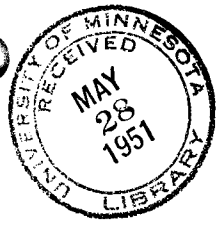

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Medical Microbiology

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I. MEDICAL MICROBIOLOGY

Standards of Application and Role in Present-Day Practice of Medicine

William J. Cromartie

Introduction

The remarkable changes in the practice of medicine brought about by the widespread use of antibiotics have tended to obscure the value of the microbiology laboratory in the practice of medicine. Even before the time when these drugs were available, patients with infectious diseases were not receiving the full benefit of diagnostic microbiology. Since the advent of antibiotics the situation, rather than improving, has become worse. Therefore, it has become apparent that there is need for complete re-evaluation of the functions of this branch of laboratory science with a clear definition of its place in present-day medicine, if microbiology is to assume its proper role in teaching and practice.

In evaluating the function of a medical microbiology laboratory the nature of the services which it is expected to perform should be taken into consideration. These fall into at least seven categories:

(1) Services necessary for the proper care of patients suffering from an infectious process;

(2) services necessary for the practice of preventive medicine;

(3) the training of students at various levels in the field of microbiology;

(4) services necessary for teaching students certain aspects of the recognition, treatment, and prevention of infectious diseases;

(5) studies of an investigative nature;

(6) systematic re-evaluation at intervals of the aseptic techniques used on the wards and in the operating room;

(7) services necessary for the proper preparation of solutions to be administered parenterally.

While there is no question of the value of these services, controversy frequently arises over specific studies to be undertaken in the areas covered by the first four categories which include patient care, preventive medicine, and teaching.

It is the purpose of this communication to consider what services the microbiology laboratory of a general hospital should render; to discuss the facilities and personnel required to render these services at a high level; to discuss the efficient utilization of these services; and to consider the value of microbiology in the present-day practice of medicine. Many of the points presented are of such an elementary nature that one hesitates to record them; yet they are overlooked often enough to justify their iteration.

Information Required for Proper Planning

What services a microbiology laboratory should be prepared to render is a basic question that must be answered before the requirements of space facilities and personnel can be defined. The answer to this question should be arrived at through close cooperation between the laboratory and the clinical departments that utilize its services in order to determine the studies essential for patient care, preventive medicine, and any teaching program for which the clinical services may be responsible.

In consultation with several clinicians in charge of infectious disease services an outline has been prepared, which indicates the studies that are believed to represent those a microbiological laboratory of a general

hospital located in Minnesota should be prepared to perform.

Practical Diagnostic Procedures for Infectious Diseases[1,2,3,4]

A. Bacterial Diseases-

1. The Staphylococci: Demonstration by direct smear; isolation by cultivation on blood agar; identification on basis of colonial form, pigment production and morphology; classification on basis of pigment production, hemolysins, coagulase production and mannitol fermentation. Antibiotic sensitivity tests are of value. Demonstration of enterotoxin.

2. The Pneumonococci: Demonstration by direct smear; isolation by cultivation on blood agar and mouse inoculation; identification by use of group specific sera, colonial form, morphology, bile solubilities and inulin fermentation; classification by use of type specific sera.

3. The Streptococci: Demonstration by direct smear; isolation by cultivation on blood agar (aerobic, anaerobic and 10 per cent CO_2) and by Pike's method; identification on basis of colonial form, morphology and bile solubility; classification on basis of grouping sera, biochemical reaction, growth in 0.1 per cent methylene blue, at 10°C. and 40°C. and in broth containing 6.5 per cent NaCl. Serological studies of patients: antistreptlysin-O titer. Antibiotic sensitivity studies of value for some groups.

4. The enteric bacteria (E. coli, Klebsiella-Aerobacter group, Paracolon, Salmonella, Shigella, Proteus, Pseudomonas and Alcaligenes): Demonstration by direct smears on some specimens; isolation by use of fluid-enrichment differential and selective media; identification on the basis of colonial form, morphology, motility, biochemical reactions and serological reactions; classification of Salmonella, Shigella, and Klebsiella by serological methods. Serological studies of patients for salmonella agglutinins. Antibiotic sensitivity studies are sometimes of value.

5. Pasteurella tularensis: Demonstration of agglutinins in sera of patients.

6. The Brucella: Isolation by cultivation in trypticase soy broth in Castaneda bottle (10 per cent CO_2); identification by serologic methods, morphology and staining reactions; classification by dye tolerance test, demonstration of need for CO_2 and H_2S production. Demonstration of agglutinins in patient's serum.

7. The Hemophilus group: (H. influenzae, H. Koch-Weeks, H. parainfluenzae, H. hemolyticus, H. pertussis, H. parapertussis, H. ducreyi, Moraxella lacunata) Demonstration by direct smear; isolation by use of rabbit blood agar, whole defibrinated rabbit blood for H. ducreyi, Bordet-Gengou cough plates for pertussis, Loeffler's media for M. lacunata; identification by staining reactions, colonial form, agglutination test, capsular swelling for H. influenzae, and demonstration of need for X and V factor; classification of H. influenzae by serological methods.

