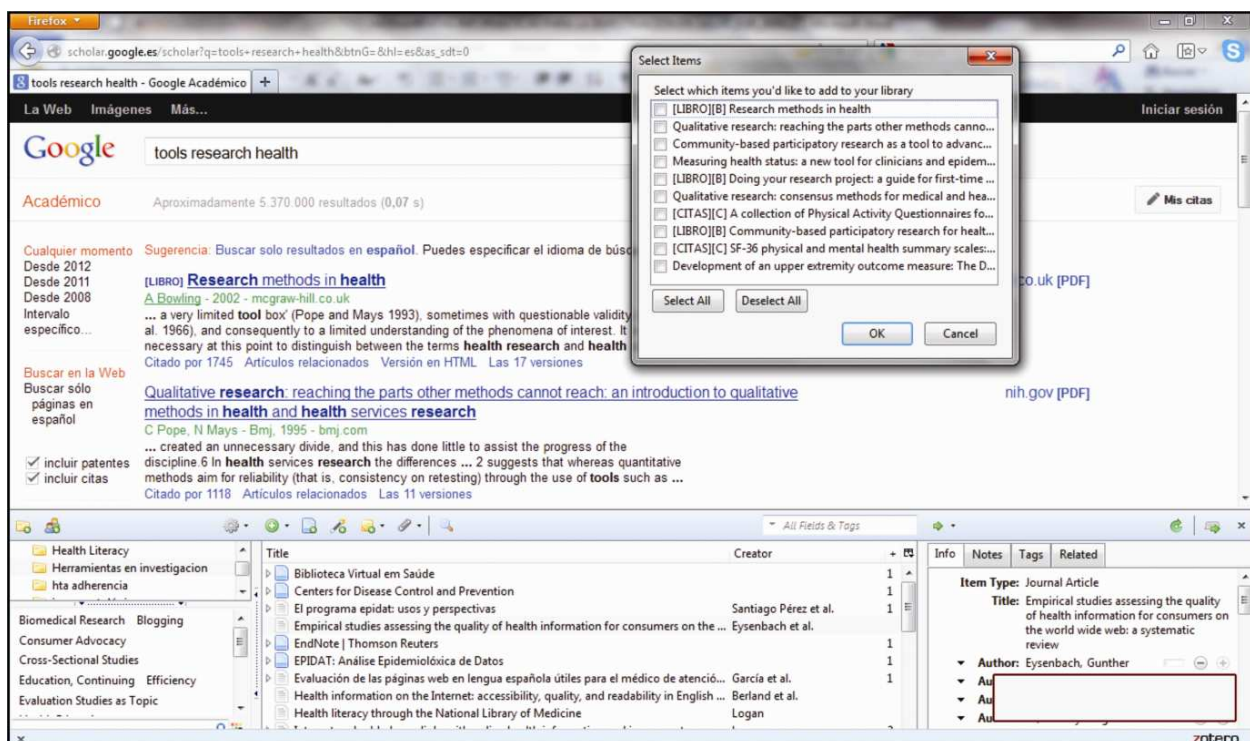

Figure 11. Applications of Zotero.

4.3. Statistic applications

A statistical package is a program or set of programs that allow sub applied to the same data file an unlimited set of statistical procedures in sync, without leaving the program. Among the statistical applications of special interest to the investigation, is the EPIDAT [67], which is a free program developed by public and led to epidemiologists and other health professionals to manage tabular data, allowing us to make a descriptive analysis, data filtering and impu-tation, sampling, parameters inference, contingency tables, matching and consistency,

diagnostic tests, rates adjustment, demographics, logistic regression, survival analysis, probability distributions, Bayesian analysis, meta-analysis, monitoring public health, measuring health inequalities, economic evaluation methods, etc. [68].

One of the most popular and used statistical packages is the SPSS, which is a statistical analysis and data management in a graphical environment system, using descriptive menus and simple dialog boxes that do most of the work, consisting of a simple interface, a data editor, with features such as multidimensional pivot tables, high-resolution graphics, database access, data processing, electronic distribution, and online help. Other programs of great usefulness are Stata, R, among others [69]

Figure 12. Software Statistics

5. Social epidemiology and the health inequities

5.1. Social epidemiology

Despite some theories, methodologies and tools currently used by social epidemiology date back to the 17th century, it hasn't been until the past century's last decades that it has consolidated as a scientific discipline. And, like any young discipline, it faced the questioning characteristic of its not well defined scope [8,9]. Some skeptics argued that the term 'social epidemiology' was redundant, because epidemiology is inherently a social term. However, the contributions made by Durkheim (1987), John Cassel (1976), Geoffrey Rose (1992) or Mervyn Susser (1994, 1996, 1998), to mention some of the most important; set the basis of the social determinants and health status of the population approach [9].

