The Role of the Hospital Laboratory in Public Health

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1. INTRODUCTION

A Working Group on the Role of the Hospital Laboratory in Public Health was convened by the WHO Regional Office for Europe, in collaboration with the Government of Sweden, in Stockholm from 8 to 12 May 1978.

The meeting brought together temporary advisers from 11 countries to define the role of the hospital laboratory in public health and its collaboration with the public health laboratory network, to assess present and future trends and to consider how all types of health laboratory service might be rationalized.

Dr Ingegerd Moberg was elected Chairman of the Working Group; Professor J. Fleurette and Professor V.V. Menšikov were elected Vice-Chairmen. Dr P.J. Sanderson acted as Rapporteur. (A list of participants is given in the Annex.)

The Working Group was welcomed by Dr L. Rinder, Senior Medical Officer, National Board of Health and Welfare of Sweden, who said that the topic to be considered by the Working Group was a difficult but important one. He wished the Working Group every success in its discussions.

On behalf of the Regional Director, Dr Leo A. Kaprio, Dr D.K. Sokolov, Chief, Strengthening of Health Services, WHO Regional Office for Europe, thanked the National Board of Health and Welfare of Sweden for acting as host to the meeting. He said that a rationally organized laboratory service should be an integral part of a national health service. Many countries in the European Region would have to evaluate new developments which had implications for laboratory services. They included community health units, the integration of the hospital and the public health system, the introduction of new techniques and automation. The difference between a clinical and public health laboratory was more quantitative than qualitative.

Dr A.H. Wahba, Regional Officer, Health Laboratory Services, then spoke on the scope and purpose of the Working Group. The prime purpose was to suggest methods of making all laboratory services more cost/effective. He suggested certain areas for discussion: the predictive, presumptive, diagnostic, therapeutic and rehabilitative value of an economic laboratory service; the availability of expertise; the siting of laboratories; the development of good communications between the laboratory user and the laboratory worker, and collaboration and coordination between laboratories.

A description of the various organizational aspects of the laboratory services in his or her country was given by each member of the Working Group. Although there were many differences among the countries represented at the meeting, as far as the organization of laboratory services was concerned, several common factors were found: the organization of laboratories required to fulfil the roles of reference centres, hospital laboratories and public health laboratories; problems of standardization and quality

control; and difficulties of communication and reporting between the different types of laboratories.

2. FUNCTIONS OF HOSPITAL LABORATORIES IN RELATION TO PUBLIC HEALTH

2.1 Clinical chemistry and haematology

The increasing number of requests for tests in the field of clinical chemistry is having an impact on routine laboratory work. Rapid, practical and precise analyses are required, and hopefully many of these will ultimately be carried out by automation. There is a need for quantitatively valid results, produced by machine, that are applicable in all countries. Furthermore, some investigations might be undertaken at the bedside. The development of gas-liquid chromatography and mass spectrometry means that nanogram and picogram quantities of materials can be detected. Similar trends are evident in haematology, where automated tests exist for haemoglobin, cell count and coagulation estimations.

A prime requirement is for laboratories to maintain close contact with the clinicians concerned.

2.1.1 *Screening techniques*

The Working Group felt that screening should be undertaken with some aim in mind, and should be economically cost/effective. Broad-profile testing without a specific problem in mind is probably of little use. Screening is of value in connexion with certain investigations, e.g., examinations for lead poisoning and cervical cytology.

The Working Group discussed the difficulty of dealing with abnormal results found by means of screening techniques that had not been requested by a physician, and concluded that only tests that had been requested should be performed.

2.1.2 *Dialogue*

Dialogue between laboratory workers and clinicians was felt to be essential by the Group, but the means of achieving this were not clear. It was suggested that common rounds in hospital wards by both the clinician and the laboratory worker, as was frequent in the USA, would be useful. Also, laboratories should have open meetings in which clinicians and public health workers could meet laboratory workers in their own surroundings.

It was mentioned that the laboratory doctor sometimes felt like a supermarket manager who wished to please his customer, i.e., the clinician, as often as he could. However, it was felt that laboratory workers had some responsibility in determining the practical value of requests made to them; moreover, they should aid in the interpretation of laboratory results.

2.1.3 *Regionalization*

The Working Group felt that regionalization was to some extent dependent on geography. Peripheral laboratories should contain well trained staff and have supportive services. They should use well established methods, leaving specialist investigations to central laboratories.