8. The Neisseria (N. intracellularis, N. gonorrheae, N. catarrhalis, N. flavescences, N. sicca): Demonstration by direct smear; isolation by cultivation on blood agar, "Chocolate" agar prepared from GC medium base and Bacto-hemoglobin (10 per cent CO_2); identification on basis of morphology staining reactions, colonial form, fermentation and serologic reactions; classification of N. intracellularis by serologic methods.

9. The Clostridia: Demonstration by direct smear; isolation on blood agar, egg yolk agar, and in chopped meat medium (anaerobic); identification on basis of colonial form, morphology, staining reaction, biochemical reactions and spore formation; demonstration of pathogenic effect in animals.

10. The Anthrax Bacillus: Demonstration by direct smear; isolation on simple solid media; identification on the basis of morphology, staining reaction, spore formation, demonstration of pathogenic effect in mice. Demonstration of antibodies in patient's serum.

11. The Leptospira (L. icterohemorrhagiae, L. canicola, L. pomona, etc.): Demonstration by dark field examination and direct smear; isolation by the inoculation of young white guinea pigs, and of Fletcher's medium; identification by typical morphology; classification by agglutination absorption test; agglutination lysis test on patient's sera.

12. The Treponema (T. pallidum, T. pertenue, T. carateum, T. cuniculi): Demonstration by dark field examination; identification by typical morphology; complement fixation, flocculation, and immobilization test on patient's serum; classification on basis of source and clinical picture.

13. The Borrelia: Demonstration by dark field and direct smear examination; isolation by inoculation of young white rats; identification by characteristic morphology and motion; classification on basis of natural history. The existence of more than one species is questionable (B. recurrentis).

14. The Spiral Organisms of the Mouth and Other Mucous Membranes: Demonstration by dark field examination and direct smear; identification by characteristic morphology. (Borreli vincentii and Treponema microdentium).

15. The Mycobacteria (M. tuberculosis): Demonstration of acid-fast bacteria in direct smears prepared from caseous particles and homogenized and concentrated specimens; isolation by culture of homogenized and concentrated specimens on at least two types of media and by inoculation of guinea pigs; identification by morphology, staining reaction and pathogenic effect in guinea pigs; classification by determination of pathogenic effect in rabbits, guinea pigs and chickens. Skin test on patients. Determination of antibiotic sensitivity. Investigation of the slide culture technique for rapid isolation and determination of sensitivity to antibiotics.

16. The Corynebacteria (C. diphtheriae, C. hofmanni, and C. xerose): Demonstration by direct smear (value questionable); isolation on Loeffler's and cystine tellurite media; identification by morphology, colonial form, and virulence test; Schick and Maloney test on patients.

17. The Streptobacillus moniliformis and Pleuropneumonia Group: Isolation by use of tryptose phosphate broth and agar with 30 per cent ascitic fluid and mouse inoculation; identification by characteristic morphology, colonial form, staining reaction and pathogenicity for animals.

18. Spirillum minus: Demonstration by dark field examination and direct smear; isolation by mouse inoculation, identification on basis of morphology and motion.

19. The Malleomyces (M. mallei and M. pseudomallei): Demonstration by direct smears; isolation by culture on veal infusion glycerin agar, glycerin potatoe medium and guinea pig inoculation; identification on basis of colonial form, morphology, staining reaction, biochemical reactions and serologic studies; Mallein skin test on patients.

20. The Listeria and Erysipelothrix (L. monocytogenes and E. rhusiopathiae): Demonstration by direct smear; isolation by use of glucose ascitic fluid medium and mouse inoculation; identification by morphology, colonial form, staining reaction, pathogenicity for animals and serologic methods. Demonstration of agglutinins in patient's serum.

21. The Bacteroides (B. fragilis and B. fusiformis) and the Veillonella: Demonstration by direct smear; isolation by use of ascitic fluid medium

(anaerobic); identification on basis of morphology; staining reaction, and anaerobic requirement.

B. Diseases Caused by Actinomyces, Nocardia, Molds and Yeasts -

1. Actinomyces and Nocardia: Demonstration by examination of fresh preparations and of direct smears; isolation by use of deep tubes of beef infusion broth, Sabouraud's glucose agar and inoculation of guinea pigs; identification by acid-fast staining properties, biochemical reaction, morphology and colonial form.

2. The Blastomyces (B. dermatitidis and B. brasiliensis): Demonstration by fresh preparation in KOH solution; isolation by culture on Sabouraud's glucose agar at room temperature, on blood agar at 37°C., and by inoculation of guinea pigs and mice; identification by demonstration of large spherical, thick-walled, budding forms (single budding forms B. dermatitidis; multiple budding forms B. brasiliensis); skin test and complement fixation test on patient's serum.

3. Coccidioides immitis: Demonstration of the univellular tissue forms in fresh preparation in KOH solution; isolation on Sabouraud's glucose agar and beef infusion agar at room temperature and by inoculation of male guinea pigs; identification by demonstration of endospore-filled mature yeast forms; skin test and serologic studies of patients.

4. The Geotrichum: Demonstration in fresh preparation in KOH solution; isolation on Sabouraud's glucose agar at room and 37°C. temperature; identification by demonstration of characteristic arthrospores.

5. The Hormodendrum and Phialophora: Demonstration in fresh preparation in KOH solution; isolation on Sabouraud's glucose agar at room temperature; identification by demonstration of characteristic conidia.

