The sequencing of the human genome has enormous implications for the Eastern Mediterranean Region in medicine, agriculture, law and sociology. Future progress in these fields will depend upon careful collection, analysis and application of information generated through genomics and biotechnology. Based on a sample of 37 institutes from 11 countries the publication appraises regional capacity in the field of genomics and biotechnology in health by examining the focus of interest, technical facilities, training facilities and staff of institutes in the Region where research in genomics and biotechnology is being pursued. It discusses the need for countries to optimize their resources to find genomic and biotechnological solutions to combat disease and other health issues prevalent in the Region. It supplies a listing of infrastructure and expertise for quick reference by health researchers, scholars, policy-makers and other stakeholders of health services.
Health-related research institutes on genomics and biotechnology in the WHO Eastern Mediterranean Region

World Health Organization
Regional Office for the Eastern Mediterranean
Cairo 2005
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Abbreviations

2DEP  
Bioinfo  
DHPLC  
DNASeq  
Ferment  
GCMass  
Hdarry  
MicArray  
NRecVac  
PCR  
RecDrg  
RecVac  
CHEF

2 dimensional electrophoresis  
Bioinformatics centre  
Denaturing high-performance liquid chromatography  
DNA sequencer  
Fermentation  
Gas chromatography mass  
High density array  
Micro array  
Non-recombinant vaccine production  
Polymerase chain reaction  
Recombinant drug production  
Recombinant vaccine production  
Clamped homogeneous electrical field
Foreword

Health research and development is an expensive undertaking. However, its long-term value, in terms of socioeconomic development and well-being of societies, is priceless. The advent of genomics now provides an opportunity for developing countries to contribute to this journey for knowledge. I believe that in our Region knowledge-based innovation is indispensable for the future development of health services, if continued health and socioeconomic gains are to be realized.

The cost of building institutions for health research is beyond the resources of most developing countries. However, despite the lack of resources genomic and biotechnological research activities have gained momentum in some countries of WHO's Eastern Mediterranean Region in recent years. Even with modest infrastructure countries can join together to optimize their limited resources for finding genomic and biotechnological solutions to combat disease and other health issues prevailing in the Region. Thus, continual assessment of the regional health research capacity in genomics and biotechnology is important to help develop guidelines for health research policy, resource sharing and identification of priorities to overcome regional health issues.

This report on health-related research institutes on genomics and biotechnology in the Eastern Mediterranean Region is an initial appraisal of the regional capacity in the field of genomics and biotechnology in health in the Member States. Based on a small sample of institutes from 11 countries of the Region it gives a glimpse of the health research activities, expertise, facilities, funding resources and training opportunities in the genomics and biotechnology institutes of the Region. A valuable contribution was made by the applicants of the EMRO-COMSTEC Grant for Research in Applied Biotechnology and Genomics in Health for Member States of the Eastern Mediterranean Region of WHO in providing all necessary data pertaining to their respective institutes. It is hoped that in due
course more information on biotechnology and genomics-related activities in the Region will be generated and harnessed, creating an ever-increasing database.

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WHO Regional Director for the Eastern Mediterranean
Executive summary

There is very little published work on the facilities for health research in genomics and biotechnology in countries of the WHO Eastern Mediterranean Region. The present report on health-related research institutes on genomics and biotechnology in the Region is based on information reported by 37 institutes from 11 countries.

The study revealed that more than 80% of all institutes were involved in research on disease diagnosis while others were engaged in the production of drugs, therapeutics and vaccines with the help of modern genomic and biotechnological techniques. The results also showed that nearly 90% of the institutes had a polymerase chain reaction (PCR) facility, while a substantial number were equipped with a deoxyribonucleic acid (DNA) sequencer, 2-dimensional electrophoresis, denaturing high-performance liquid chromatography (DHPLC), bioinformatics centres and fermentation facilities.

Nearly 60% of the institutes shared their staff with others. A highly variable personnel composition was observed in regional institutes with respect to technical staff, staff with Doctorates of Philosophy (Ph.D.), Master of Philosophy (M.Phil.) degrees, Master of Science (M.Sc.) degrees and research scholars. More than 90% of the institutes reported national, and more than 50% reported international, collaboration. The collaboration between professionals from multiple health-related disciplines is fundamental to bridging the gap between the identification of genetic contributions to disease and the development of new genomics-based interventions to improve health outcomes.

A total of 35 institutes reported short-term training facilities in molecular biology and genetics, clinical techniques, genomics, disease diagnosis, biotechnology and proteomics. Ph.D. training facilities were reported for 14 institutes, while 3 reported M.Phil. and 11 reported M.Sc. programmes in various fields of biotechnology and molecular biology and genetics.
Funding resources of more than 70% of the institutes came wholly or partly from the public sector. As regards international funding resources, 27% of the institutes received financial assistance from WHO. Other resources worth mentioning included the European Union, United States Agency for International Development (USAID), National Institutes of Health (NIH, USA), Swedish International Development Cooperation Agency (Sida), World Bank, UNICEF, UNDP, World Bank, WHO Special Programme for Research and Training in Tropical Diseases (TDR), and Karolinska Institute, Sweden. Three institutes, each from Egypt, Jordan and Oman, reported their research collaboration with National Human Genome Research Institute (NIH), which is one of the major funding agencies for supporting health research and training in genetics and related sciences in developing countries.

Recent advances in genetics hold enormous promise for addressing public health issues of grave concern to countries of the Eastern Mediterranean Region. This promise however, remains to be actualized. Implementing the strategies discussed in the present study requires a larger-scale study of the health research institutional capacity in the Region as well as a new mindset, as success in employing biotechnology and genomics in health research will be measured, not by the number of scientists trained or the volume of academic publications, but rather by the ability of countries to apply global, regional and country-specific knowledge to local problems. Country-specific health research has the potential to contribute to global knowledge through innovation, adaptation and new discovery.

The opportunities before us also present some new challenges. In addition to investments in infrastructure, major investments will be required in the development of human resources. Therefore, large-scale analysis of the regional institutional capacity for biotechnology and genomics in health research will help in the establishment of networks, assessment of training needs, resolving bioethical issues and framing of priorities for applied health based on genomics and biotechnology.
Introduction

After a massive global scientific effort stretching back ten years, the full map of the human genome has finally been completed and published. The breaking of the genetic code, and the secrets it has now exposed, has already sparked a revolution in human understanding, but this is only the beginning. The human genome will change our understanding of human origins, of domestication, of migration and of development. It will teach us about the evolution and basis of racial difference. It will inform us about the genetic basis of diseases and help find means to prevent them. It will change our scientific horizons and with them the ethical and legal framework within which we operate.

