



## A NEW SCIENCE, TECHNOLOGY AND INNOVATIVE POLICY

### Task Force: Medical Sciences and Public Health (TFM)

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## **Introduction**

The state of scientific research in Lebanon needs to be evaluated regularly. This task is even of more immediate importance in the post-war years. Lebanon has been blessed with a unique geographic location that enabled it to play an important interface role between many cultures. This resulted in heightened awareness and involvement in education throughout its history. In recent years, the events in the region and the continuous instability have derailed Lebanon's position. Now after healing internal wounds, Lebanon is poised to resume a pioneering and a leadership role in education in general, health and biomedical issues in particular. If one would critically evaluate the overall current status of science in Lebanon, one could pinpoint deficiencies at many levels in our approach to science and technology. This report has been compiled to assess our weakness and strengths, opportunities and threats (SWOT) and recommend strategies and modalities to address them.

## **General background**

Lebanon is currently basking in the light of reconstruction after the civil war. Although the effect of the war is still felt widely, Lebanon still boasts higher than other regional countries GDP, relatively young population and a healthy sector of multicultural and highly educated population. Historically, Lebanon has been home not only to numerous higher education institutes but also to some very prestigious ones. The number of educational institutes in Lebanon has recently mushroomed. This explosion in the higher educational system in Lebanon is not without perils. Recently, in the absence of significant Ph.D. programs and uniform academic standards, interest has been focused on degrees at the level of B.Sc., M.Sc. and MD that exceeds our needs hence creates a pool of unemployed or underemployed qualified graduates. Moreover, the emphasis of these degrees is on the arts and humanities and theoretical sciences with little emphasis on applied sciences. This overproduction results in a mass exodus of our graduate students, leading to a significant "brain drain".

Excellence in education in Lebanon can be attributed to dependence on indigenous talent and a local thirst for achievement through education. This results in a high percentage of educated individuals with a relative gender un-bias when compared to neighboring countries. The relative strengths of our education system are matched by some serious problems. The general disinterest in scientific research has an important impact on the quality of teaching. It is dangerous to continue university teaching without research. This situation is further complicated by a prevailing dismal economical situation, humongous national debt which is reflected by a meager budget for national research.

Currently, very few institutions are monopolizing the bulk of scientific research in Lebanon. Funding for this sporadic research effort is limited to very few sources whether public or private. Moreover, the most productive research is usually championed by dynamic individuals, based on their earlier achievements abroad, with little or no institutional incentives. The lack of reward and punishment "up or out" in our universities, in general, cultivates a culture of apathy. This coupled with the absence of any meaningful collaboration within the institution, or between institutions, adds to the severity of the problem. The outcome is a weak research out-put with few quality publications that jeopardizes the chances of external funding from international competitive sources, or the capitalization on potential patents from important discoveries.

Research is a national priority that needs solid commitments. It is mandatory to fall in line with the international direction. The UNESCO declaration for the new millennium states that scientific

research is the motor for technology and advancement. The future of the developing countries rests on their ability to acquire research skills. The creation of research culture and proper environment has not been forthcoming. The establishment of the tools for the creation of this proper research environment and the providing of all needed resources should guarantee the reversal of the current weak research out-put. We should engage in a serious discussion to define research priorities, recognize the importance of scientific research and be creative in its funding. The recruitment of the private sector through tax incentives to invest in research, the creation of translational research and linking centers of excellence with the economical players are currently missing.

### ***State of medical and health science research in Lebanon***

Unfortunately, the picture from medical and health science research is not any brighter despite a large number of physicians working in well-equipped medical centers. For a developing country, Lebanon ranks with developed countries' statistics as far as number of physicians and sophisticated medical equipment per capita. Clinical research seems to revolve around relatively un-important epidemiological or retrospective clinical studies. This is in part due to the nature of funding usually supported by drug companies for promotional purposes rather than through drug development. This kind of research has a limited impact on the practice of medicine locally and abroad.

The Lebanese population conforms to the rest of the world with respect to medical and health needs. Although there are a few regional genetic and infectious disease states, the Lebanese suffer from diseases common worldwide. Some of the specific problems arise from the developing nature of Lebanon where ignorance and poverty may impact health issues.