Social epidemiology is defined as the branch of epidemiology that studies the social distribution and social determinants of the health, implying that the purpose of its study is the identification of socio-environmental exposures that can be related to a wide range of physical and mental health problems [63]. To put it simpler, what distinguishes the action of a conventional epidemiologist from a social epidemiologist is the level of causal thinking. While the first one thinks: why does a person get sick?, identifying the best statistic tool to evaluate the association between a risk factor and the disease, the second one wonders: why is a society not healthy?, making out that factors which determine collective health are not individual, but that social determinants which have a direct impact on the health status of a population exist [8].

The concepts of social epidemiology have been evidenced since the findings of John Grant (1662), who identified social variations of mortality that was quantified on England chapels on the 17th century. Villerme (1830) and Virchow (1848) identified the social class and the working conditions as crucial determinants for sickness and health. Since then, these findings constitute the theoretic foundation necessary to try to resolve the persistency and even the recent increase in social inequities in health. While some communicable diseases have been eradicated, other have emerged or re-emerged. The epidemiologic transition has changed the disease profile to favor the chronic or non-communicable diseases, and the social inequities of health prevail [9]. This makes it necessary to incorporate social variables like direct determinants of disease or population disability [70].

This approach widens the need to use theories, and especially multidisciplinary techniques, to answer the new questions and rethink the answers to questions that were posed before. Theories like the social capital, particular of economy, can now be applied to resolve social epidemiology problems. Tools such as the multilevel analysis (multilevel regression models), first designed for social sciences (especially pedagogic research) and that were introduced into epidemiology in the beginning of the 80s, are now being spread as powerful analysis tools [71].

5.2. Differences between social epidemiology and field epidemiology

Even though field epidemiology and social epidemiology have the same epistemological, methodological and practical bases [4], in some situations they can be considered as the two extremes of a spectrum, between the practical application of the information for action on an

individual territory and the usage of the information for the elaboration of theories about the macro-social economic and political determinants, with few or hard practical application [4]. It is necessary then, to highlight some differences over the practical development of these disciplines and the implications these carry.

Taking into account this duo action-reflection, we could say that on one hand, field epidemiology it is developed an individual analysis of the diseases risk factors, searching for its application in the field to control the outbreaks, aided by strategies such as epidemiologic vigilance. On the other hand, social epidemiology seeks to analyze social factors (considered social determinants) and their distribution in populations as aggregate variables that have are more distantly related but crucial in the behavior of diseases in population groups [4].

It is important to mention than the places where both disciplines take place are different. While the first one acts in confined environments, the second one tries to take on broader territories, in which the public politics' implementation and design are necessary for health management. Social epidemiology focuses its concerns in the generation of evidence, to avoid health inequities, and its effect in the socio-environment conditions that increase a population's risk of getting ill. Otherwise, field epidemiology centers its work in the search for recognizable risk factors on an individual and collective level, to attend immediate healthcare problems such as epidemic outbreaks. However, the limit between these two disciplines is diffuse, so the challenge for young professionals in epidemiology is exactly to strengthen an integral and multidisciplinary profile to guarantee the generation of the best evidence that will allow answering to diverse problems of public health in all the levels

5.3. Theoretical background of social epidemiology

The role of the theoretical background to guide the direction of addressing the main research question in general in epidemiology, and particularly in social epidemiology, is unquestionable. The main theories that have given base over time to the foundation of social epidemiology can be summarized in: the psychosocial theory, the theory of social production of a disease, and the ecosocial theory of disease and its multilevel dynamic perspectives [72]. These theories not only allow to define the social epidemiology and to draw work lines in its field, but also to direct the dynamic and connections between the individual-biologic levels, along with our social existence.

5.4. Methodological background of social epidemiology

Most efforts to generate new methodological paradigms in social epidemiology are based in the generation of models that seek for the best way to incorporate the social factor in biomedical research. The simplest and most common model to incorporate these social processes considers them as distal antecedents of the biological cause of disease [73]. This implies that the distal social factors are related with a disease through common causal paths. Then, for example, the educative levels (distal social factor) are related to an inadequate diet and this, in time, may be related to many diseases like cardiovascular disease or cancer. Despite this focus would contribute evidence for the prevention, adding these distal social factors would not be entirely

necessary if we had an adequate knowledge of the biological factors, so we could indirectly eliminate the social gradient, taking part only the proximal factors.