The sequencing of the human genome has enormous implications for the WHO Eastern Mediterranean Region, in medicine, agriculture, law and sociology, but future achievement in these areas will depend on careful collection and analysis of the huge amount of data available in the public domain. There is little doubt that significant scientific advances will soon be made in the fight against malaria, tuberculosis, pneumonia and even human immunodeficiency virus and acquired immunodeficiency syndrome (HIV/AIDS). These advances are almost certain to be achieved as a consequence of our understanding of the human genome and will inevitably have a huge impact on people throughout the world. New light thrown on the capacity of humanity to shape its environment is another likely consequence of our new understanding. It is therefore crucial that scientists, thinkers and ordinary citizens of the Eastern Mediterranean Region are kept informed and take a full part in the genomic era.

Scanty information is available regarding institutes where genomics and biotechnology for health research in countries of the Region can be carried out [1,2,3,4]. It is essential now to build on the opportunity to develop institutional capacity in genomics and biotechnology in the Region and thus establish a solid foundation for long-term success in the field of health research.
Institutional weaknesses are one of the major reasons for poor development performance. Institutional capacity-building is therefore fundamental to effective poverty alleviation programmes, including those which strengthen health systems so that they better serve the poor. Poorly functioning institutions lead to wasted resources, inadequate infrastructure, shortages of supplies, corruption, poor quality of care, and a demotivated and insufficiently skilled workforce. This study is the first step in analysing the existing institutional capacity in genomics and biotechnology in the Region.

Promotion of regional capacity in biotechnology and genomics for health research

In 2001 the WHO Regional Office for the Eastern Mediterranean, with the support of Member States, embarked upon a renewed policy for health research and development in the Region [5]. Since then the Regional Office has been actively engaged in raising the issue of biotechnology. In 2002, the Regional Consultative Committee for the Eastern Mediterranean recommended affirmative action for the development of biotechnology and bioethics in the Region [6]. In the same year, the Eastern Mediterranean Regional Advisory Committee for Health Research (ACHIR), in its twentieth session, extensively debated bioethics and biotechnology development in the Region and made strong recommendations to policy-makers in the Member States to take necessary action to develop capacities for promoting the use of genetics and biotechnology [7]. Specifically emphasized was the need to provide support for development of resources, raising awareness regarding ethical, social and legal issues among communities and stakeholders and identification of specific areas of health which may benefit from developments in biotechnology.

In 2003, a meeting of experts on genomics and public health policy was organized by the Regional Office in Muscat, Oman, in which eminent scientists, managers, policy-makers and representatives of civil society from the Region participated. The need to develop a broad regional consensus, vision and policy for genomics and biotechnology development was emphasized [8]. At that meeting, the Regional Office
and the Organization of Islamic Conference Standing Committee on Scientific and Technological Cooperation (COMSTECH) were urged to provide coordination and networking with national biotechnology bodies and to consider establishing a regional fund to support research and capacity-building in genomics and biotechnology.

In the Fiftieth Session of the Regional Committee in 2003, the Regional Office was requested to advocate for the development and application of genomics and biotechnology for health with national authorities [9]. In 2004, a consultation on establishing a regional biotechnology network was held in Tehran, in the Islamic Republic of Iran, for representatives of selected centres of excellence in health-related molecular biology, biotechnology and genomics in the Eastern Mediterranean Region [10]. In 2004, in its Fifty-first Session, the Regional Committee, having reviewed the technical paper on development and use of genomics and biotechnology for public health, recognized the potential significance and impact of genomics and biotechnology to improve health by resolution EM/RC50/R.11 [11]. Noting the establishment of the Eastern Mediterranean Health Genomics and Biotechnology Network for the promotion of greater coordination and collaboration in research and development among centres of excellence in genomics and biotechnology in the Region, the resolution urged the Member States to create a conducive environment, frame national policies, strengthen institutions, raise public awareness, and facilitate collaboration between key stakeholders for appropriate national capacity development programmes in genomics and biotechnology. The resolution also requested the Regional Office, inter alia, to foster partnerships among the main stakeholders in order to contribute to capacity-building and resource mobilization in the Region. In the same year the Regional Office and COMSTECH established a joint grant to support research in countries of the Region.

Methodology

For the present study, data were procured from two sources. The applications for the EMRO-COMSTECH grant included an information questionnaire on capacities of the applicant’s institute in genomics and
Health-related research institutes on genomics and biotechnology (Annex 1). Out of 63 applications received from nine countries of the Region, information on 34 institutes was provided by the applicants (Annex 2). Similar information, procured during the Eastern Mediterranean Consultation on Establishing a Regional Biotechnology Network, in 2004 [10], was also available on a few other institutes of the Region. As a result, information on 37 institutes was available from 11 regional countries. A database of this information was established for quick retrieval and analysis.

A database of the information available on all the 37 genomic and biotechnology institutes was established using MS Excel. The program’s system for analysis, ToolPak and Macros, was employed for studying distribution, trends and for statistical analysis. Statistics were worked out for the following quantitative aspects of the institutes:

- focus of interest in genomics and biotechnology research and development in the institute;
- donors and funding agencies;
- faculty strength;
- training facilities in the institute;
- institutional ethics committee;
- collaborating partners in research and development;
- technical facilities for genomics and biotechnology.

**Results**

From 11 countries of the Region 37 institutes participated in the study (Figure 1). The Islamic Republic of Iran was represented by 16 institutes while 5 countries were represented by only 1 institute from each. Only 1 institute was purely industrial based, while 10 institutes belonged to medical or science universities of the Region (see Annex 2 for details). There was national collaboration between 34 institutes (92%) and 30 (81%) had international collaboration with other institutes, universities, and laboratories. Out of 34 institutes which specified their national funding resources, 26 (70%) were funded by more than one agency, national or international or both. Funding of 27 (73%) institutes came wholly or partly from the public sector, i.e., the ministry of health, other ministries and public sector universities (Figure 2).
Figure 1. Information on institutional capacities on genomics and biotechnology from 11 countries of the Eastern Mediterranean Region

Figure 2. National and international funding resources of the genomics and biotechnology institutes
Figure 3. Focus of interest in genomics and biotechnology research and development in the Region

Figure 4. Focus of interest in genomics and biotechnology research and development in the institutes of regional countries
International funding resources were specified by 22 institutes and 10 (27%) received financial assistance from WHO. Other resources worth mentioning included the European Union, United States Agency for International Development (USAID), NIH USA, Sida, World Bank, TDR and Karolinska Institute, Sweden (Figure 2).

The short-term training facilities reported by 35 (95%) institutes included molecular biology/genetics, clinical techniques, genomics, disease diagnosis, biotechnology and proteomics. Concerning long-term training specified by 31 (84%) institutes, 14 (38%) had Doctor of Philosophy, 3 (8%) had Master of Philosophy, and 11 (30%) had Master of Science programmes in various fields of biotechnology and molecular biology/genetics (see Annex 2 for details).

The analysis revealed that 31 institutes (84%) were involved in research on disease diagnosis while some were engaged in activities such as production of drugs, therapeutics and vaccines (Figures 3 and 4). There was activity in bioinformatics and other related fields of biotechnology and molecular biology. The presence of an ethics committee with varying numbers of research proposals processed was reported by 25 institutes (68%).