6. Cryptococcus neoformans: Demonstration in fresh preparation by utilizing KOH and India ink; isolation on blood agar and beef infusion agar at 37°C. and on Sabouraud's glucose agar at room temperature and by inoculation of mice; identification by the demonstration of the encapsulated yeast forms that fail to grow in mold forms.

7. The Candida: Demonstration by examination of fresh preparation in KOH solution and in direct smears; isolation on Sabouraud's glucose agar at 37°C. and at room temperature; identification and classification by demonstration of characteristic chlamydospores on corn meal agar, pathogenicity test in rabbits and by biochemical reactions.

8. Histoplasma capsulatum: Demonstration by direct smears; isolation by culture at 37°C. on beef-infusion glucose agar or broth, and on blood agar, by culture at room temperature on Sabouraud's glucose agar, and by inoculation of guinea pigs and mice; identification by demonstration of characteristic tuberculate chlamydospores; demonstration of skin hypersensitivity and of precipitating and complement-fixing antibodies in patients.

9. Sporotrichum schenskii: Isolation on Sabouraud's glucose agar at room temperature and on blood agar at 37°C., and by inoculation of male white rats; identification by demonstration of characteristic conidia in the mold form and cigar-shaped yeast forms; demonstration of skin hypersensitivity and complement-fixing and agglutinating antibodies in sera of patients.

10. Monosporium apiospermum: Isolation on Sabouraud's glucose agar at room temperature; identification by demonstration of characteristic conidia.

11. The Aspergilli: Demonstration in fresh preparation in KOH solution; isolation on Sabouraud's glucose agar at room temperature; identifica-

tion by demonstration of characteristic conidiophores and spore chains.

12. Rhinosporidum seeberi: Identification by demonstration of the large thick-walled endospore-filled structures in fresh preparations in KOH solution.

13. The Dermatomyces: Demonstration in fresh preparation in KOH solution; isolation on Sabouraud's glucose agar at room temperature; identification by colonial form and microscopic morphology. Demonstration of skin sensitivity in patients.

C. Virus and Rickettsial Diseases

Serological diagnosis by complement fixation test on mumps, influenza, arthropodal-borne virus encephalitides, lymphocytic choriomeningitis, ornithosis, lymphogranuloma venereum, epidemic typhus, marine typhus, Rocky Mountain spotted fever, Q fever, rickettsial pox and Colorado tick fever; agglutinin-inhibition test for influenze; cold hemagglutinin determination for primary atypical pneumonia; sheep erythrocyte agglutination and absorption tests using guinea pig kidney for infectious mononucleosis; identification of the agent of trachoma and inclusion blenorrhea by direct examination; isolation and identification of herpes simplex, variola and vaccinia viruses.

A review of this outline by the laboratory and clinical services would permit a selection of the studies necessary for efficient care of infectious disease patients seen in any institution. The selection would be influenced by the number of types of patients treated.

The laboratory service can then decide what additional studies are needed as a part of any training or research program for which it might be responsible, since the level of the training program, whether technician, medical student, intern, graduate student and/or resident training is to be offered, would influence the studies to be made and the personnel and facilities required. The extent of any investigative work that might be undertaken should be clearly defined.

When the above questions have been decided, it will be possible for the laboratory department to determine what personnel, space, equipment and supplies are required to make available to the hospital or institution the indicated services. The number and training of the personnel will be determined by the volume of work and the scope of the program to be undertaken. The training and experience of each individual should be in keeping with the responsibility he, or she, is asked to assume. The laboratory space will also be influenced by the volume and scope of the studies performed. If possible, there should be separate rooms for the study 1) of viruses and rickettsia, 2) bacteria, 3) molds and yeasts, and 4) sera; specially equipped space for handling the highly infectious agents; properly equipped animal room including facilities for incineration for the isolation of many agents, and adequate space for the preparation and storage of media and glassware. Ideally, the laboratories for microbiology are located in the same area as the other hospital laboratories in order that they may function as an integral part of the general hospital laboratories.

When the basic space and equipment are provided, it is not difficult to develop a scheme of procedure that will not miss any common pathogenic microorganisms and one that is capable of being expanded in order to isolate and identify the more exotic agents. The additional space and equipment required for any training and research program would vary depending on the number of students and the level of training offered. Each student should be allowed a definite amount of work space in keeping with his, or her, level of training. Otherwise, it is impossible to offer practical experience as a method of teaching. With the support of the clinical departments that will utilize the services,

the laboratory should be able to justify its request for the space and funds necessary to render such services. The ability and desire of the administration to comply with the request will, of course, markedly influence any program that might be planned.

Responsibility of the Physician

The availability of a complete diagnostic microbiological service for infectious diseases places great responsibility on the clinical departments that utilize this service, since to keep the cost of such program within reasonable bounds, the service must be used with maximum efficiency. This requires that each request for laboratory study be made with a clear understanding of the natural history of the infection in question and of the potentialities and limitations of each diagnostic study available. Such a procedure will allow the choice of only those laboratory studies that are likely to be of value. The ecological and epidemiological factors, the clinical picture and the stage of the suspected disease should be considered in deciding what studies will be requested. Frequent consultations between the laboratory service and the clinical services will often lead to a more efficient utilization of the laboratory facilities. The physician must also be aware of his responsibility for the collection and handling of specimens submitted for study, for the physician seldom recognizes the important relationship of his attention to detail in the proper collection and handling of materials to the results and the value of a procedure. Much valuable laboratory time is wasted in studying useless specimens, and many diagnoses are missed because improper specimens are submitted for study.