A second model considers social factors as biological factors modifiers, in a way that these two would interact, generating biological processes that lead to disease. This model if genetic-environmental interaction implies that the presence of genetic factors is not enough to make a disease express itself, but that it depends of the environmental context in which it raises. Analogously, the influence of social factors depends on the underlying genetic conditions of the individual [73].

The third model considers social factors as an integral part of two biological systems, with the capacity to modify functional and structurally the biological aspects of individuals. This way, social experiences are able to generate direct changes in biological systems, being a fundamental piece on the understanding of these complex systems [73].

5.5. Social epidemiology and the analysis of health inequities

Currently, epidemiology constitutes an emerging field with an enormous potential to generate improvements in public heath, for it becomes evident that social factors and group dynamics affect the health status [74]. Understanding the biological phenomenon related to disease is necessary, but it is also vital to understand how society influences in biology, aiming to modify the illness risk. Social understanding is fundamental in the process of change and reduction of the burden of disease [75].

In the poor countries, people die unnecessarily. In rich countries, this also happens. This is explained by a social gradient that generates high mortality rates among those who have unfavorable socio-economic conditions, for which it is also considered unnecessary. The term inequity has a moral and ethical dimension: it means to differences that are unnecessary and avoidable, but also considered unfair and arbitrary. So, to be able to describe a specific situation as inequitable, the cause must be examined and judged as unfair in the context of what is happening to the rest of society. The crucial evidence to know if the resulting health differences are considered unfair seems to largely depend if the people chose the situation that caused the ill health or if that was basically out of their direct control [76]. Therefore, in the contexts where the fundamental and necessary execution of the autonomy and personal freedom is impossible, the health is powerfully affected, and it is the social conditions that determine the degree of these fundamental needs limits [75].

The health inequities analysis is based in the social epidemiology, to reinforce the important role of the environment as cause of the disease. A typical example is the modification of the disease profile that happens in migrant population when they change their resident environment [75]. And this environment is the own social context in which diverse factor interact to favor the development of diseases. The analysis and understanding of the dynamic that governs the interactions of individual and social factors would allow us to modify the inequities and improve the health. Besides, we must take into account some considerations: there is the need to act over the social gradient that limits the people's autonomy and freedom, to adopt healthy surroundings, but one must not focus the efforts only on the

poorest sectors, but in the whole social gradient aspect [76]. This way we can generate health politics that will cover all the sectors in an integral way, with a proportionally bigger impact in the least favored sectors. This politics generation must be sustained in the systematic application of the best evidence, relating knowledge with action and opening new opportunities for the prevention [77].

6. Health inequities in Latin America and Peru

Latin America is considered the region with the largest inequities on the planet. It's the continent where, according to multiple studies, the polarizations are larger in diverse fields, and the access to opportunities is notably different for the different social sectors; and maybe where the difference is more notorious is in health, which belongs to the most basic human rights category [78].

There have been considerable progresses in the health matter in Latin America. However, there are serious problems that show the presence of an acute pattern of inequity. The national averages show progress, but when they are broken down to socioeconomic levels, regions, gender and ages, there can be observed wide sectors of the population with serious problems [78].

In this context, the clinical epidemiology has the commitment to measure the impact of the healthcare interventions, where the clinical trials rarely are reported by socioeconomic levels, given that the population's health and the clinical epidemiology support evaluating the efficacy, effectiveness and cost-effectiveness are very importan to define the impact of healthcare in health inequities [17].

In Peru, this type of analysis is being carried out more frequently since the beginning of the past decade. For example, in the year 2002, the Grupo de Análisis para el Desarrollo (Group of Analysis for the Development - GRADE), led by Dr. Martin Valdivia, did a study about the health inequities in Peru, using socio-economic indicators taken from socio-demographic national surveys and evaluating its strength to generalize the results [79].