The frequency of facilities for the technologies in the 37 institutes presently studied is shown in Figure 5. Most of the institutes had PCR facilities, while a substantial number were equipped with DNA sequencers, 2 dimensional electrophoresis, DHPLC, bioinformatics centres and fermentation facilities. However, only 60% of the institutes shared their facilities with others.

The distribution of the technical facilities in the 11 countries presently studied (Table 1) showed that Bahrain, Jordan, Kuwait, Morocco, Oman, Pakistan, Sudan and Syrian Arab Republic had a high frequency of advanced analytical facility but almost no production facilities such as recombinant drug, recombinant vaccine and non-recombinant vaccine production as well as a very low frequency of the latest technologies such as micro and high density
arrays. Egypt, Islamic Republic of Iran and Tunisia had higher frequencies of analytical as well as production facilities.

Figure 5. Genomics and biotechnology research facilities in the Region
<table>
<thead>
<tr>
<th>Technical facilities</th>
<th>Bahrain</th>
<th>Egypt</th>
<th>Islamic Republic of Iran</th>
<th>Jordan</th>
<th>Kuwait</th>
<th>Morocco</th>
<th>Oman</th>
<th>Pakistan</th>
<th>Sudan</th>
<th>Syrian Arab Republic</th>
<th>Tunisia</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCR</td>
<td>1</td>
<td>5</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>DNASeq</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2DEP</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>DHPLC</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ferment</td>
<td>0</td>
<td>3</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bioinfo</td>
<td>0</td>
<td>2</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>GCMass</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RecDrg</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>RecVac</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NRecVac</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MicArry</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hdarry</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
A highly variable staff composition was observed in regional institutes with respect to technical staff with Doctors of Philosophy, Masters of Philosophy, Masters of Science and research scholars (Table 2). There were two Egyptian institutes, namely, National Research Centre, Giza, and VACSERA, with strengths of 6200 and 1300 personnel, respectively. None of the institutes from any other country was comparable with these two institutes on the basis of faculty strength. However, the Pasteur Institutes of Tunisia and the Islamic Republic of Iran were next in rank, with personnel strength of 997 and 474, respectively.

Table 2. Composition of regional research institutes as related to the number of staff

<table>
<thead>
<tr>
<th>Country</th>
<th>Total technical staff</th>
<th>Staff with Ph.D.</th>
<th>Staff with M.Phil./M.Sc.</th>
<th>Ph.D. scholars</th>
<th>M.Sc./M.Phil. scholars</th>
<th>Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Egypt</td>
<td>4069</td>
<td>1249</td>
<td>897</td>
<td>797</td>
<td>632</td>
<td>5</td>
</tr>
<tr>
<td>Iran, Islamic Republic of</td>
<td>949</td>
<td>392</td>
<td>400</td>
<td>130</td>
<td>133</td>
<td>16</td>
</tr>
<tr>
<td>Jordan</td>
<td>32</td>
<td>32</td>
<td>18</td>
<td>8</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Kuwait</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Morocco</td>
<td>52</td>
<td>23</td>
<td>10</td>
<td>8</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Oman</td>
<td>13</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>Pakistan</td>
<td>34</td>
<td>34</td>
<td>64</td>
<td>225</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Sudan</td>
<td>12</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Tunisia</td>
<td>179</td>
<td>725</td>
<td>0</td>
<td>45</td>
<td>48</td>
<td>1</td>
</tr>
</tbody>
</table>
Discussion

The present study is based on a small sample of institutes involved in genomic and biotechnological activities with special reference to health research in the Eastern Mediterranean Region. However, taking into account the overall size of the potential health research institutes in countries of the Region, as can be assessed from the number of medical institutes listed in the Regional Office online database [12], whereby most of the institutes are not research institutes, it can be safely assumed that the sample at hand is quite representative of the situation in the Region (Table 3).

Table 3. Medical institutes in countries of the Eastern Mediterranean Region

<table>
<thead>
<tr>
<th>Country</th>
<th>Medical institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>4</td>
</tr>
<tr>
<td>Bahrain</td>
<td>2</td>
</tr>
<tr>
<td>Egypt</td>
<td>39</td>
</tr>
<tr>
<td>Iran, Islamic Republic of</td>
<td>29</td>
</tr>
<tr>
<td>Iraq</td>
<td>21</td>
</tr>
<tr>
<td>Jordan</td>
<td>3</td>
</tr>
<tr>
<td>Kuwait</td>
<td>7</td>
</tr>
<tr>
<td>Lebanon</td>
<td>6</td>
</tr>
<tr>
<td>Libyan Arab Jamahiriya</td>
<td>11</td>
</tr>
<tr>
<td>Morocco</td>
<td>21</td>
</tr>
<tr>
<td>Oman</td>
<td>8</td>
</tr>
<tr>
<td>Pakistan</td>
<td>26</td>
</tr>
<tr>
<td>Qatar</td>
<td>3</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>51</td>
</tr>
<tr>
<td>Somalia</td>
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<tr>
<td>Sudan</td>
<td>9</td>
</tr>
<tr>
<td>Syrian Arab Republic</td>
<td>11</td>
</tr>
<tr>
<td>Tunisia</td>
<td>15</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>3</td>
</tr>
<tr>
<td>Yemen</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: [12]
More than 80% of the institutes in the present analysis showed disease diagnostic as their major focus of interest and nearly an equal proportion was equipped with sophisticated molecular diagnostic facilities, such as PCR, which are indispensable for diagnosis of several genetic disorders. It should be of significant interest to health authorities in these countries to know the causes of these diseases: in the short term, to be able to offer genetic counselling and prenatal diagnosis to families, and in the long term to find ways to ameliorate, cure, or eliminate these diseases. Moreover, these genetic resources have the potential to make major contributions to the study of diseases that are of worldwide significance, underlining the importance of carrying out research in this region of the world [13].

The appropriate level at which countries should begin to engage in biotechnology and genomic sciences will vary widely among the countries of the Eastern Mediterranean Region, a subject that has engendered active debate as far as development of these areas in developing countries is concerned [14]. The WHO Report on Genomics and World Health recommends that a serious cost–benefit analysis is undertaken and the value of such an investment weighed against all the competing health needs of each country [4]. Training a small core of scientists in genetic epidemiology and gene mapping to help better understanding of diseases within their own populations will serve national interests at a modest cost.