Routine procedures designed to isolate only the more common infectious agents are established by most laboratories for handling specimens. It is therefore, essential that the physician inform the laboratory of the nature of the clinical problem under study, in order that the established routine may be expanded when indicated. When the clinical picture does not clearly suggest a diagnosis, consultation with the laboratory services is often helpful in selecting proper methods of study. The physician can save the laboratory much work if he is aware of the circumstances under which information concerning the sensitivity of organisms to antibiotics is of value and those under which it is not necessary.

Responsibility of the Laboratory

Aside from correctly studying each specimen that it receives, the microbiological laboratory must meet other responsibilities if it is to render maximum services. Every effort must be made to utilize methods that will make available the information requested in the shortest period of time and to transmit this information to the clinical services as quickly as possible. Since the nature of microbiological studies often make preliminary reports of value, means should be established for transmitting such information to the clinicians whenever indicated. The laboratory should be prepared to demonstrate to the clinical staff the evidence on which it bases the identification of any agent isolated. The physician will aid in maintaining high standards of work in the laboratory by requesting this evidence.

Need for Cooperation

The nature of microbiological studies makes essential a close and friendly cooperation between the clinical and laboratory services. Constructive criticism on the part of the clinician is of great value to the maintenance of high standards of work in the laboratory. Properly documented accounts of failure of the laboratory to perform any service correctly should help prevent such mistakes in the future. Unfounded criticism makes the essential friendly cooperation impossible.

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Post-Mortem Microbiology

The same principles of utilizing the methods of microbiology which are followed by the clinical services are applicable to autopsy cases. One differnce is that specimens at autopsy can be collected from many more sites than is possible from the living patient. Specimens collected at the autopsy table should be handled in the same manner as those collected on the ward or in the operating room. Moreover, the same principles of selecting and requesting studies apply in both cases. The value of such studies is well established.

Microbiology Applied to a Study of Biopsy Specimens

The value of using the methods of microbiology has also been established for studying specimens removed at biopsy or at other operative procedures. Surgeons frequently depend entirely upon the methods of anatomical pathology for study of such material. A combination of both methods has proven in many cases to be more efficient in establishing a precise diagnosis. However, the laboratory must be prepared to handle such material properly if this is to be accomplished.

Use of Outside Microbiological Laboratory Services

Many institutions and hospitals are depending more and more on microbiological laboratory services rendered by state and federal public health laboratories. The purpose and value of such laboratories is not in question. However, any hospital depending upon their services should recognize the following points:

1) How quickly is the information available from these sources?
2) Are preliminary reports rendered?
3) How completely and effectively do the services offered substitute for the services that can be expected from a hospital diagnostic laboratory?
4) How closely can the clinical services work with these laboratories?
5) To what extent will the utilization of such service weaken any teaching programs that the hospital laboratory may be carrying out?

It should also be kept in mind that these laboratories are planned as a part of a preventive medicine program and generally do not attempt to render all the services required for proper management of infectious disease patients.

Personnel Needs

The lack of well trained personnel of all types in this field is well recognized. The manner in which the organization of laboratory medicine has evolved in this country has contributed greatly to this shortage of personnel. Standards of training in medical microbiology have not been clearly defined. In most instances, the responsibility for microbiology has been in the hands of individuals primarily interested in other areas of laboratory medicine. There is a need for a definition of training programs at various levels in this field, and for a definition of training and experience to be required of the individuals who assume various responsibilities in microbiology laboratories. The same need is recognized for clinical chemistry and other branches of laboratory medicine. The recognition of microbiology as an equal subspecialty of general laboratory medicine along with anatomical pathology, clinical chemistry, and hematology, and the establishment of standards of training in all these areas would tend to improve the practice of this important medical specialty.

The Value of the Methods of Microbiology in Present-Day Practice of Medicine

The availability of antibiotics effective against many microorganisms has raised the question of the value of exact etiological diagnosis of infectious diseases in present-day practice of medicine. If one is interested in studying and teaching the natural history of infectious diseases, the value of exact diagnosis is obvious. Also, the institution of proper preventive medicine measures requires information that can be gained only by laboratory methods. Nevertheless, the nature of available antibiotics and other chemotherapeutic agents, and the fact that many infectious diseases may be recognized with a fair degree of accuracy by proper interpretation of the history and physical examination, makes possible the cure of a large number of cases without exact diagnosis. Under some circumstances, the institution of therapy without attempting laboratory diagnosis seems to be justified. Under other conditions; therapy should be started after materials for laboratory studies have been collected, and before the results are available. Other clinical pictures warrant delay in therapy until the laboratory studies are completed. If a careful history is recorded and physical examination performed. and the findings interpreted in the light of an understanding of the natural history of the various infectious diseases, the choice of the proper procedure to follow in requesting laboratory studies and starting antibiotic therapy should be possible.

A few examples will serve to illustrate certain types of problems whose solution requires sound clinical judgement and intelligent use of laboratory procedures.