The descriptive analysis establishes that the largest inequity is in the children's chronic malnutrition and the usage of health services in general. About 30% of the rural children of the poorest decile suffer from chronic malnutrition, but this rate is *just* 4% in the richest decile. This means that the poor/rich ratio is 7.8. In rural areas, this ratio is *just* 3.6, but this is the reflection of an even worse generalized condition where the malnutrition rate between the poorest children reaches 64%. On the other hand, medical attention during labor shows an inverse relation where the rich/poor ratio in rural areas reaches 17.2, and less than 4% of the poorest rural women have a doctor present at the moment of labor. This ratio decreases to 2 in urban zones, and almost 50% of the women of the poorest decile can access this type of healthcare. This results don't change with the socio-economic level indicator (ELI) used, except In the case of child mortality, where an astounding and disturbing result is that there is no finding of an overwhelming relation with the ELI of the home, especially in the rural areas [77]

7. Evidence based medicine in hospital practice and in public health

Currently, the tendency of science is focused in the generation of evidence to contribute in its development and has an impact on the patient's health. This approach of Evidence Based Medicine (EBM) is shown mainly in healthcare, related to drugs and medical devices. However, it is admitted that the community interventions through Public Health deserve to be recognized as transcendent elements that have had an impact in the population's health. In this way, it is necessary to recognize the existence of research that advocate to evidence the impact of Public Health's diverse activities.

The Evidence Based Public Health (EBPH) maintains a cause-effect logic, and allows to add the health determinants, like lifestyles, culture and environment, in a scientific context, because many times it's them who characterize the good or bad performance of a certain intervention. This way, EBPH is a new tendency that has been joining efforts to give the best information for the most efficient politics decisionmaking.

7.1. Evidence based medicine in the clinical environment

The practice of EBM in the hospital environment benefits doctors and students, for it collaborates in the obtaining of evidence selected for its quality, informatics value and relevance for the user (for example, the services produced by McMaster premium service literature [PLUS] as well as the ACP Journal Club Plus). One of the current benefits is that it allows concentrating opinions related to methodological quality and potential relevance for its use. This way, the McMaster University has developed the program 'McMaster Online Rating of Evidence' (MORE), in which it allows the professional to have literature of the most technical quality and relevance. This is through a classification given by professionals from diverse latitudes from around the world. Beside, these services present clear and relevant results, and offer to visualize comments or criticism, independently for the management of said information [76]. This information, according to the analogy used, tells us that 'the EBM and nuclear fission can be very powerful when they are appropriately used and dangerous if not', because the fact that EBM separates describing, the underlying quality of the evidence, the magnitude of the effects or the applicability of any of the results in the context, the values and the preferences of the patients should not be considered [80].

Therefore, there is no doubt that EBM has allowed to progress in the medical practice. However, the application in the Health System has been inconsistent, meaning that the EBM would improve the health of the population. The differences in the health systems, globally, on the healthcare of the population, limit the capacity to incorporate easily the progress of the EBM, or often to certain discriminating point by economic or politic limitations [81]. Nevertheless, it is important to point out that it has been found in primary healthcare a relation between the high knowledge of EBM and a better quality of healthcare [82]. Although, when evaluating EBM at workplace, as a method of formative performance evaluation, there is not much evidence that shows the impact on the education of the doctors and their performance [83].

In relation to the use of EBM, one can point out that the public hospitals there is a favorable attitude. Besides, it is recognized that doctors who practice the EBM show a more prone attitude to change information and counseling through mutual collaboration networks [84,85]. Doctors recognize also the gap that exists between the EBM applications to clinical practice, for it is difficult to avoid the clinical experience, colleague's opinions or some scientific studies, which are not EBM, in their decision making. The confidence in decision making based on clinical experience increases with the time of service. However, there are few doctors that inform that clinical experience should be the only one used. Most doctors estimated that EBM practice should be guided by local evidence collected from local practice, because it will allow to back up their actions in clinical practice [86]. Therefore, the fact of automanaging the evidence would help the patient's, for example, chronic diseases and to pay attention to the unhealthy factors of a community, which could be added in the EBM to create a wider paradigm [81].

Regarding this, it should be noted the experiences from Canadian family doctors (where the EBM was born) who report positive attitude toward EBM, recognizing that it improves patient's healthcare and considering that the research findings are useful in the management of everyday patients. However, in clinical practice, the decision making can be influenced by a demanding patient, that can call for some detection test (OR: 5.15; IC95%: 2.9-9.2). Though this relation was not kept regarding the therapeutic, it is important to value the preferences of the patient and the clinical context seems to reflect more precisely the clinical reality of EBM and primary healthcare doctors [87].