Sequencing and other genomic practices require expensive equipment that is continually being modified as technology matures. In the present study nearly 60% of institutes reported having a DNA sequencer. Unfortunately, even the newest genomic technologies may soon become obsolete. In addition, a recent survey reported in Nature showed that poor countries have to pay up to 70% more than other countries for identical scientific supplies [15]. Therefore, countries with limited resources should collaborate and outsource until the technologies stabilize, and should meanwhile invest in better computers, broadband access and software to allow for efficient data analysis, bioinformatics and data mining [14].
More than 90% of the institutes in the present study reported national collaboration. The collaboration between professionals from multiple health-related disciplines will be fundamental to bridging the gap between the identification of genetic contributions to disease and the development of new genomics-based interventions to improve health outcomes. In many instances, populations in countries of the Region have specific advantages in carrying out genetics research, particularly for common disorders, including cardiovascular disease, cancer and mental illness, which are leading causes of morbidity and even mortality worldwide [16,17]. It is likely that small variations in several unidentified genes make significant contributions to the onset and expression of these common disorders, which are further influenced by environmental and behavioural risk factors. However, there are disorders that are specifically prevalent among the Arab ethnic group, either uniformly or in certain locations [18]. The Arab genetic diseases include Bardet-Biedl syndrome, Meckel syndrome, autosomal recessive severe childhood muscular dystrophy, osteopetrosis and renal tubular acidosis, Sanjad-Sakati syndrome and others. In all populations of the Region, marriages between close relatives are common, leading to a high rate of genetically-influenced diseases that may be rare in other regions [14]. Armed with the new tools of genomic analysis, geneticists of the Region can gain footholds against many of these diseases by careful analysis of these special populations.

While the benefits of genomic and biotechnological technologies are clearly relevant to all countries of the Region, not all countries have the infrastructure and resources necessary to support new, emerging and expensive technologies. For those countries that do, and are willing to make this commitment at the highest level, the potential rewards, both for economic activities and for relevant health outcomes, are very promising.

There are two major obstacles to full participation in genomic research in the Region that can be assessed from the present study: the first is a lack of financial capital, and the second is a dearth of well-qualified, trained personnel. This is apparent with the funding
resources of more than 70% of all institutes coming wholly or partly from the public sector, which is likely to represent only a small fraction of the total health budget of countries of the Region, as has been reported in several international forums [19]. Although science and technology is seldom viewed as a high-priority strategic sector by developing countries, some governments have recognized the potential health, social and economic benefits of investing in the genetic sciences during this critical window of opportunity. China, for example, was the only developing country to participate in the Human Genome Project. The establishment of the Beijing Genomics Institute and the Chinese National Human Genome Center not only allowed a Chinese contribution to the physical sequencing of the human genome, but also created the capacity for Chinese researchers to fully engage in a range of genomics research [14].

It is clear that recent advances in genomics and biotechnology hold enormous promise for addressing public health issues of grave concern to countries of the Region. That promise, however, remains to be actualized. It is not a simple problem to weigh when and at what level a country that is poor in resources and facing severe shortages of personnel and infrastructure should invest in capacity-building. Nonetheless, these countries have much to contribute and there are many ways to enable genetic sciences. Within 5 to 10 years, many developing countries will have entered the epidemiological transition and will face increasing public health crises of the common chronic, noncommunicable diseases, in addition to carrying a burden of infectious disease [20,21]. To prepare for that transition, development of scientific capacity in genomics and bioinformatics, at levels appropriate to the needs and resources of each country, must begin without delay.

How can poorer nations get more access to genomics for development? Much genomics knowledge has been made public, so it can be considered a global public good, although private companies make use of this information to develop products and services [3]. Countries of the Region need a governance mechanism that fosters a balance between the global-public-good characteristics
of genomics knowledge and the private-good nature of its application.

The major ethical, legal and social issues that have arisen in the context of developments in genomics and health in developed countries are also of relevance to countries of the Region. In the present study 67% of all institutes reported the presence of an ethics committee. The question before the Region today is what role it can play vis-à-vis these issues. Ethical issues raised by genomic and biotechnological research include privacy, community benefits, informed consent, gene ownership and expropriation, stigmatization and intellectual property, among others. Each country, with its own culture and history, will approach these issues in unique ways. In order to carry out international collaborative genetics research, it is necessary to both understand and participate in building international consensus on how to involve individuals and communities in research, while also respecting culture-specific sensitivities and solutions. Consequently, an equally critical aspect of each programme is training in the ethical, legal and social implications of genetics and genomics research within the cultural context of the participating countries.

The Eastern Mediterranean Advisory Committee on Health Research, in its twentieth session, inter alia, strongly recommended establishing a regional advisory committee on genomic research and biotechnology [7]. Such a committee would be requested to focus on providing advocacy, technical guidance and advice on priority-needs, applications, training, building linkages and resource mobilization, as well as to advise on ethical, social and legal issues to the Regional Office and Member States, to develop research and development in genomics and biotechnology. At the same time, the Member States were urged to provide, inter alia, necessary support for development of human, financial and material resources in molecular biology, biotechnology and genetic research and to develop country and intercountry research networking in biogenetics. As a follow-up of these recommendations, the Regional Office undertook such initiatives as organizing a consultation on establishing a regional
biotechnology network for representatives of selected centres of excellence (health-related) in molecular biology, biotechnology and genomics [10], and establishing the EMRO-COMSTECH grant to support research in biotechnology and genomics for solving health-related problems in countries of the Region. All these efforts help in strengthening the existing infrastructure but the issues and challenges for countries in the Region remain immense. Countries need to build appropriate capacity in genomics and biotechnology, such as micro array analysis and bioinformatics. Development of national and regional networks and partnerships to share information, resources and skills can greatly help in complementing existing tools and methodologies within resource constraints and confines [2].

Conclusion

Genomics and biotechnology provide an opportunity to understand and modify biological functions and products to an extent never previously possible. The opportunities before us also present some new challenges. In addition to investments in infrastructure, major investments will be required in the development of human resources. The new technologies also present a new set of ethical, social and legal issues that require serious study by the social science community. Therefore, large-scale analysis of the regional institutional capacity for biotechnology and genomics in health research will help in the establishment of networks, assessment of training needs, resolving bioethical issues and framing of priorities for applied health research involving genomics and biotechnology. In order to make visible these strategies a regional website, depicting infrastructure, manpower, human resources, financial resources, research opportunities and ethical issues, will keep regional researchers, institutes and governments up to date, and will serve as an effective tool in the promotion of health research in general and research in biotechnology and genomics in particular.

Implementing the strategies discussed in this study requires a new mindset, as success in employing biotechnology and genomics in
health research will be measured not by the number of scientists trained, nor the volume of academic publications, but rather by the ability of countries to apply global, regional and country-specific knowledge to local problems. Above all, country-specific health research has the potential of contributing to global knowledge through innovation adaptation and new discovery.

References


12. Medical education opportunities.
   http://www.emro.who.int/EMROInfo/MedicalEducation.htm.


Annex 1

Information questionnaire on institutional capacities on genomics and biotechnology

NOTE:
Please note that the purpose of obtaining this information is to ascertain the facilities in your centre/institute and to what degree your institute would be willing to lend support to other institutes/centres whether national or regional. **This information will not be confidential and you may choose not to respond to any of the sections in this form if you deem appropriate.** Please use the extra page if you wish to provide any further information. Also please indicate how you envision sharing facilities with other partners; i.e. which areas, what facilities etc.