### **Lebanon's ambition**

Lebanon has for many years established itself as a regional leader in the field of higher education, medicine and health care. Lebanon remains poised to resume this function. We believe that capitalizing on our proven history coupled with investment in the future should regenerate and expand our ability to lead in the fields of health and medicine. It is well recognized that good quality teaching, medical and health care depends on the upgrading of knowledge through good quality research and production of new knowledge. Also, improvement of technology depends on improvement of scientific research. For these reasons, investment in research will improve higher education, medical and health care. This will also create the potential for generating new companies and hence offer new jobs in the sector of biomedical industries.

### **Specific aims**

In the initial phase of STIP implementation, the task force members elected not to specify any particular research topic but rather to recommend some general measures as well as the mechanism for identification of these research priorities. This choice is justified by two reasons: First, our medical and health needs are common worldwide. Second, the current research activity must be evaluated thoroughly, as a prerequisite to define research priorities and suggest future research axes. Four specific aims were identified. We propose the following for the improvement of the medical education and health care in Lebanon:

Specific aim 1: Improvement of higher medical and health science education through mandating the development of scientific research in the medical and health fields.

Good quality teaching depends on good quality research and production of new knowledge. Most of the universities in Lebanon are institutions for automatic transmission of “second hand” knowledge without significant contribution to the production of knowledge. Scientific research is neither a hobby nor a luxury or a tool to achieve self-promotion. Research should be mandatory at the university level and research output should be used in the auditing process of universities and their teaching activity. A healthy balance between demand and supply of qualified medical doctors, basic science researchers and support personnel should be based on a continuous critical assessment of assets and liabilities both at the local and regional levels.

Modern research does not necessarily need extraordinary equipment or massive investments that are the privilege of rich and developed countries. Nowadays, many modern research centers could be realized through relatively moderate investment provided the necessary networking and better use of resources are available. Rational investment of the human potential in fields such as molecular and cellular biology requires well-defined structures rather than very expensive equipment. These structures are based on qualified technicians, students and trainees (M.Sc., Ph.D, post-doctoral), appropriate equipment, access to modern tools of information, qualified mentors with established records that could be recruited from within Lebanese institutions or from abroad.

The most productive years in a student life are during the Ph.D. and post-doctoral training. Lebanon so far has been deprived of the most valuable and fundamental resource, namely qualified, educated and motivated people, hence, and no effort should be spared to correct it. Every effort should be made to create, over time, all the prerequisite conditions required for the successful launching of Ph.D. programs in Lebanon. Concurrently, funding of post-doctoral research fellowship in Lebanon should be established and encouraged. For this to be achieved, support for documented successful research by local scientists should be emphasized. This could be attained through the creation of teaching versus research tracks within universities or the lightening of teaching and administrative duties of promising research scientists.

Local public and university funding of research proposals should be funneled to collaborative research programs where the expertise of many scientists and resources are pooled to ensure the successful completion of the proposed studies. Scientific research is a highly specialized activity where most advanced instruments and techniques are used. Also, research is now evolving at a high rate that necessitates constant investment in new technologies and reagents. For this to be facilitated, the country should gear itself to deal with this issue (expedite paper work, reduce red-tape, custom and governmental restrictions). Also, creating the right research atmosphere should attract back to Lebanon prominent and established scientists who have proven records as judged by their excellent positions outside Lebanon. Moreover, we should entice and use established Lebanese scientist’s from reputable institutions to contribute to the establishment and seed collaborative research programs through funding of bilateral travel and support.

Successful modern research is conditioned by recruitment of a group of researchers reaching the level of a critical mass in one field of knowledge. This is to be considered at national and regional level. Reciprocally, isolated researchers, even with the best qualifications, may decline over time and may fail to follow the advances of modern science. This justifies the creation of incubators and centers of excellence for a better use of available resources and to attract and enroll new comers for a better investment. Identification through auditing and quality assurance of the research output of current and potential centers of excellence and investing in their success through priority funding, possibly in partnership with industry, should create these incubators

where applicable scientific innovations are created and their benefits are reaped.

### **Recommendations**

Legislate and audit new standards for education, training, and research for existing medical and public health (health sciences) schools that ensure good quality teaching and value-added research conducive to a certain measurable outputs. Adherence to such standards should be used for evaluation of eligibility for re-licensure and eligibility for research funding.

Identification or creation of centers of excellence in research grouping qualified teams of professionals, personnel and trainees together with appropriate equipment, access to professional networks and modern tools of information. Senior professionals and researchers committed, partly or totally, to such “Centers” through incentives and reward systems from the CNRS could serve as mentors to others. By being part of international networks of research, these centers of excellence could attract to Lebanon prominent and established scientists who would be able to develop research dynamics that would develop opportunities for other researchers thus helping address the challenges of brain drain.