7.2. Evidence based medicine compared to evidence based public health

The EBM is a methodology to evaluate the published clinical research, and its use is starting to be considered as a referent for knowledge and in the clinical practice evaluation, Its methodology is mainly based in the usage of evidence, like systematic reviews and meta-analysis, through which it seeks to offer answers to concrete clinical questions, this answer being backed up by statistic evidence. The application of EBM has multiple benefits, but also has various difficulties in clinical practice for it is hard to hold it freely, without taking into account the cultural, academic and socio-economic environment of every latitude. Therefore, its correct use is a challenge for contemporary medicine [10]. This approach of EBM allows the health provider (health professional) to use it in favor of his clinical practice, like in the hospital environment. Athough it is not compulsory, its utilization serves in health teams committed to improve hospital healthcare.

This EBM approach, applied to the Public Health interventions, it is not adequately adjusted, because EBm uses as a gold standard the clinical trials, whose use in public health is of difficult extrapolation for when it is applied to the population, it demands other variables to be considered that may directly influence over the expected outcome [83]. To this situation, the EBPH approach collaborates to concentrate efforts to sustain evidence that backs up the health politics and community interventions, though there are known limitations of the EBPH's use of evidence for using observational studies that have been systematically underestimated by EBM as a reference. Currently, models of technical evaluation have been developed, serving

as a filter for evidence and collaborating to improve the selection of more methodological stringency studies to be used in Public Health.

Among some of the evaluation models for effectiveness of the Public Health interventions, many maintain common aspects. However, there still isn't a global consensus regarding it. Some strategies can be noted, lie the TREND (Transparent Reporting of Evaluations with Non randomized Designs), which evaluates the severity of publications which inform of Public Health interventions. The MOOSE (Meta-analysis Of Observational Studies in Epidemiology), for the reading of observational studies meta-analysis, or the STROBE (STrenghtening the Reporting of OBservational studies in Epidemiology), for cohorts and case-control studies, can complement the ability to improve the systematization of information related to Public Health interventions [11].

In general, it can be said that the EBM and EBPH have a common origin, which is the use of epidemiology as a decisive tool for the selection, evaluation and recommendation of evidence for its use, whether in hospital clinical practice of the social environment, which is Public Health.

It can also be said that there are obstacles in the incorporation of research in the politics, apart from limited budgets. Although the politic makers could benefit of the EBM if they train in said approach, to help them identify and evaluate high quality information. This way, researchers and those who are designing health politics can make a synergy for the best decision making for the population and the country. This can be used as generation and intervention experience exchange networks for future health politics [88].

8. The cause-effect logic in the public health interventions

Epidemiology as such helps the health sciences to understand the diverse causal mechanisms where the cause-effect relation aids to evidence factors that determine health problems. This way, Public Health is one of the specialties that uses it as an essential tool to show reliable evidence that will help understand the diverse health problems that populations have. However, at the moment of structuring the causal map, in many of the public health causal factors it can be seen that they rely on social determinants. And, on the other hand, that the public health problematic is multifactorial. The analysis shows us that this is the epidemiology's challenge to obtain a critical causal path that collaborates to understand that the modification of an event sequence (factors) can be stimulated to generate the expected outcome in the health problems of a population, being this event sequence the critical causal path.

According to what it is stated, a group of steps that aid to develop this critical causal path will be explained, which will be used as an axis for the diverse approaches of the public health's interventions.

Step 1: Recognize the public health problem: The problem evaluation approach in public health can be obtained from different sources, primary or secondary. Primary sources are the most difficult to be obtained, because they demand resources and time to be able to get scientific studies that collect the divers health problematic. In general, given the technical and political

circumstances, it is more viable to use secondary sources, which collaborate to problematize the health status of a population. This way, one of the main management tools used according to the geographic space is the Health Situation Analysis (HAS), whose methodology allows to evaluate three important aspects: social determinants (socio-economic, cultural, lifestyle, commerce, environmental, etc. aspects), morbidity and mortality (Child mortality rate, Maternal death rate, main diseases and death causes, etc) and the social answer (health systems, health establishments, human resources in health, equipment, etc.) which, when analyzed in an integral way, can issue the main health problems of a certain geographic space, as well as its interaction with the intervention carried out by the Nation. At the end, it must be highlighted the health problem that must be taken in tis real context.

Step 2: Causal map with an evidence approach. It is the evidence systematic evaluation that explains the health problem related to its causes and the effects it can generate. When graphed in a causal map, it aids to show the cause-effect relation, and being back up by scientific evidence, it makes the health decision maker to have a wider spectrum of the multiple causality of the health problem. Then, it helps to maintain a multifactorial perspective of the public health problems. In the design of the causal map one should provide the most scientific evidence there exists, doing a bibliographic research using the informatics tools and main scientific portals, without putting aside the selection and evaluation of the articles with the methodological severity already noted in the EBPH.