1. Country:

2. Name of institution:

3. Address:

   Telephone:
   Facsimile:
   Email:

4. Name of the head/director:

5. Focus of interest in genomics and biotechnology research and development in the institute:
   Please put x where applicable
   - Disease diagnostics  
   - Drugs, therapeutics and products
   - Vaccine development
   - Bioinformatics
   - Others (specify).

   Main (key) genomics and biotechnology research and development area of the institute:
6. List of collaborating partners in research and development
   National:

   International:

7. List of donors/funding agencies
   National:

   International:

8. Faculty strength
   Total technical staff(#)
   Staff with Ph.D.(#)
   Staff with M.Phil./M.Sc.
   # Staff currently undergoing Ph.D. programmes
   # Staff currently undergoing M.Sc./M.Phil. programmes

9. Training facilities in the institute
   Please specify kind/type and duration

   Short term:

   Long term:
10. Institutional ethics committee
Does the institute have an ethical review committee (ERC)?
   Yes/No
(Please encircle)
If no, please indicate source/mechanism for ERC support:
If yes, please indicate (during 2003) the number of research proposals
   a) submitted to the ERC
   b) approved by the ERC

11. Technical facilities
Please add if there are other facilities you may wish to report.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Yes/No</th>
<th>Facility</th>
<th>Yes/No</th>
<th>Facility</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro array</td>
<td></td>
<td>PCR (RNA or DNA)</td>
<td></td>
<td>Recombinant drug production</td>
<td></td>
</tr>
<tr>
<td>High density array DNA</td>
<td></td>
<td>DNA sequencer</td>
<td></td>
<td>Recombinant vaccine production</td>
<td></td>
</tr>
<tr>
<td>2 dimensional electrophoresis</td>
<td></td>
<td>GC Mass</td>
<td></td>
<td>Non-recombinant vaccine production</td>
<td></td>
</tr>
<tr>
<td>DHPLC</td>
<td></td>
<td>Fermentation</td>
<td></td>
<td>Bioinformatics centre</td>
<td></td>
</tr>
</tbody>
</table>

12. Does your institute share the facilities with other institutes/partners? Yes/No
### Annex 2

**A summary of health-related genomic and biotechnological institutes of the Eastern Mediterranean Region**

<table>
<thead>
<tr>
<th>Country</th>
<th>Institute</th>
<th>Address</th>
<th>Tel.</th>
<th>Fax</th>
<th>Email</th>
<th>Head</th>
<th>Focus of interest</th>
<th>Key technical facilities</th>
<th>Training facilities</th>
<th>Short-term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>Genetic Department, Salmanya Medical Complex</td>
<td>P.O. Box 12, Salmanya Medical Complex, Manama</td>
<td>+973 17289490</td>
<td>+973 17289496</td>
<td><a href="mailto:ssrayed@batelco.com.bh">ssrayed@batelco.com.bh</a></td>
<td>Dr Sheikh S. Ali Arrayed</td>
<td>1) Disease diagnostic</td>
<td>1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) DNA sequencer; 5) GC Mass</td>
<td></td>
<td>1) Clinical techniques/research; 2) Molecular biology/genetics</td>
</tr>
<tr>
<td>Egypt</td>
<td>Ain Shams University Centre for Genetic Engineering and Biotechnology (ACGEB)</td>
<td>Ain Shams University, Abassya, Cairo</td>
<td>+20 26837862</td>
<td>+20 24837888</td>
<td><a href="mailto:wagidaanwar@yahoo.com">wagidaanwar@yahoo.com</a></td>
<td>Professor Wagida Anwar</td>
<td>1) Disease diagnostic; 2) vaccine development; 3) bioinformatics</td>
<td>1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) DNA sequencer</td>
<td></td>
<td>1) Molecular biology/genetics</td>
</tr>
<tr>
<td>Egypt</td>
<td>Genetic Engineering and Biotechnology Research Institute (GEBRI)</td>
<td>Protein Research Department, GEBRI, Mubarak City, New Borg EL Arab, Alexandria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Health-related research institutes on genomics and biotechnology

Tel.: +20 34593420  
Fax: +20 34593423  
Email: Redwan@yahoo.com  
Head: Professor Dr Medhat Saif EL Nasr  
Focus of interest: 1) Drugs, therapeutics and products  
Key technical facilities: 1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) DNA sequencer; 5) GC Mass; 6) Fermentation; 7) Recombinant drug production; 8) Recombinant vaccine production; 9) Non-recombinant vaccine production; 10) Bioinformatics centre  
Other facilities: Structure biology; CHEF electrophoresis; Peptide synthesizer; Oligs synthesizer  
Training facilities —  
Short-term: 1) Biotechnology; 2) molecular biology/genetics  
Long-term: Ph.D. and M.Sc.  
Country: Egypt  
Institute: Holding Company for Biological Products and Vaccines, VACSERA - The Egyptian Company for Biotech Industries – EGYTEC  
Address: 51 Wezaret Al Zeraa St. Agouza, Giza  
Tel.: +20 27611111  
Fax: +20 23483187  
Email: m_abadi@vacsera.com  
Head: Dr Mohammed Ali S. Abadi  
Focus of interest: 1) Drugs, therapeutics and products; 2) vaccine development; 3) bioinformatics  
Key technical facilities: 1) Micro array; 2) High density array; 3) Two dimensional electrophoresis; 4) DHPLC; 5) PCR (RNA or DNA); 6) DNA sequencer; 7) GC Mass; 8) Fermentation; 9) Recombinant drug production; 10) Recombinant vaccine production; 11) Non-recombinant vaccine production; 12) Bioinformatics centre  
Country: Egypt  
Institute: National Hepatology and Tropical Medicine Research Institute  
Address: 10 Kasr El-Eini St., Cairo 11441  
Tel.: +20 23688400
Fax: +20 23682774
Email: skafrawy@umbegypt.com
Head: Professor Mohamed Abdel Hamid
Focus of interest: 1) Disease diagnostic
Key technical facilities: 1) Micro array; 2) PCR (RNA or DNA)
Training facilities —
Short-term: 1) Clinical techniques/research
Long-term: Ph.D. and M.Sc.