2.1.4 *Quality control*

The Working Group was strongly in favour of quality control in laboratory work. It was easy to introduce quality control in clinical chemistry and haematology, but some difficulty was experienced by microbiology laboratories. Nevertheless, a preliminary scheme for this discipline had been undertaken in France, while in the United Kingdom a system had been in existence for some years. The Working Group felt that the rapid and simple tests that could be undertaken at the bedside constituted a difficult area for quality control, although manufacturers clearly had a responsibility in providing information and reliable materials.

2.2 Bacteriology

The role of the bacteriology laboratory in the diagnosis of diseases is well established; mechanization as well as skill and knowledge has increased in recent years. The bacteriology laboratory has an obvious role in public health in the following respects:

(a) early diagnosis of communicable diseases,
(b) control and follow-up of communicable diseases,
(c) mass screening, standardization and quality control.

Bacteriology laboratories also have a role in the control of hospital infection, and in gauging the spread of organisms from hospitals to the community. They are involved in assessing the immunity of the population to infectious diseases and in assessing occupational hazards such as tularaemia, anthrax and leptospirosis.

In its discussion of this aspect, the Working Group considered the role of automation in the bacteriology laboratory. It was felt that the bacteriology laboratory was not ready for total automation, but serological techniques and

sensitivity testing could be automated. A distinction was to be made between mechanization, which rendered a work process more rapid, and automation, which involved electronic devices to undertake more complex tasks.

2.3 Virology

Three aspects were considered under this heading: (a) the various diagnostic activities carried out by a virological laboratory, (b) the importance of rapid techniques in virology, and (c) the requirements of different hospital departments for virological diagnosis. The necessity for close cooperation between clinicians and the laboratory means that virological laboratories should be near, or within, hospitals.

Smaller laboratories should concentrate on rapid diagnosis, "rapid" meaning that a result is available within 20 hours of receipt of the specimen. As rapid methods become available more use should be made of them.

In planning the siting of laboratories, it is important to take the view of the laboratory user into account; for instance, a list of the clinical conditions which most often lead to requests should be established and, in this way, the hospital departments making most demands on the laboratory will be identified. This procedure would help in deciding the most appropriate site for the diagnostic virology laboratory. It has been found that respiratory secretions and vascular fluids yielded the highest percentage of virus isolates and this indicates that paediatricians, dermatologists and infectious diseases departments make most requests for laboratory virological tests.

In the discussion, it was asked whether rapid techniques reduced costs and whether they could be undertaken by less experienced technicians. It was generally felt that immunoelectroosmophoresis, though of moderate cost, probably required rather well trained physicians to carry it out.

2.4 Immunology, mycology, parasitology and serology

The Working Group felt that these topics were less important at hospital level and could be referred to during the general discussion on this section.

2.5 Histopathology, clinical physiology and toxicology

One member of the Group described the wide application of fine-needle aspiration for palpable tumours in Sweden. This technique had begun some 10 years ago and was now widely available to patients, both in hospital and in the community. The results were felt to be worthwhile. The Group discussed the question of whether this type of specimen should regularly be examined for the presence of bacteria and viruses. While all histological specimens could not be examined in this way, it was felt that needle aspiration

was often used for diagnostic problems and, in these circumstances, it was recommended that culture for organisms should be undertaken.

2.6 Special activities: screening, surveillance, monitoring, allergy testing

Turning to the role of the laboratory in public health, the Group recognized that hospital laboratories played a part in public health in all specialities, the data obtained being relevant to public health problems, cost/effectiveness and the establishment of norms. However, it is important to avoid duplication of effort between hospitals and other laboratories. There is a lack of biological personnel in most parts of the world and it is unwise to disperse expertise too widely.

The value of mobile units in providing community laboratory services in developing countries was discussed. Although the capital costs of these units may be fairly high, they can be equipped with elementary but appropriate equipment and are able to provide an efficient service in remote areas. If they are used in association with a "ferry" service to central laboratories, then back-up facilities would be available to them.

Mobile units may be used for personnel training, quality control and laboratory safety in large countries and where it might be difficult to organize a national quality control service. Mobile units may also be used for special purposes of a temporary nature; for instance, they have been used to detect bacteriuria in schoolchildren. However, in some countries, it has been found difficult to recruit staff to work in such units, where living away from home is involved.