As an example, it can be shown in Figure 13, the causal map of the health problema: "Chronic malnutrition in children under 5 years old from rural zones".
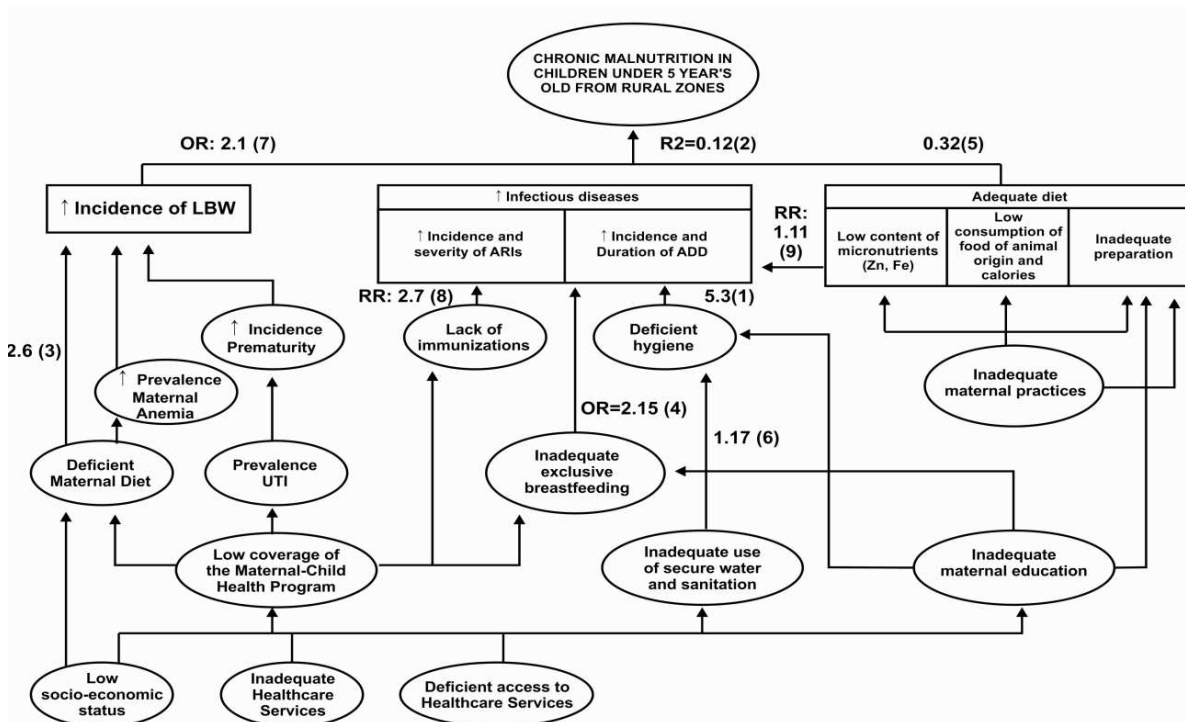

Figure 13. Causal map of chronic malnutrition in children under 5 years old from rural zones.