Country: Egypt
Institute: National Research Centre, Giza
Address: Behooth St. (ex-Tahrir St.), Dokki, Giza
Tel.: +20 23354971
Fax: +20 23370931
Email: yzgad@tedata.net.eg
Head: Professor Hani El-Nazer
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development; 4) bioinformatics
Key technical facilities: 1) Two dimensional electrophoresis; 2) PCR (RNA or DNA); 3) DNA sequencer; 4) Fermentation; 5) Non-recombinant vaccine production

Country: Islamic Republic of Iran
Institute: Bu Ali Research Institute
Address: Immunogenetic and Tissue Culture Department, R.C. Bu-Ali-Bu-Ali Sq., Mashhad
Tel.: +98 0512 ext:12
Fax: +98 0512 ext:12
Email: abbaszadegan@ams.ac.ir
Head: Dr Mohammad R. Abbaszadegan
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development
Key technical facilities: 1) PCR (RNA or DNA); 2) GC Mass; 3) Fermentation; 4) Recombinant drug production; 5) Recombinant vaccine production; 6) Bioinformatics centre
Training facilities —
Short-term: 1) Molecular biology/genetics
### Cellular and Molecular Research Centre, Iran University of Medical Sciences

**Address:** Shahid Hemat High Way, Iran University of Medical Sciences, Tehran

**Tel.:** +98 218054365

**Fax:** +98 218054355

**Email:** cmrc@iums.ac.ir

**Head:** Dr Issa Nourmohammadi

**Focus of interest:** 1) Disease diagnostic

**Key technical facilities:**
- 1) Micro array
- 2) Two dimensional electrophoresis
- 3) DHPLC
- 4) PCR (RNA or DNA)
- 5) DNA sequencer
- 6) GC Mass
- 7) Fermentation
- 8) Recombinant drug production

**Other facilities:** Tissue processor; Tissue culture facilities; ELISA reader; H-counter; B-counter; HPTLC; GC

**Training facilities**
- Long-term: Ph.D. and M.Phil.

### Centre for Disease Control, Ministry of Health and Medical Education

**Address:** Centre for Disease Control, Ministry of Health and Medical Education, Tehran

**Tel.:** +98 218822145

**Fax:** +98 218300444

**Email:** samarataa@hotmail.com

**Head:** Dr Poya

**Focus of interest:** 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) bioinformatics

**Other facilities:** Facilities in universities and other research centres are utilized

**Training facilities**
- Long-term: Ph.D.
Country: Islamic Republic of Iran
Institute: Child Development and Congenital Disorder Research Centre
Address: Separ St., Jahan-E-Koodak Cross, Africa Ave., Tehran
Tel.: +98 218793645
Fax: +98 218779007
Email: info@cded.ir
Head: Dr Hossein Malekzafali Ardakani
Focus of interest: 1) Disease diagnostic
Key technical facilities: —
Training facilities —
Short-term: 1) Molecular biology/genetics

Country: Islamic Republic of Iran
Institute: Endocrinology and Metabolism Research Centre
Address: Shariati Hospital, North Karagar St., 14114, Tehran
Tel.: +98 218026902/3
Fax: +98 218029399
Email: emrc@ina.tums.ac.ir
Head: Professor Bagher Larijani
Focus of interest: 1) Disease diagnostic
Key technical facilities: 1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) Recombinant drug production; 5) Recombinant vaccine production; 6) Non-Recombinant vaccine production; 7) Bioinformatics centre
Training facilities —
Short-term: 1) Disease diagnosis; 2) Clinical techniques/research
Long-term: Ph.D. and M.Sc.

Country: Islamic Republic of Iran
Institute: Gastrointestinal and Liver Disease Research centre, Golestan University of Medical Sciences
Address: Main offices at the west entrance of GOUMS (Anjirab), Gorgan, Golestan
Tel.: +98 1714424540
Fax: +98 1714424553
Email: sh_semnani@yahoo.com
Head: Dr Shahryar Semnani
Focus of interest: 1) Disease diagnostic
Key technical facilities: 1) Two dimensional electrophoresis; 2) PCR (RNA or DNA)
Other facilities: ELISA Reader

Country: Islamic Republic of Iran
Institute: Iranian Blood Transfusion Organization
Address: Hemat highway, Iranian Blood Transfusion Organization, P.O. Box 14665-1157, Tehran
Tel.: +98 218601501/30
Fax: +98 218601555
Email: shsamie@ibto.ir

Head: Dr Ali-Akbar Pourfathollah
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) bioinformatics
Key technical facilities: 1) DHPLC; 2) PCR (RNA or DNA); 3) DNA sequencer; 4) Bioinformatics centre
Training facilities —
Short-term: 1) Disease diagnosis; 2) Molecular biology/genetics
Long-term: M.Sc.

Country: Islamic Republic of Iran
Institute: Iranian Research Organization for Science and Technology, Biotechnology Department
Address: Biotechnology Dep. No 71 Forsat St. Engelab Ave P.O. Box 15815/3538 Tehran 15819
Tel.: +98 218838350
Fax: +98 218838350
Email: ofoghi@irost.ir

Head: Dr Hamid Fathi
Focus of interest: 1) Drugs, therapeutics and products
Key technical facilities: 1) Micro array; 2) Two dimensional electrophoresis; 3) DHPLC; 4) PCR (RNA or DNA); 5) Fermentation; 6) Non-recombinant vaccine production; 7) Bioinformatics centre
Other facilities: Plant tissue culture; DNA and protein electrophoresis and purification
Training facilities —
Short-term: 1) Genomics
<table>
<thead>
<tr>
<th><strong>Country:</strong></th>
<th><strong>Islamic Republic of Iran</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institute:</strong></td>
<td>Mazandaran University of Medical Sciences</td>
</tr>
<tr>
<td><strong>Address:</strong></td>
<td>Department of Genetics and Biochemistry, Sari Medical Faculty, Khazar Boulevard, Sari</td>
</tr>
<tr>
<td><strong>Tel.:</strong></td>
<td>+98 1513 ext:11</td>
</tr>
<tr>
<td><strong>Fax:</strong></td>
<td>+98 1513 ext:11</td>
</tr>
<tr>
<td><strong>Email:</strong></td>
<td><a href="mailto:hashemisoteh@yahoo.co.uk">hashemisoteh@yahoo.co.uk</a></td>
</tr>
<tr>
<td><strong>Head:</strong></td>
<td>Mr Mehdi Yonesi</td>
</tr>
<tr>
<td><strong>Focus of interest:</strong></td>
<td>1) Disease diagnostic</td>
</tr>
<tr>
<td><strong>Key technical facilities:</strong></td>
<td>1) Two dimensional electrophoresis; 2) PCR (RNA or DNA); 3) DNA sequencer</td>
</tr>
<tr>
<td><strong>Other facilities:</strong></td>
<td>Conformational Sensitive Gel Electrophoresis; Laminar flow</td>
</tr>
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<th><strong>Country:</strong></th>
<th><strong>Islamic Republic of Iran</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institute:</strong></td>
<td>Medical Science Faculty, Tarbiat Modarres University</td>
</tr>
<tr>
<td><strong>Address:</strong></td>
<td>Parasitology Department, Medical School, Tarbiat Modarres University, P.O. Box 14115-331, Tehran</td>
</tr>
<tr>
<td><strong>Tel.:</strong></td>
<td>+98 218011001</td>
</tr>
<tr>
<td><strong>Fax:</strong></td>
<td>+98 218013030</td>
</tr>
<tr>
<td><strong>Email:</strong></td>
<td><a href="mailto:ghafarif@modares.ac.ir">ghafarif@modares.ac.ir</a></td>
</tr>
<tr>
<td><strong>Head:</strong></td>
<td>Dr M. J. Rassaii</td>
</tr>
<tr>
<td><strong>Focus of interest:</strong></td>
<td>1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development</td>
</tr>
<tr>
<td><strong>Key technical facilities:</strong></td>
<td>1) Micro array; 2) High density array; 3) PCR (RNA or DNA); 4) DNA sequencer; 5) Recombinant drug production; 6) Recombinant vaccine production; 7) Non-recombinant vaccine production; 8) Bioinformatics centre</td>
</tr>
<tr>
<td><strong>Training facilities</strong></td>
<td>—</td>
</tr>
<tr>
<td><strong>Short-term:</strong></td>
<td>1) Genomics; 2) Disease diagnosis; 3) Molecular biology/genetics</td>
</tr>
<tr>
<td><strong>Long-term:</strong></td>
<td>Ph.D. and M.Sc.</td>
</tr>
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<table>
<thead>
<tr>
<th><strong>Country:</strong></th>
<th><strong>Islamic Republic of Iran</strong></th>
</tr>
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<tbody>
<tr>
<td><strong>Institute:</strong></td>
<td>National Prenatal Diagnostic Reference Laboratory for Thalassemia, Genetic Research Centre</td>
</tr>
<tr>
<td><strong>Address:</strong></td>
<td>The Social Welfare and Rehabilitation Sciences University, Daneshjoo Blvd., Koodakyas St., Evin, Tehran 19834</td>
</tr>
</tbody>
</table>
38 Health-related research institutes on genomics and biotechnology