2.7 General discussion on the functions of hospital laboratories with regard to public health

A major topic of the discussion was the consideration that hospital and public health laboratories are now tending to merge towards the common goal of better services for the community as a whole. The hospital laboratory has become separated from the community for largely historical reasons; its development had begun and had continued in relation to hospital work. However, this barrier is essentially artificial, and therefore governments should encourage communication between the hospital laboratory and the community. To achieve this aim, the hospital laboratory should be prepared to forward its results to doctors working outside the hospital and such doctors should have free access to hospital laboratories.

Medically qualified personnel should be in charge of medically oriented laboratories, since only in this way can fruitful collaboration between the clinician and the laboratory take place. Indeed, the recognition of new patterns in disease and the interpretation of results and of the clinical relevance of specimens require medical training. Further, the introduction of new techniques is usually undertaken by persons other than technicians.

Since hospital laboratories are often rather isolated in their work, they need to improve collaboration among themselves. In many countries, the public health laboratory service has central and interconnected laboratories and there is a constant exchange of information between them. All laboratories, including hospital laboratories, might well establish such patterns of communication, since they obtain information that is of value to public health and which might not otherwise be utilized. Antibiograms of micro-organisms, determination of limits of normality and other features of laboratory work could be made the responsibility of community physicians.

With regard to the financial support of laboratories, multiple sources of finance often exist, and university, hospital and public health laboratories are usually funded separately. This often leads to duplication of effort and to a lack of standardization. A more uniform approach to the funding of laboratories should therefore be made.

The centralization of laboratories was also discussed. It was generally agreed that the organization of laboratories should extend in a series of levels from central laboratories to regional and then to peripheral laboratories. Communication should occur both horizontally and vertically. Central laboratories may provide several facilities not otherwise widely available; for instance, reference techniques, education and perhaps, in certain cases, media and materials. There is also a strong need for the standardization of equipment and this too might be the responsibility of a central laboratory.

3. DEVELOPMENT OF HOSPITAL LABORATORIES

3.1 Extension of available services to the community

The demands hospitals make upon their own laboratories are such that the latter have little capacity for other work. Problems exist in the provision of sufficient staff and equipment for the demands of the community services, such as ambulatory care and services to schools. There must be effective localization of laboratories for this type of service, based upon the adequate provision of neighbourhood hospitals.

The extension of available services to the community will depend on the manpower available, and on the size, function and ownership of laboratories. A major question is how to integrate laboratories, since in most European countries public health laboratories are firmly established. Integration becomes more imperative when manpower and equipment is in short supply, and it is essential in developing countries. There is perhaps a danger that clinical work might take precedence over public health work; this should be avoided, since both are essential.

In the discussion the use of standardized methods was suggested. These could be investigated and then recommended by central laboratories. A recognized list of such methods could then be established. The basic tests to be performed at a first-level hospital laboratory were discussed and are outlined in Table 1. The Working Group felt that the development of new methods should be undertaken in laboratories possessing the appropriate expertise, and that their wider adoption should come about through persuasion of colleagues. New methods might need to be licensed by appropriate bodies.

Laboratory development should be coordinated by, for example, laboratory councils, headed by laboratory specialists, who would take into account the interests of all participants.

3.2 Introduction of new techniques; mechanization and automation

An average clinical chemistry laboratory possesses a repertoire of some 150–200 different methods. If it is assumed that a particular method has a life of about 5 years, then some 40 new methods would need to be introduced each year. The function of introducing and developing new methods could be undertaken by a regional laboratory. Mechanization would lead to cheaper and more precise methodology but decisions regarding cost/benefit to the patient and community should be taken within each laboratory.

The introduction of computing methods and electronic data processing methods has yielded several benefits for laboratories. Mathematical calculations and statistics are made more readily available, while reporting systems can eliminate transcription errors and laboratory results are more quickly obtainable. Correlations between certain body parameters and particular disease states are possible and analysis of these may lead to the development of more discriminatory investigations.

One member of the Working Group referred to two international conferences on automation in microbiology, the results of which had been published. He went on to describe an automated system for blood culture and compared this system with traditional methods. Referring to the advantages and disadvantages of laboratory automation, he mentioned the potential disturbance to the working routines of the laboratory caused by the introduction of automation.

Another member of the Group then described the application of the enzyme-linked immunosorbent assay technique (ELISA). This technique was used in his laboratory to detect antibodies to several bacterial antigens, including those of *Salmonella* spp., tularaemia, and *Brucella* spp. The method was sensitive, specific and simple. The materials used were stable and the method capable of automation.