Evidence	Place	Type of Study	Interventions/Results	Evidence level	Quality of Evidence	Value
1.- N. Etilera, S. Velipasaoglub, M. Aktekinc. Risk factors for overall and persistent diarrhoea in infancy in Antalya, Turkey: a cohort study. Public Health (2004) 118, 62–69. (13)	Turkey	Cohort	Evaluation of lack of hygiene and increase of ADD.	II-2	3	RR : 5.3
2.- Peter G. Lunn. The impact of infection and nutrition on gut function and growth in childhood. Medical Research Council, Ke Peter.Lunn1@tesco.net CAB International PNS Proceedings of the Nutrition Society (P185©N4S N 9u9tr-i1ti1o6nC Slion cicieatly nutrition in childhood P. G. Lunn147 2000)© Nutrition Society 2000 59. (14)	Gambia	Review	Papers done in Gambia on the association between digestive infections and chronic malnutrition are evaluated.	II-3	4	$R^2 : 0.12$
3.- Maleta K, Virtanen S.M, Chilhood malnutriition and its predictor in rural Malawi. Paediatric & Perinatal Epidemilogy, volume 17, Number 4, October 2003, pp. 384-390. (15)	Malawi	Case-Control	Evaluates the association between deficient maternal diet and the increase in LBW.	II-2	3	RR: 2.6
4.- Alex K Anderson, Grace Damio, Sara Young, Donna Chapman. A Randomized Trial Assessing the Efficacy of Peer counseling on Exclusive Breastfeeding in a predominantly Latina Low income Community. Arch Pediatric Adolesc Med 2005; 159, 836-841. (16)	Latin communities	Randomized Clinical Trial	Association between breastfeeding and ADD	II-1	1	RR: 2.15
5.- Bhandari N, Mazumder S, Bahl R, Martines J, Black R and Bhan M. An Educational Intervention to Promote Appropriate Complementary Feeding Practices and Physical Growth in Infants and Young Children in Rural Haryana, India.J. Nutr. 134:2342-2348, September 2004 (17)	India	Cluster Clinical Trial	Evaluation of the educational intervention in feeding practices and malnutrition.	I-2	1	Difference in growth 0.32 cm and 0.5cm
6.- Merchant AT, Jones .C, Kiure A, Kupka R, Fitzmaurice G, Herrera MG, Fawzi WW. Water and sanitation associated with improved child growth European journal of clinical nutrition 2003 Dec57 12 1562-8 (18)	India	Observational	Association between inadequate water-drainage services and inadequate practices.	II-3	3	OR: 1.6
7.- Instituto Nacional de Estadística e Informática PRISMA – Dirección de Investigación. Determinantes de la desnutrición aguda y crónica en niños menores de 3 años. Un sub-análisis de la ENDES 1992 y 1996. (19)	Peru	Observational	Association between low birth weight and malnutrition.	II-3	3	OR: 2.1
8.- Deb SK. Acute respiratory disease survey in Tripura in case of children below five years of age. J Indian Med Assoc. 1998 Apr;96(4):111-6. (20)	India	Cohort	Association between immunizations and ARIs.	II-2	3	RR: 2.7
9- Tarun Gera, H P S Sachdev. Effect of iron supplementation on incidence of infectious illness in children: systematic review. BMJ vol 325 16 Nov. 2002. (21)	-	Systematic Review	Effect of iron on infections in ADD.	I-1	1	RR: 1.11

Table 5. Evidence of the causal map of chronic malnutrition in children under 5 years old from rural zones.

Following the direction of the arrows in the causal map, the cause-effect logic can be defined, and the numbers attached to the arrows represent the scientific evidence that support said causal relation, which can be compiled in an evidence table as it is shown in Table 5.

So, showing the interaction of variables in relation to a health problem, the decision maker of health policy can see in the bottom of causal map, which it can fall on social determinants, such as low socio-economic status, and often it is not feasible his intervention from short to medium term. On the other hand, we can see that variables are likely to be modified, and that the modification of these stimulates the changing chain of whom it has direct causal association. Under this perspective the formulation of a critical causal pathway can be based.