Tel.: +98 212407814
Fax: +98 212407814
Email: hnajm@mavara.com
Head: Dr Hossein Najmabadi
Focus of interest: 1) Disease diagnostic
Key technical facilities: —
Training facilities —
Short-term: 1) Clinical techniques/research; 2) Molecular biology/ genetics
Long-term: Ph.D. and M.Sc.
Country: Islamic Republic of Iran
Institute: National Research Centre for Genetic Engineering and Biotechnology
Address: P.O. Box 14155-6343, Tehran
Tel.: +98 214580396
Fax: +98 214580399
Email: m-sanati@nrgeb.ac.ir
Head: Dr Mohammad Hossein Sanati
Focus of interest: 1) Disease diagnostic; 2) Drugs, therapeutics and products
Key technical facilities: 1) PCR (RNA or DNA); 2) DNA sequencer; 3) fermentation; 4) recombinant drug production; 5) Bioinformatics centre
Training facilities —
Long-term: Ph.D.
Country: Islamic Republic of Iran
Institute: Pasteur Institute of Iran
Address: 69 Pasteur Ave., Tehran 13164
Tel.: +98 216959911/20
Fax: +98 216465132
Email: office@institute.pasteur.ac.ir
Head: Dr Mohammad Taghikhani
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development; 4) bioinformatics
Key technical facilities: 1) Micro array; 2) Two dimensional electrophoresis; 3) DHPLC; 4) PCR (RNA or DNA); 5) DNA sequencer;
6) GC Mass; 7) Fermentation; 8) Recombinant drug production; 9) Recombinant vaccine production; 10) Non-recombinant vaccine production; 11) Bioinformatics centre

Other facilities: Flow cytometry, Electronic-microscope

Training facilities —

Short-term: 1) Proteomics; 2) Disease diagnosis; 3) Biotechnology
Long-term: Ph.D. and M.Phil.

Country: Islamic Republic of Iran
Institute: Razi Vaccine and Serum Research Centre
Address: P.O. Box 11365-1558, Tehran
Tel.: +98 2614554658
Fax: +98 2614552194
Email: Kiin@imamreza.net
Head: Dr M.A. akhavizadehgan
Focus of interest: 1) Drugs, therapeutics and products; 2) vaccine development
Key technical facilities: 1) PCR (RNA or DNA); 2) Fermentation; 3) Non-recombinant vaccine production
Other facilities: Ultra centrifuge; Freeze dryer; Gel Doc
Training facilities —
Short-term: 1) Genomics

Country: Islamic Republic of Iran
Institute: Research Centre for Gastroenterology and Liver Diseases
Address: 7th floor, Taleghani Hospital, Yaman St., Evin, Tehran
Tel.: +98 212417283
Fax: +98 212402639
Email: saniee@regld.org
Head: Dr Mohammad Reza Zali
Focus of interest: 1) Disease diagnostic; 2) Drugs, therapeutics and products; 3) bioinformatics
Key technical facilities: 1) PCR (RNA or DNA); 2) DNA sequencer; 3) Fermentation; 4) Bioinformatics centre
Training facilities —
Short-term: 1) Clinical techniques/research
Long-term: Ph.D.
Country: Islamic Republic of Iran
Institute: Shaheed Beheshti University of Medical Sciences
Address: Evin, Tehran
Tel.: +98 2123871
Fax: +98 212400052
Email: webmaster@sbmu.ac.ir
Head: Dr Habibollah Peyrovi
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development
Key technical facilities: 1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) Fermentation; 5) Recombinant drug production; 6) Recombinant vaccine production; 7) Non-recombinant vaccine production; 8) Bioinformatics centre
Other facilities: Mutation detection; Hybridization; ELISA
Training facilities —
Short-term: 1) Genomics; 2) Biotechnology

Country: Jordan
Institute: Department of Biotechnology and Genetic Engineering, Jordan University of Science and Technology
Address: P.O. Box 3030, Irbid
Tel.: +962 27201000 ext: 21111
Fax: +962 3 ext: 12
Email: wajih@just.edu.jo
Head: Dr Wajih M. Owais
Focus of interest: 1) Disease diagnostic; 2) bioinformatics
Key technical facilities: 1) Two dimensional electrophoresis; 2) PCR (RNA or DNA); 3) DNA sequencer; 4) GC Mass
Training facilities —
Short-term: 1) Genomics

Country: Jordan
Institute: Higher Council of Science and Technology
Address: Higher Council of Science and Technology, Amman
Tel.: +962 27201000 ext: 23674
Fax: +962 27095010
Email: nbashir@just.edu.jo
Head: —
Focus of interest: 1) Disease diagnostic
Key technical facilities: 1) Two dimensional electrophoresis; 2) PCR (RNA or DNA); 3) DNA sequencer; 4) GC Mass; 5) Fermentation

Country: Kuwait
Institute: Centre for Clinical and Molecular Virology, WHO Collaborating Centre for Virus Reference and WHO Collaborating Centre for AIDS
Address: Department of Microbiology, Faculty of Medicine, Kuwait University, Health Sciences Centre, P.O. Box 24923, Safat 13110
Tel.: +965 5312300 ext:6560
Fax: +965 5336719
Email: widad@hsc.kuniv.edu.kw
Head: Professor Widad Al-Nakib
Focus of interest: 1) Disease diagnostic
Key technical facilities: 1) Micro array; 2) PCR (RNA or DNA); 3) DNA sequencer
Training facilities —
Short-term: 1) Clinical techniques/research; 2) Molecular biology/genetics
Long-term: Ph.D. and M.Sc.