Intra or inter-university collaboration between established Lebanese scientist’s working in complementary fields is highly recommended and should be encouraged through incentives and reward systems including priority funding.

Increase national funding to reach a level of research competitiveness that is appropriate to attract further funding. Make and diffuse accessible information about opportunities for extramural funding from competitive international sources. Provide technical support for application process and improving chances through providing matching funds.

Facilitation of research at the governmental level: expedite paper work, reduce red-tape, custom and governmental restrictions.

Create, over time, all the prerequisite conditions required for the successful launching of Ph.D. programs in Lebanon. Start by using a hybrid Ph.D. program whereby foreign universities are granting degrees for research activity completed in Lebanon under the mentorship of faculty in various local universities. Also, funding of post-doctoral research fellowship in Lebanon should be implemented.

Specific aim 2: Improvement of the quality and cost-effectiveness of medical and health care through the development of scientific research in the medical and health fields.

Medicine is becoming a pure science rather than a pragmatic practice. Appropriate medical and health care depends on the upgrading of knowledge of the medical and paramedical staff. We should aim to put restrictions to the current abuse in medications, medical procedures and “sick-leaves”, which represent a substantial economical drain. Appropriate and responsible engagement of the health care system by beneficiaries and consumers would result in serious economic savings through: (i) avoidance of states of illness, disease and sickness; (ii) rational use of physical facilities, technology, and pharmaceuticals; (iii) responsible attitudes towards sick leaves; and (iv) proactiveness in favor of prevention and promotion activities.

The improvement of the quality of health care in a country depends on the concepts of continuous medical education, auditing and quality control. Continuous medical education depends intimately on continuous production of knowledge through research. The development of research-dependent medical centers of excellence that will attract regional interest should be realized.

Quality control and auditing must be based on updated knowledge about procedures and advances in knowledge. Quality care depends on the good training of medical students, interns, residents, fellows and paramedical personnel. This training depends on the contribution to knowledge and ability to acquire new and appropriate technologies.

### **Recommendations**

Encourage and provide incentives for the creation and development of multidisciplinary research teams that integrate basic health and medical sciences with social sciences and clinical medicine. Encourage, and provide incentives for, the involvement of social scientists in health related research

Encourage and provide incentives for research in the fields of health promotion, prevention, rehabilitation, and towards identification of alternatives to hospitalization.

Development of research-involved health and medical centers of excellence which can attract national and regional attention and interest.

Encourage and provide opportunities and incentives for the involvement of paramedical personnel in modern medical and paramedical technologies

Recommendations for specific aim 1.

Specific aim 3: Creation of academic/industrial/community bridges for their mutual benefit through biomedical technology transfer and development.

UNESCO declaration for the new millennium states that scientific research is the motor for technology and advancement. Improvement of technology depends on improvement of scientific research. The pool of money available to researchers can be divided into four categories: government sponsored research, academic institutions' sponsored research who also serves as conduit for charitable funding, drug and pharmaceutical manufactories and companies and lastly extramural competitive international funding.

A valuable source that should be tapped and developed, based on other countries successful experiences, is partnership with local and international biomedical industries. Biomedical technologies include pharmaceuticals, biotechnology, medical devices, hybrid devices, biomedical engineering, diagnostics, and health care-related information technologies. In the area of biotechnology, there is a long lag phase between initial investment and profitability and it is difficult for capital markets to assess accurately the risk associated with early-stage technologies. For these reasons, and due to lack of incentives to encourage such investments, the private sector under-invests in commercializing the results of basic and early-stage applied research. Currently, in Lebanon, support for basic and clinical research from industry is negligible. Special effort should be made to provide clear and attractive information about the promises and the investment opportunities in medical research and technologies. To convince local industrials using imported technology to invest in research and biotechnology, several mechanisms should be implemented.

This could be started by giving tax incentives that will launch the "ball rolling" process. This should serve as a starting point for confidence building.

This should be accompanied by establishing bridges between researchers looking for sponsors and industrials looking for investment. The CNRS needs to initiate such interaction by providing proof-of concept funding through a seed capital followed by an early market development fund.