Table 1. Basic tests to be performed in a first-level (primary or peripheral) laboratory

I. Haematology

Sedimentation rate, haemoglobin, erythrocyte count, leucocyte count, bleeding time, clotting time

When possible: platelet count, differential leucocyte count, reticulocyte count, ABO blood groups, Rh

II. Clinical chemistry

Blood

Glucose, urea N, bilirubin, total protein, protein fractions, prothrombin, Na^+, K^+, Cl^-

Urine

Physical examination, glucose (qualitative and quantitative), albumine (qualitative and quantitative), acetone bodies, bile pigments, urobilin, urobilinogen, sediment microscopic examination

Gastric fluid

Physical examination, lactic acid detection, pepsine activity, sediment microscopic examination

Duodenal fluid

Physical examination, microscopic examination

Faeces

Physical examination, microscopic examination, Protozoa determination, helminth determination, blood detection, stercobilin detection

III. Microbiology

Urine

Direct examination, culture and microbial identification, antibiotic sensitivity, microbial enumeration

Throat

Examination (mainly for *Streptococcus A*)

Skin and mucous membrane

Infections

Direct examination, culture, antibiotic sensitivity

Genital fluids

Direct examination, culture and bacterial, mycotic and parasitic identification

Faeces

Direct, bacterial, mycotic and parasitic examination

3.3 Rationalization and improvement of lines of communication

While central laboratories are able to concentrate attention on the development of new techniques, research and training, centralization may lead to delay in the delivery of results to the physician.

Diagnostic programmes, standardization of tests, centralized administration, quality control, systems analysis, the preparation of statistics for performance analysis and the regulation of new and obsolete tests are all potential tasks for central laboratories.

In medium-sized laboratories tests should be orientated towards patient care, and new tests in these laboratories should only be undertaken in agreement with the central unit.

3.4 Research

Most hospital laboratories have a potential to carry out applied research in the fields of (a) methodology, (b) clinical work, and (c) laboratory organization. In the area of methodology, laboratories must be prepared to undertake projects that improve the clinical relevance of their techniques. Similarly, research into cost/effectiveness and into the techniques themselves is valuable. Laboratories are also well placed to conduct research into clinical conditions. New techniques lead to the elucidation of certain clinical problems and these opportunities should not be missed.

Another area of research lies in laboratory organization. Hospital laboratories should be prepared to investigate automation techniques, computer methods and other topics related to their work routines.

The foundation for successful research lies in the attitude of the staff concerned. An appreciation of the value of research must be introduced during the training of both doctors and technicians.

3.5 General discussion on the development of hospital laboratories

It was suggested that a distinction should be made between fundamental and applied research, since hospital laboratories were clearly unable to undertake fundamental-type research projects. The Group was in agreement, but felt that it was sometimes difficult to distinguish between fundamental and applied research. Hospital laboratories were also well placed to undertake research concerning therapeutic agents. Cooperation between laboratories could often lead to the solution of larger problems.

It was agreed that the initiation and quality of research depended on the personnel involved. Some discussion took place on the direction of research and whether it should be limited to central laboratories. It was felt that research could, and indeed should, be undertaken at medium-sized hospital laboratories and although central laboratories may indicate areas for research, they should not direct it too closely.

4. COLLABORATION AND COORDINATION BETWEEN VARIOUS TYPES OF HEALTH LABORATORY

4.1 Hospital and public health laboratories

The prime aim of collaboration is to prevent duplication of activities, and to distribute expertise and equipment in an efficient and rational manner. For instance, it is possible to locate an expert in a small and fairly remote laboratory provided communications and coordination are good. This arrangement would reduce the costs of providing expert facilities.

In the case of communicable diseases, the possibility of making certain laboratory results notifiable to the authorities was suggested.

4.2 The role of national institutes and university laboratories

In many countries, research institutes and laboratories often pursue specialized research projects which bear little relation to the provision of health care to the community. Such institutes are often poorly coordinated among themselves; they should attempt to collaborate more with other types of laboratories and perhaps become more concerned with medical problems of a practical nature.

National laboratories should be strengthened with regard to personnel and equipment in order that they can participate in community and public health without losing the functions they already possess. A policy for national and university laboratories should be included in such a programme, so that the results of their particular expertise can be more widely disseminated.