Country: Morocco
Institute: Pasteur Institute of Morocco
Address: Place Louis Pasteur, 20100 Casablanca
Tel.: +212 22434460
Fax: +212 22260957
Email: pasteur@pasteur.ma
Head: Professor Mohammed Hassar
Focus of interest: 1) Disease diagnostic; 2) bioinformatics
Key technical facilities: 1) Two dimensional electrophoresis; 2) PCR (RNA or DNA); 3) DNA sequencer
**Country:** Oman

**Institute:** Genetic Unit of the Ministry of Health

**Address:** P.O. Box 393, Postal code 113, Muscat

**Tel.:** +968 601489

**Fax:** +968 696099

**Email:** dg-ha@moh.gov.om

**Head:** Dr Ali Jaffer Mohammed

**Focus of interest:** 1) Disease diagnostic; 2) bioinformatics

**Key technical facilities:** 1) DHPLC; 2) PCR (RNA or DNA); 3) Bioinformatics centre

---

**Country:** Oman

**Institute:** Sultan Qaboos University

**Address:** P.O. Box 35, Al-Khod, Muscat 123

**Tel.:** +986 515113

**Fax:** +968 513880

**Email:** Bayoumi@squ.edu.om

**Head:** Dr Saud Al-Riyami

**Focus of interest:** 1) Disease diagnostic; 2) bioinformatics

**Key technical facilities:** 1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) DNA sequencer; 5) GC Mass

**Training facilities** —

**Long-term:** M.Sc.

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**Country:** Oman

**Institute:** Sultan Qaboos University College of Medicine and Health Sciences

**Address:** Department of Child health, P.O. Box 35, Al-Khoudh

**Tel.:** +968 84415137

**Fax:** +968 24415137

**Email:** zakiya@squ.edu.om

**Head:** Dr Zakia Al-Lamaki

**Focus of interest:** 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) bioinformatics

**Key technical facilities:** 1) DHPLC; 2) PCR (RNA or DNA); 3) DNA sequencer; 4) GC Mass

**Training facilities** —
Health-related research institutes on genomics and biotechnology

Short-term: 1) Clinical techniques/research
Long-term: M.Sc.

Country: Pakistan
Institute: Dr Panjwani Centre for Molecular Medicine and Drug Research
Address: University of Karachi, Karachi 75270
Tel.: +92 219243232/33/37/38
Fax: +92 219243290/91
Email: shakilakhandwala 1@yahoo.com
Head: Professor Dr Atta-ur-Rehman
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development; 4) bioinformatics
Key technical facilities: 1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) DNA sequencer; 5) GC Mass; 6) Fermentation; 7) Bioinformatics centre
Other facilities: Tissue culture; 1 and 2d NMR with Cryprobe technology; flow cytometry; X-ray; beta-scintillation counter; Gamma counter
Training facilities —
Short-term: 1) Proteomics
Long-term: Ph.D. and M.Phil.

Country: Pakistan
Institute: International Centre for Chemical Sciences, HEG RIC
Address: University of Karachi, Karachi 75270
Tel.: +92 219243232/33/37/38
Fax: +92 219243290/91
Email: drsaif@super.net.pk
Head: Professor Atta-ur-Rehman
Focus of interest: —
Key technical facilities: 1) PCR (RNA or DNA); 2) GC Mass

Country: Pakistan
Institute: National Institute of Health
Address: Islamabad
Tel.: +92 519255117
Fax: +92 519255099
Health-related research institutes on genomics and biotechnology

**Country:** Pakistan

**Institute:** Postgraduate Medical Institute

**Address:** Phase-IV, Peshawar

**Tel.:** +92 919217190

**Fax:** +92 929217190

**Email:** arshadj@hotmail.com

**Head:** Professor Arshad Javed

**Focus of interest:** 1) Disease diagnostic

**Key technical facilities:** 1) PCR (RNA or DNA); 2) DNA sequencer; 3) Fermentation

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**Country:** Sudan

**Institute:** Ahfad University for Women, Ahfad Biomedical Research Laboratory

**Address:** P.O. Box 167, Omdurman

**Tel.:** +249 87553363

**Email:** ahfad@sudamil.net

**Head:** Ms. Durria Mansour Elhussein

**Focus of interest:** 1) Disease diagnostic

**Key technical facilities:** —

**Training facilities**

**Short-term:** 1) Genomics

**Long-term:** Ph.D. and M.Sc.

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**Country:** Sudan

**Institute:** Institute of Endemic Diseases, University of Khartoum

**Address:** P.O. Box 11463, Khartoum

**Tel.:** +249 912 ext:11

**Fax:** +249 184 ext:11

**Email:** —
Health-related research institutes on genomics and biotechnology

Head: Professor+D31 Maowia Mohammad Mukhtar
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development; 4) bioinformatics
Key technical facilities: 1) Two dimensional electrophoresis; 2) PCR (RNA or DNA); 3) DNA sequencer; 4) Bioinformatics centre
Other facilities: Tissue culture; Liquid nitrogen storage
Training facilities —
Long-term: Ph.D. and M.Sc.

Country: Syrian Arab Republic
Institute: Ministry of Health, PHLs/Molecular Biology Laboratory
Address: PHLs/Damascus, Aleppo St, Alghassani, Damascus
Tel.: +963 114 ext:11
Fax: +963 114 ext:11
Email: mounakh@scs.net.og
Head: Dr Maisoum Nasri
Focus of interest: 1) Disease diagnostic
Key technical facilities: 1) DHPLC; 2) PCR (RNA or DNA)

Country: Tunisia
Institute: Pasteur Institute of Tunisia
Address: 13, Place Pasteur – BP 74, 1002, Tunis, Belvedere
Tel.: +216 71783022/21671843755
Fax: +216 71791833
Head: Professor Dellagi Mohamed Koussay
Focus of interest: 1) Disease diagnostic; 2) drugs, therapeutics and products; 3) vaccine development; 4) bioinformatics
Key technical facilities: 1) Two dimensional electrophoresis; 2) DHPLC; 3) PCR (RNA or DNA); 4) DNA sequencer; 5) Fermentation; 6) Recombinant drug production; 7) Recombinant vaccine production; 8) Bioinformatics centre
Other facilities: HPLC; Real time PCR
The sequencing of the human genome has enormous implications for the Eastern Mediterranean Region in medicine, agriculture, law and sociology. Future progress in these fields will depend upon careful collection, analysis and application of information generated through genomics and biotechnology. Based on a sample of 37 institutes from 11 countries the publication appraises regional capacity in the field of genomics and biotechnology in health by examining the focus of interest, technical facilities, training facilities and staff of institutes in the Region where research in genomics and biotechnology is being pursued. It discusses the need for countries to optimize their resources to find genomic and biotechnological solutions to combat disease and other health issues prevalent in the Region. It supplies a listing of infrastructure and expertise for quick reference by health researchers, scholars, policy-makers and other stakeholders of health services.