Patients with chronic febrile illnesses who have been treated with repeated courses of antibiotics, singly or in combination, without termination of their illnesses present a real challenge. This group of patients includes those with obscure infections due to insensitive organisms; those with infections which have been modified but not cured by antibiotics; and those with neoplastic and "collagen" diseases. The clinician who attempts to manage this group of patients should have a wide knowledge of the natural history of all chronic febrile diseases and the services of a laboratory which can perform all indicated studies. It is much more difficult to recognize infectious diseases whose course has been modified by antibiotics than untreated cases.

The clinical pictures that may result from a variety of unrelated organisms may be difficult to treat effectively without aid of laboratory studies.

Twenty-one unrelated groups of infectious agents have been found to produce the clinical picture of subacute bacterial endocarditis. The value of laboratory diagnosis and sensitivity studies in the management of this severe infection is not questioned. However, the indiscriminate use of antibiotics without careful history and physical examination, and the use of laboratory studies when indicated has resulted in the inadequate treatment of many cases of subacute bacterial endocarditis. The possibility of this disease should be considered in all patients with fever and a cardiac murmur and laboratory studies initiated when indicated.

The importance and difficulty of specifically classifying patients presenting clinical pictures suggestive of meningitis or encephalitis is well recognized. It is impossible to treat a case of bacterial meningitis with maximum efficiency unless the causative organism is identified. Acute purulent meningitis may be caused by twelve unrelated groups of infectious agents. No single antibiotic or single combination of drugs would be ideal for treatment of all of these different types of infections.

Green, Sweet, and Prichard[5] in a recent paper, point out the difficulty of establishing a diagnosis of lymphocytic choriomeningitis because of the many conditions which may produce a serous meningitis which is clinically similar to that caused by the virus of lymphocytic choriomeningitis. A list of the conditions that should be considered in this differential diagnosis includes: poliomyelitis; the various types of arthropodal borne encephalitides; Coxsackie virus infection; secondary involvement of the central nervous system associated with rubeola, mumps, varicella, rubella, and vaccinia; herpes simplex, infectious mononucleosis; lymphopathia venereum; syphilis; Weil's disease; chronic inflammation impinging on the meninges; lead poisoning; tuberculosis; torulosis; toxoplasmosis; and serous meningitis in scarlet fever. Without the aid of laboratory studies, the diagnosis of lymphocytic choriomeningitis is very questionable, making prognosis and treatment difficult.

The problem attendant to the diagnosis and treatment of non-bacterial pneumonia was recently reviewed[6]. The author points out that the etiological agents include viruses, rickettsia, fungi, protozoa, toxins and allergens. Emphasizing the same point, Feller[2] suggested that the diagnosis of primary atypical pneumonia should be made only after the possibility of the diseases of known etiology that may produce a similar clinical picture has been excluded. These diseases include tuberculosis, tularemia, the various common bacterial pneumonias, psittacosis, influenza, lymphocytic choriomeningitis, Q fever, coccidioidomycosis, and histoplasmosis.

Weed and Woolner[7] have emphasized the importance of microbiological and histopathological studies in the diagnosis of granulomas of lung and other tissues. They isolated seven different agents from solitary pulmonary lesions removed surgically. These include Mycobacterium tuberculosis, Coccidioides immitis, Nocardia asteroides, Brucella suis, Blastomyces dermatitidis, Histoplasma capsulatum, and Cryptococcus neoformans. The same methods that these workers applied to pulmonary lesions would be of great value in studying granulomas of lymph nodes, bones, liver, spleen, skin, and other organs. It is obvious from this study that histopathological studies alone will not permit a specific classification of these lesions. Prognosis and treatment of individual cases of this type are markedly influenced by a specific diagnosis.

The clinical picture of acute nasopharyngitis may result from a great variety of infectious agents, some of which can be identified by laboratory methods. Infection with Group A streptococci is difficult to separate with certainty from the other infections except by laboratory studies. The serious non-suppurative sequellae that may follow infection by these organisms warrant efforts to establish a specific diagnosis, especially if the individual is known to have had rheumatic fever.

The six groups of organisms that frequently cause infection of the urinary tract produce clinical pictures that are very similar. It is impossible to suspect which of these groups is involved on the basis of clinical findings alone. After the organism is classified as belonging to one of the following genera: Escherichia, Aerobacter, Proteus, Pseudomonas and Staphylococcus or Enterococcus groups, the sensitivity of various strains to chemotherapeutic agents is variable to such a degree as to make selection of the proper drug difficult. Sensitivity studies are helpful in making the choice. These principles apply to infections outside of the urinary tract that are caused by these organisms.

A failure to apply the most effective and efficient methods for the demonstration, isolation, and identification of Mycobacterium tuberculosis results in many wasted hospital days for patients suspected of having tuberculosis. Nevertheless, few hospital laboratories are able to carry out the most efficient

studies for this purpose.

Jawetz and Marshall[8] have reviewed the role of the laboratory in antibiotic therapy. They report a series of cases, including Klebsiella pneumonia treated with penicillin, several penicillin-resistant staphylococcal infections treated for long periods with this drug, enterococcus septicemia treated with penicillin and tuberculosis lymphadenitis treated with penicillin and summarize their thesis by stating: "To safeguard the best interest of the patient the physician must know the proper indications for essential laboratory procedures in rational antibiotic therapy. He must be aware of the fact that haphazard administration of antibiotic agents may produce serious damage which can be prevented by utilizing the information obtained from intelligent use of laboratory examination."