4.3 General discussion

The essential and principal tasks of public health and hospital laboratories were discussed and are outlined in Table 2.

The Working Group suggested that there should be some type of national body to coordinate research programmes more closely than is at present the case in most countries.

More research should be devoted to the real needs of health delivery.

Although attempts to direct research are to be avoided, research programmes should be coordinated. Applications for research grants should be presented to research committees or councils which would judge them in the light of their collective experience and in relation to other applications. Such committees or councils should also lay down research priorities, so that the available funds can be channelled into projects that have been assessed collectively by experts.

Table 1. Essential and principal tasks

Principal tasks / Field	Public health laboratory	Hospital laboratory
	Serving the community Contribution to public health Legal functions	Serving the individual and the community under certain circumstances
Haematology Clinical chemistry Toxicology	Screening for deficiency diseases	Haematology Clinical chemistry Clinical toxicology Clinical physiology
Microbiology Virology Bacteriology Parasitology Mycology Immunology/ Serology	Recognition and control of communicable diseases, e.g., tuberculosis, food-borne and venereal diseases ("public health" microbiology) for tracing and control of outbreaks of infection Examination of food handlers	Clinical microbiology Recognition of certain communicable diseases
Histopathology	Screening procedures	Clinical histology Clinical cytology
Sanitation Environmental hygiene	Surveillance of air, water, food, wastes by microbiological and chemical methods Surveillance of hygiene in hospitals Surveillance of apparatus, methods of sterilization and disinfection Environmental medicine (radiation, noise, pollution) Industrial hygiene	Control of hospital infections Control of cleaning and disinfection methods
Epidemiology	Sampling and supply of epidemiogical data Infectious diseases (prevalence and distribution) Deficiency diseases Occupational diseases Surveillance of immunization programmes	Some aspects of occupational diseases Participation in tracing outbreaks of infections
Pharmaceuticals Biologicals	Monitoring supervision, control of sera, vaccines, reagents, disinfectants; development and production of reagents	Supervision of hospital pharmacy
Research Development Reference	Reference laboratory for microbiology (typing, methodology) Special laboratories Development of immunization methods and programmes Research activities in applied microbiology and hygiene Quality control	Development of new methods and techniques Testing of new agents and reagents Laboratory organization Quality control
Consultation Information Training	Advice on control of communicable diseases Training of microbiologists, other technical personnel, disinfecters, public health officers	Information and training of hospital personnel

5. CONCLUSIONS AND RECOMMENDATIONS

1. To provide useful support to health care services in the predictive, preventive, diagnostic, therapeutic and rehabilitative fields, a rationally organized health laboratory service should be accessible to the community.

2. More effective collaboration between existing laboratory services, such as the public health laboratories, the university laboratories and the hospital laboratories is necessary.

3. Hospital laboratory services, particularly at regional level, could undertake various public health activities in the absence of an elaborate public health laboratory service.

4. Coordination of various laboratory activities should be promoted at national level; this will lead to greater efficiency in the existing services.

5. More information on other types of laboratory such as veterinary laboratories, food hygiene laboratories, water and wastewater laboratories and any other laboratories dealing with public health problems, as well as laboratories working in the sector of occupational health, requires greater collaboration, but this could also be organized at national or regional level.

6. Standardization and quality control schemes are an essential element for reliable laboratory results and Member States should initiate, develop and reinforce them through a central or regional laboratory.

7. Laboratory services at primary health care level need greater attention since development of them would improve community health. A list of tests, activities and basic equipment should be recommended with the understanding that these activities should be flexible and organized according to local priorities.

8. Studies on appropriate technology in the various laboratory disciplines are necessary in order to develop rational, economic but also precise and accurate techniques.

9. Mechanized and automated procedures should be carefully planned and tested for optimum cost/benefit.

10. Rationalization procedures should be encouraged, but only be permanently introduced after pilot studies.

11. Applied research should be stimulated in the various types of health laboratory.

12. The exchange of information and collaboration on laboratory techniques, as well as information about their standardization, should be encouraged both among laboratories within individual Member States and internationally.

13. To improve the relationship between the clinical and laboratory services, as well as the quality and usefulness of biological investigations, the importance of proper initial and continuing training of medical biologists and laboratory technicians should be stressed.

14. For all laboratory activities it is desirable and sometimes even necessary to encourage continuous contact between laboratory specialists and clinicians.

Annex

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