Step 3: Build critical causal pathways: Many times in the search for evidence in Public Health to develop interventions that will reduce health problem, one must have clear interaction of the direct and indirect variables that are related to health problems, in order to provide technical support on what you want to modify. Thus the critical causal pathway contributes to show schematically the interaction of the direct and indirect variables to health problems and allows the decision maker to choose to evaluate the various critical paths that can be noted in health interventions. Regarding the causal map example of Figure 14, one can observe the causal pathway designed as an example of a way of assessing a probable health intervention, which pretends to check how the intervention with fortified food programs can collaborate to reduce chronic malnutrition in children under 5 years old
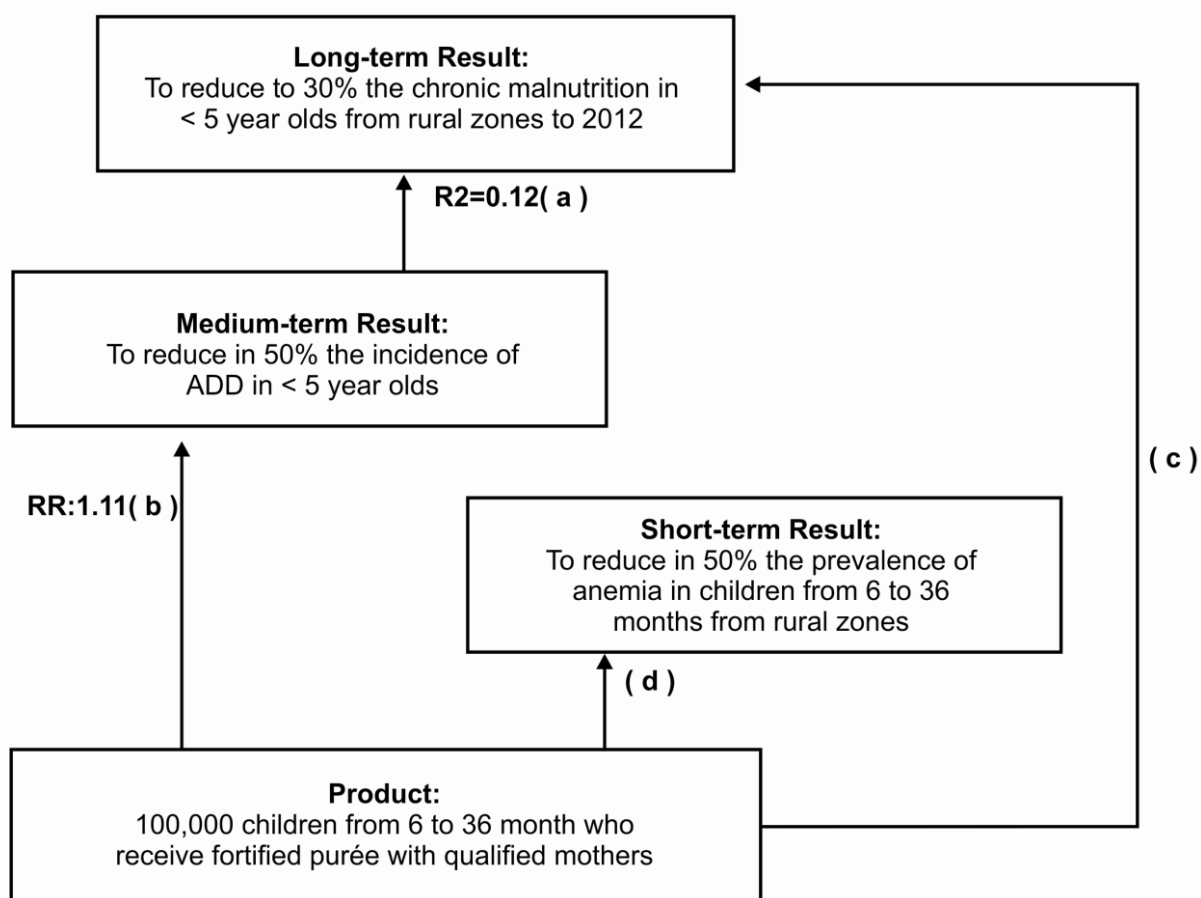
Figure 14. Critical causal chain of the fortified food program to reduce the chronic malnutrition in children under 5 years old from rural zones.

Author	Design	Outcome	Population	Effect	Degree of recommendation	Evidence level
Peter G (a)	Analytical	Chronic malnutrition	Children	Diarrhea increases chronic malnutrition (R2 : 0.12)	B	III
Tarun Gera (b)	Review	Diarrhea	Children	Iron supplement RR: 1.11	A	Ia
Apolaya M (c)	Review	Chronic malnutrition	6 to 36 months	Non conclusive	A	Ia
Assunção MCF (d)	Review	Anemia	Infants	Non conclusive	A	Ia

Table 6. Evidence that sustains the causality relationship

Furthermore, it is important to contextualize the propositions of health interventions with economic aspects of each one, and the methodologies, as economic assessments developed by each country. That brings us to rethink that one must recognize that the health problems or health interventions that are probable to be carried out are greatly influenced by socio-political considerations, but that despite the political and circumstances it is our desire, as technical authorities, to show, in the most objective, efficient and effective way in this task, with the support of scientific information through the MBE or SPBE (Table 6)

9. Conclusion

Clinical epidemiology and field epidemiology share the same methodology and tools, differing in individual application and the population respectively, but are complementary to public health.

The EBM is demanded by patients for a better diagnosis and treatment, in addition to recognizing the importance of clinical epidemiology in the development and promotion of research, progress that is driven by the software tools that facilitate the researchers' performance and in modern times it is essential to know and apply them.

Social epidemiology studies the social distribution and social determinants of health states ranging from individual levels (risk factors) to social phenomena (social determinants), seeking answers to the complex dynamics behind social distribution of health and in that context is EBPH an important tool to improve the analysis of public health interventions that can help to improve decision-making at the policy makers of a country's health.

Finally clinical epidemiology has enormous potential to generate real and positive changes in public health, becoming a challenge for new professionals in epidemiology and public health for their increasing and complex development

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