There is no doubt that much can be accomplished with antibiotics for the treatment of infectious diseases diagnosed on the basis of the clinical findings alone; however, under many circumstances the information obtained from the intelligent use of laboratory examination will allow a much more effective utilization of these therapeutic agents. The exact etiological diagnosis of many infections is of more importance now than prior to the time when antibiotics were made available.

The introduction of antibiotics has brought about striking changes in the practice of medicine. The extensive use of these drugs has markedly altered the course of many infectious diseases and has caused a definite change in the number and types of infectious disease cases that are seen in hospital practice. Genrally speaking, this remarkable accomplishment has been brought about by the empirical use of single antibiotics or combinations of these drugs. The time has come to evaluate the accomplishments that have been made and to determine if patients are receiving full benefit from these drugs. There has been a great reduction in the mortality rate from infectious diseases, and the course of many infectious diseases has been decidedly shortened. It is apparent, however, that there is still much to be accomplished in this field. It is the opinion of this writer that, if full intelligent use is made of the methods of microbiology, the laboratory will play an important role in obtaining for patients the full benefit of the antibiotics. The accomplishment of this goal requires that necessary personnel and facilities be made available to perform properly the studies requested by the physician.

Summary

1. There is a great need for improvement in the standards of practice of medical microbiology in this country.

2. Proper planning of a microbiology laboratory requires clear definition of the services that it is expected to render. These services may include not only studies necessary for care of patients but also those necessary for training and research programs. Requirements for space, equipment, supplies and personnel should be based on this information.

3. The studies necessary for patient care should be selected by the clinical and laboratory services. An outline of possible methods of study is included in this report.

4. If the cost of a complete microbiological laboratory service is to be kept within reasonable bounds, the clinicians must utilize the service with great efficiency. This requires a clear understanding of the natural history of various infectious diseases and a

knowledge of the potentialities and limitations of each laboratory method.

5. If microbiological laboratory studies are to be of maximum value to the clinician, the information must be furnished as quickly as possible.

6. The need for close friendly cooperation between the clinical and laboratory services is pointed out.

7. The value of microbiological methods in the study of specimens removed at operation and autopsy indicated.

8. The use of state and federal public health microbiology laboratory services is discussed.

9. A recognition of medical microbiology as a separate subspecialty of general laboratory medicine might tend to attract much needed personnel into the field.

10. The value of the methods of microbiology in present-day practice of medicine is considered.

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II. MEDICAL SCHOOL NEWS

Coming Event

June 19 -- Duluth Clinic Lecture: "Fourteen Years' Experience with the Ballistocardiograph," Isaac Starr, University of Pennsylvania School of Medicine; Medical Science Amphitheater, 8:00 p.m.

Student Day Inaugurated

A large audience of students and faculty of the Medical School heard four senior medical students present reports on medical research as a part of the first annual Student Day sponsored by the Minnesota Medical Foundation. All who attended were impressed not only by the fine caliber of scientific work which had been done but also by the mature and polished way in which the material was presented. Students who presented papaers were: Kenneth G. Berge, Sanford Bloom, Thomas A. Good, and Bernard E. Herman. Dr. Howard L. Horns, Assistant Dean of the Medical School, announced that Sanford Bloom was the recipient of the annual Borden Award. This honor carries with it a prize of $500.00. It was also announced at the meeting that Richard Lillehei had been awarded the annual Southern Minnesota Medical Association prize of $100.00.

Student Day was sponsored by the Minnesota Medical Foundation in an effort to interest undergraduate medical students in medical research and acquaint them with the fact that opportunities are present to engage in such research during their undergraduate medical school careers.

Six O'Clock Club Entertains Students and Faculty

Medical students had an opportunity to poke fun at faculty members throughout the laugh-filled evening. Dr. Charles May opened festivities with his sparkling wit and kept the program moving along briskly in this capacity as to toastmaster. Mark Listerud, President of of the Inter-Fraternity Council, sponsoring organization, spoke for the medical students and presented Assistant Dean Howard L. Horns with a loving cup as a token of esteem from the student body. Skits presented by the medical fraternities brought roars of laughter from the audience as various faculty members were "gently" ribbed for their many characteristic mannerisms and phrases. The Phi Rho Sigma chorus presented several musical selections and were in turn ribbed by a clever pantomime presentation skillfully performed by the Alpha Epsilon Iota Medical Sorority.

Rochester Meeting

Officers who were elected at the meeting of the Minnesota Medical Alumni Association in Rochester April 30 were: President, Dr. Herman E. Drill, Hopkins; First Vice-President, Dr. Russell J. Moe, Duluth; Second Vice-President, Dr. Brian J. McGroarty, St. Paul; Secretary, Dr. Sheldon M. Lagaard, Minneapolis, and Treasurer, Dr. Donald R. Iannin, St.Paul.