## **Recommendations**

1. Investigate privileged sectors where we can do contract research for international industry with limited funds from the industry. A relevant example is through establishing and funding new research programs in genomics (proteomics, structural genomics and drug discovery, pharmacogenomics, etc..) where investment is likely to be profitable in short terms and long terms.
2. Involve interested community and industry representatives and activists in research boards / steering committees and in research related decision making.
3. Priority and proactive funding of research programs / activities that aim at producing a “product” that is of value to involved / targeted industry and could be marketed in actual or adapted form.
4. Sponsor advanced training (doctoral and postdoctoral) in fields that would facilitate value-added “product” oriented research.
5. Encourage the private sector to invest through taxes incentives.
6. Market, through appropriate means, the investment opportunities and potential available through value-added “product” oriented research.
7. Dedicate and mobilize professional, financial and legal resources in support of value-added “product” oriented research. Such resources would be important for patenting, marketing, financing, etc...

### **Specific aim 4: Establishment of an adequate environment to host and develop qualified and creative minds in the field of medical, biomedical and health sciences.**

Qualified researchers are forced to leave Lebanon (brain drain) to find proper opportunities abroad. Furthermore, young investigators coming back to Lebanon or recruited by many local institutions cannot find the proper environment that present adequate infrastructure and opportunities to continue their research activities.

In an attempt to break this vicious cycle, it is essential to establish a research center that contains the entire necessary infrastructure (equipment and qualified personnel) that can provide opportunities to host young researchers, PhD students and post-doctoral fellows and to promote collaborative efforts between researchers at national and regional levels. This should be realized through the establishment of a physically independent research institute managed by the CNRS.

This institute should contain all the necessary equipment for molecular and cellular biology, as a basic tool for modern research as well as other facilities that correspond to the set priorities in medical research. This center must also contain a basic skeleton of qualified technicians and research assistants and must be administered by one or two senior scientists with established and recent achievements in one field of medical and health science.

The institute can also carry research by contracts with other institutions or companies in Lebanon or abroad. These contracts may provide a source of revenue to the center.

Finally, the scientific activities of this center should be audited on annual basis by an international panel of specialists.

## **Recommendations**

1. Establish an autonomous research institute managed by the CNRS. This institute should be associated to different research centers and universities in Lebanon. Its ultimate goal is to provide the proper mechanism and the help for the transfer of research and research culture to the universities.
2. The proposed “Research Institute” should contain all the necessary equipment for molecular and cellular biology as well as other facilities that correspond to other research areas in the medical and health fields.
3. It should group a basic skeleton of qualified scientists with full time research positions (full time researchers) and qualified research assistants or technicians. Several group leaders are required to maintain sustainable, productive and high quality research activity. Research programs will benefit from the expertise and the involvement of visiting Lebanese scientists working within institutions in Lebanon or abroad.
4. It should be led and managed by one or two senior scientists with established expertise and achievements in the fields of health and medical sciences.
5. This institute will host and provide services to PhD students, post-doctoral research fellows, junior and senior researchers and university professors.
6. This “Research Institute” will create academic/industrial/community bridges and may/should lead to the creation of a “technopole” for biomedical and health related technologies.
7. Scientific activities of this “Research Institute” should be audited on annual basis by an international panel of specialists.

## **Mechanisms for implementation of the STIP recommendations**

This report addressed the main specific aims for a research policy for the Health and Medical Field and the appropriate individual or overlapping recommendations for their implementation. In medicine, research is of applied nature whether for short or long term considerations. Furthermore, some research issues in the health and medical fields can become a priority depending on the prevailing circumstances.

Considering the highly competitive international research activities in various biological domains and the quite limited resources in Lebanon, a prudent policy must concentrate on the establishment of multidisciplinary research groups or units that attract specialists and experts from different disciplines (molecular, cellular and system biology, bioinformatics, biotechnologists among others). These qualified groups due to their flexibility are able to tackle different research topics (cardiovascular, cancer, aging, genetic and infectious diseases etc) with minimal requirement for extra equipment and human resources.

In addition to the previously defined recommendations that have been made regarding each specific aim, it would be most useful if the future direction of research in Lebanon is based on / and related to what has been done in the health research field in the last 5 years.