Physicians elected to the Executive Committee for a two-year term include: Dr. Joseph Gaida, St. Cloud; Dr. John T. Pewters, Minneapolis; Dr. Charles H. Scheifley, Rochester; and Dr. Royal Sherman, Red Wing. Dr. W. F. Widen was elected delegate to the General Alumni Association.

Other business conducted by the Alumni Association included the adoption of two ammendments. The first of these provided that the annual meeting shall hereafter be the joint meeting with the Minnesota Medical Foundation during the Minnesota State Medical Association's annual convention rather than the meeting held at the time of the homecoming football game in the fall. The second ammendment stated that five members of the executive committee shall constitute a quorum.

Faculty News

Dr. Leo G. Rigler, Professor and Head of the Department of Radiology and Physical Medicine, recently addressed the Indiana Roentgen Society in Indianapolis. Dr. Rigler spoke on the subject, "Vascular Disturbances of the Lungs".

III.

UNIVERSITY OF MINNESOTA MEDICAL SCHOOL
WEEKLY CALENDAR OF EVENTS

Visitors Welcome

May 28 - June 2, 1951

Monday, May 28

Medical School and University Hospitals

9:00 - 9:50 Roentgenology-Medicine Conference; L. G. Rigler, C. J. Watson and Staff; Todd Amphitheater, U. H.

9:00 - 10:50 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff; M-109, U. H.

10:00 - 12:00 Neurology Rounds; A. B. Baker and Staff; Station 50, U. H.

11:00 - 11:50 Physical Medicine Seminar; E-101, U. H.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Eustis Amphitheater, U. H.

12:00 - 12:50 Physiology Seminar; Serum Cholesterol, Giant Molecules, and Atherosclerosis; Ancel Keys; 214 Millard Hall.

12:15 - 1:20 Obstetrics and Gynecology Journal Club; Staff Dining Room, U. H.

1:30 - 2:30 Pediatric-Neurological Rounds; R. Jensen, A. B. Baker and Staff; U. H.

4:00 - Public Health Seminar; 113 Medical Sciences.

4:00 - Pediatric Seminar; Streptococcal Enzymes; Benjamin Katz; Sixth Floor West, U. H.

4:30 - 5:30 Dermatological Seminar; M-436, U. H.

5:00 - 5:50 Clinical Medical Pathologic Conference; Todd Amphitheater, U. H.

5:00 - 6:00 Urology-Roentgenology Conference; C. D. Creevy, O. J. Baggenstoss, and Staffs; Powell Hall Amphitheater.

Minneapolis General Hospital

8:30 - 10:00 Pediatric Rounds; Dr. Lowry; 7th Floor Annex.

11:00 - Pediatric Rounds; Franklin Top, 7th Floor Annex.

1:00 - 2:00 Staff Meeting; Classroom, 4th Floor.

1:30 - Pediatric Rounds; Dr. Ulstrom; 5th Floor Annex.

Veterans Administration Hospital

9:00 - G. I. Rounds; R. V. Ebert, J. A. Wilson, Norman Shrifter; Bldg. I.

Monday, May 28 (Cont.)

Veterans Administration Hospital (Cont.)

11:30 - X-ray Conference; Conference Room; Bldg. I.

1:00 - Metabolic Disease Rounds; N. E. Jacobson and G. V. Loomis; Bldg. I.

4:00 - Medical Surgical Conference; Conference Room, Bldg. I.

Tuesday, May 29

Medical School and University Hospitals

9:00 - 9:50 Roentgenology-Pediatric Conference; L. G. Rigler, I. McQuarrie and Staffs; Eustis Amphitheater, U. H.

9:00 - 12:00 Cardiovascular Rounds; Station 30, U. H.

12:30 - 1:20 Pathology Conference; Autopsies; J. R. Dawson and Staff; 102 I. A.

1:00 - 2:00 Physiology Seminar on Cardiac Metabolism; 129 Millard Hall.

3:15 - 4:20 Gynecology Chart Conference; J. L. McKelvey and Staff; Station 54, U.H.

4:00 - 5:00 Pediatric Rounds on Wards; I. McQuarrie and Staff; U. H.

4:00 - 5:00 Physiology-Surgery Conference; Todd Amphitheater, U. H.

4:00 - 5:00 Electrocardiographic Conference; EKG Laboratory, 6th Floor, U. H.

5:00 - 6:00 X-ray Conference; Presentation of Cases by Ancker Hospital Staff; Drs. Aurelius, D. Peterson, and Traub; Eustis Amphitheater, U. H.

Ancker Hospital

8:00 - 9:00 Fracture Conference; Auditorium.

1:00 - 2:30 X-ray Surgery Conference; Auditorium.

Veterans Administration Hospital

8:45 - Surgery Journal Club; Conference Room, Bldg. I.

9:30 - Surgery-Pathology Conference; Conference Room, Bldg. I.

10:30 - Surgery Tumor Conference; Conference Room, Bldg. I.

1:00 - Chest Surgery Conference; T. Kinsella and Wm. Tucker; Conference Room, Bldg. I.

1:30 - Liver Rounds; Samuel Nesbitt.

2:00 - 2:50 Dermatology and Syphilology Conference; H. E. Michelson and Staff; Bldg. III.

Tuesday, May 29 (Cont.)

Veterans Administration Hospital (Cont.)

3:30 - 4:20 Autopsy Conference; E. T. Bell and Donald Gleasen, Conference Room, Bldg. I.