It is fair to assume that our current research strengths and activities in Lebanon will be, at least for the coming years, maintained at the same level and potentially increased. The following criteria will be used to develop a national consensus on research priorities in Lebanon:

1. Analysis of research activities and research output in Lebanon in the last 5 years:
  - Quantitative analysis and tabulation of the distribution of funded research

- proposals submitted to the CNRS, based on the assumption that research applications to the CNRS constitute a representative sample of Research in Lebanon
- Quantitative and qualitative analysis of the research output (list of publications in peer reviewed international journals)
  - Identification of the sources of research funding as well as the institutions that have received research funding in the past. (Amount of extramural and total funding), when available.
2. It is also important to identify what human resources and infrastructure facilities exist in Lebanon. This mapping will include an estimate of the number of:
- The number of established researchers
  - The number of recent recruits in the biomedical research fields
  - Major equipment and their distribution
  - Qualified engineers, technicians and other personnel
  - Trainees (MS, PhD, post-doc).
3. The data generated through the analysis of research activities and output and the mapping of the human resources and infrastructure facilities, shall serve as a basis to be used by a committee of international experts, to define the major three or four research areas that should be the focus of Lebanese researchers in the health fields in the next 5-10 years.
4. The recommendations of the committee of international experts should lead to the:
- Definition of the basic structure of the Lebanese National Institute/Center of Health that may house the basic core of full time researchers and technical staff and conduct some research on some of the proposed projects.
  - Formation of the major research groups based on the existing research activities in the various institutions.

## **SWOT analysis**

### ***The players***

- Universities and affiliated teaching hospitals
- Local funding agencies: CNRS and other governmental agencies, NGO (WHO) and benefactors...
- International funding agencies: EU, NIH, NSF, French CNRS and INSERM...
- Drug companies, local pharmaceutical industry
- Third party payers: MOH, NSF, insurance companies.
- Human resources:
  - \* Scientists and Faculty professors
  - \* Students (local, foreigners)
  - \* Physicians, engineers, biostatisticians, computer specialists, qualified technicians
  - \* Educators
  - \* Administrators
  - \* Patients

### ***Strengths***

- Numerous higher education institutions, some using research output as a criteria for promotion

- Excellence dependent on indigenous talent
- Relatively young population with tremendous eagerness and understanding of the value of higher education
- Healthy sector of multicultural and highly educated population
- Important highly educated Lebanese Diaspora
- Pioneering role for graduates from the Lebanese universities in regional development
- GDP relatively higher than other regional countries
- Lebanon ranks with developed countries statistics as far as number of physicians and sophisticated medical equipment per capita
- Public awareness of the importance of scientific research
- Lebanon was a pioneer in investing in scientific research in the Middle East (CNRS was one of the first in the area)
- Adequate environment for the development of individual initiatives

### ***Weakness***

- Most universities in Lebanon are institutions for automatic transmission of “second hand” knowledge without any significant contribution to the production of knowledge
- Emphasis on the arts and humanities and theoretical sciences with little emphasis on applied sciences
- Absence of significant Ph.D. programs
- General disinterest in scientific research within universities which has an important impact on the quality of teaching
- Meager national budget for research due to the prevalent economic situation
- Unequal distribution of research activities and facilities
- Little or no institutional incentives: lack of reward and punishment “up or out”
- Weak research out-put with few quality publications
- Most productive research championed by dynamic individuals, based on their earlier achievements abroad
- Limited capitalization on potential patents from important discoveries
- Clinical research seems to revolve around relatively un-important epidemiological or retrospective clinical studies with funding usually supported by drug companies for promotional purposes rather than through drug development.
- Lack of collaboration between different researchers or groups working on related topic
- Support for basic and clinical research from industry is negligible due to lack of incentives to encourage such investments, lack of confidence of pharmaceutical companies in research ability in Lebanon, lack of confidence of Lebanese scientists in local industry.

### ***Opportunities***

- Low cost of quality research compared to Europe or USA
- Potential support from the Lebanese Diaspora and established network in different countries
- Large number of qualified people in various areas
- Opening on various cultures which is unique in the Middle East area

- Free environment
- International funding as a country through the recent partnership agreement with the European Union (grace period) and international support to Lebanon through Paris II conference

***Threat***

- Increased competition via European partnership, after the grace period is over.
- Increasing regional competition.
- Mass exodus of our graduate students, leading to a significant “brain drain”
- Isolated researchers, even with the best qualifications decline over time and fail to follow the advances of modern science
- Negative impact on the future of the young population from
- overwhelming presence of inflated higher education institutions
- Reduction of funds for scientific research due to the economical situation

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