Wednesday, May 30 HOLIDAY

Thursday, May 31

Medical School and University Hospitals

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; M-109 U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Todd Amphitheater, U. H.

12:00 - Physiology Chemistry Seminar; Anterior Pituitary and Liver Metabolism; D. Simmons; 214 Millard Hall.

4:30 - 5:20 Ophthalmology Ward Rounds; Erling W. Hansen and Staff; E-534, U. H.

5:00 - Bacteriology Seminar; 214 Millard Hall.

5:00 - 6:00 Radiology Seminar; Early X-ray Signs of Carcinoma of the Lung; B. J. O'Loughlin; Eustis Amphitheater, U. H.

7:30 - 9:30 Pediatric Cardiology Conference and Journal Club; Review of Current Literature 1st hour and Review of Patients 2nd hours; 206 Temporary West Hospital.

Minneapolis General Hospital

8:30 - Neurology Rounds; Dr. Heilig, 4th Floor Annex.

11:30 - Pathology Conference; Main Classroom.

1:00 - 2:00 EKG and X-ray Conference; Classroom, 4th Floor Annex.

2:00 - Psychiatry Rounds; Dr. Benton; 4th Floor Annex.

Veterans Administration Hospital

8:00 - Surgery Ward Rounds; Lyle Hay and Staff.

9:15 - Surgery Grand Rounds; Conference Room, Bldg. I.

11:00 - Surgery Roentgen Conference; Conference Room, Bldg. I.

2:15 - Chest Rounds; William Stead.

Friday, June 1

Medical School and University Hospitals

8:30 - 10:00 Neurology Grand Rounds; A. B. Baker and Staff; Station 50, U. H.

9:00 - 9:50 Medicine Grand Rounds; C. J. Watson and Staff; Todd Amphitheater, U.H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:30 - 11:50 Otolaryngology Case Studies; L. R. Boies and Staff; Out-Patient Department, U. H.

11:45 - 12:50 University of Minnesota Hospitals Staff Meeting; Biography of Carcinoma of the Lung; Bernard J. O'Loughlin and Richard C. Tucker; Powell Hall Amphitheater.

1:00 - 2:50 Neurosurgery-Roentgenology Conference; W. T. Peyton, Harold O. Peterson and Staff; Todd Amphitheater, U. H.

2:00 - 3:00 Dermatology and Syphilology Conference; Presentation of Selected Cases of the Week; H. E. Michelson and Staff; W-312, U. H.

3:00 - 4:00 Neuropathological Conference; F. Tichy; Todd Amphitheater, U. H.

4:00 - 5:00 Dermatology Seminar; W-312, U. H.

4:00 - 5:00 Vascular Rounds; Davitt Felder and staff members from the departments of Medicine, Surgery, Physical Medicine, and Dermatology; Eustis Amphitheater, U. H.

5:00 - Urology Seminar; Cystoscopic Manipulation for Ureteral Calculi; Murray Ersfeld; Eustis Amphitheater, U. H.

Ancker Hospital

1:00 - 3:00 Pathology-Surgery Conference; Auditorium.

Minneapolis General Hospital

8:30 - Pediatric Rounds; Dr. Lowry; 7th Floor Annex.

10:00 - Pediatric Rounds; Franklin Top; 7th Floor Annex.

1:30 - Pediatric Rounds; Dr. Ulstrom; 5th Floor Annex.

Veterans Administration Hospital

10:30 - 11:20 Medicine Grand Rounds; Conference Room, Bldg. I.

1:00 - Microscopic-Pathology Conference; E. T. Bell; Conference Room, Bldg. I.

1:30 - Chest Conference; Wm. Tucker and J. A. Myers; Ward 62, Day Room.

3:00 - Renal Pathology; E. T. Bell; Conference Room, Bldg. I.

Saturday, June 2

Medical School and University Hospitals

7:45 - 8:50 Orthopedic X-ray Conference; Wallace H. Cole and Staff; M-109, U. H.

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Sraff; E-221, U. H.

9:00 - 10:30 Pediatric Grand Rounds; I. McQuarrie and Staff; Eustis Amphitheater, U. H.

9:15 - 10:00 Surgery-Roentgenology Conference; J. Friedman, O. H. Wangensteen and Staff; Todd Amphitheater, U. H.

10:00 - 11:30 Surgery Conference; Anterior Resection for Cancer of the Rectum; Charles Mayo; Todd Amphitheater, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:00 - 12:50 Obstetrics and Gynecology Grand Rounds; J. L. McKelvey and Staff; Station 44, U. H.

11:00 - 12:00 Anatomy Seminar; The Histochemical Localization of Plasmal, Morton Alpert; The Role of the Spleen in Radiation Injury; Joseph Wagner; 226 Institute of Anatomy.

Ancker Hospital

8:30 - 9:30 Surgery Conference; Auditorium.

Minneapolis General Hospital

11:00 - 12:00 Pediatric Clinic; Dr. Thomas and Dr. Good; Classroom, 7th Floor Annex.

Veterans Administration Hospital

8:00 - Proctology Rounds; W. C. Bernstein and Staff; Bldg. III.

8:30 - Hematology Rounds; P. Hagen and E. F. Englund.