



Stanley L. Inhorn, MD

The Wisconsin State Laboratory of Hygiene: A Century of Service and Progress

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Introduction

At the start of the 20th century, childhood infectious diseases, waterborne epidemics, tuberculosis, and pneumonia ravaged Wisconsin's population. Prior to 1900, investigators in Europe, notably Pasteur and Koch, proved that bacteria were the causative agents of specific diseases, thereby providing the first opportunity to control these scourges. Doctor Edward A. Birge, a University of Wisconsin (UW) biology professor, traveled to Europe to study in the laboratories of these men, and after his return in 1885, he developed a bacteriology course. Two of his students were Cornelius Harper, who became a physician and later State Health Officer, and Harry Russell, who later traveled to study with Koch. In 1893, Russell became the first bacteriology appointee in the UW Department of Agriculture.

Between 1886 and 1910, 38 states were in the process of developing public health laboratories. In 1903, when the State Board of Health recommended that a "hygienic laboratory" be established to assist the Board in carrying out its duties, Russell and Harper persuaded the

legislature to fund a "hygienic laboratory" at the UW. This unique concept, supported by the Wisconsin Medical Society and by Birge, who was then the UW's acting president, would provide benefits from the university's scientific capabilities to promote public health. The concept of a university-based laboratory was in keeping with the "Wisconsin Idea" developed by Governor Robert M. LaFollette, Sr, and UW President C. R. Van Hise to extend the expertise of the university to state government and to Wisconsin citizens.

On October 1, 1903, the Wisconsin State Laboratory of Hygiene (WSLH) began operations in a basement room of Agriculture Hall with a mission to assist all health officers and physi-

cians of the state and to serve as the laboratory for the Board of Health. The laboratory was directed to examine water supplies and cases of contagious diseases such as typhoid fever, diphtheria, anthrax, and hydrophobia. Russell, who was appointed director, fostered the concept that the academic affiliation would provide opportunity for developing research and teaching programs. Under his leadership, the services of the laboratory expanded, so that in 1907 the WSLH was relocated to the fourth floor of South Hall. The same year, Russell became Dean of the College of Agriculture, and Dr Mazyck P. Ravenel, a distinguished bacteriologist, was recruited as director. Ravenel's research interest was the relationship of bovine to human tu-



The University of Wisconsin-Madison's Agriculture Hall, the Wisconsin State Laboratory of Hygiene's first home, as it was pictured in 1903. During its first year, the modest one-room, basement laboratory tested just over 100 samples. Photo courtesy of UW-Madison Archives.

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The WSLH Cytology lab in 1952. In 1957, the School of Cytotechnology opened to train students in cytology techniques. The first class had 2 students.

berculosis. Studies on tuberculosis, anthrax in animals, and rabies in dogs greatly increased the laboratory's workload. When Ravenel left Madison in 1914 to accept the chairmanship of the Department of Preventive Medicine at the University of Missouri, UW President Van Hise appointed the dean of the medical school, C. R. Bardeen, as acting director. At the time, the WSLH had seven employees, one of whom was William D. Stovall, MD, who had come to Wisconsin for one year to gain experience in bacteriology. Stovall, however, relishing the activities at the university and the WSLH, decided to remain in Wisconsin and, in 1918, was appointed director. Early in the laboratory's existence, health officers and physicians expressed difficulty in submitting specimens to Madison, so in 1916 the Board of Health created a branch laboratory in Rhinelander under the supervision of the WSLH Director. The success of this venture led the Board of Health to develop eight other branch laboratories strategically located throughout Wisconsin during the next two decades.

Stovall/Nichols Era 1918-1958

When Stovall assumed the directorship in 1918, he named M. Starr Nichols, PhD, a chemist, to be his assistant director and to develop the sanitary chemistry section. Nichols investigated the process for laboratory examination of drinking water, lakes and streams, and recreational waters. He was instrumental in instigating the chlorination of water supplies and swimming pools, and, later, the fluoridation of drinking water. Nichols was recognized as a national authority on these topics through his many publications.

With his background in laboratory diagnosis and pathology, Stovall embarked on a course of expanding the services of the WSLH to physicians and small hospitals and clinics. He embraced the Wisconsin Idea with the premise that all Wisconsin physicians should have access to the latest laboratory tests for diagnosing and managing their patients. The WSLH provided services in all phases of microbiology, as well as clinical chemistry, toxicology, serology, anatomic pathology, sanitary chemistry, and bacteriology.

When the Wisconsin General Hospital opened in 1924, Stovall was asked to direct the clinical laboratories. Although the Department of Pathology was assigned to provide the surgical pathology services, their faculty would not provide the on-call frozen section capability required by the surgeons. The hospital superintendent turned to Stovall, who provided pathologists from the WSLH to establish a functioning surgical pathology program within Wisconsin General Hospital. In 1928, the WSLH moved to larger quarters in the Service Memorial Institute (SMI), a medical school building adjacent to the hospital. This proximity en-

abled Stovall to run the two laboratories as a coordinated operation. Microbiology and serology for the hospital were carried out at the WSLH, while clinical chemistry, hematology, and blood banking were conducted in the new hospital laboratories.

The 1930s and 1940s saw great expansion of the WSLH's services. An occupational health program was begun. Nichols and colleagues studied the utility of copper in suppressing algae in lakes and the effects of DDT and other chemicals on aquatic vegetation. Production of typhoid-paratyphoid vaccine, skin test reagents such as old tuberculin and histoplasmin, and silver nitrate vials for newborns became major programs. A virus isolation and diagnostic laboratory was opened to serve the entire state. Blood group antigen/antibody testing was introduced, and microbiology services in the areas of parasitology and mycology expanded. During these years of growth, all services were provided free-of-charge to physicians and hospitals. Services were also provided to the Department of Public Welfare institutions, local health officers, veterinarians, and sanitary engineers.

It became clear in the late 1940s that the programs had outgrown the laboratory facilities in SMI. In 1949, the Wisconsin Medical Society supported a concerted effort to obtain federal Hill-Burton construction funds and state appropriations for construction of a new WSLH building. After administrative and legislative hurdles were overcome, funding was obtained and a new laboratory was built on Henry Mall, in the heart of the University's bioscience campus and adjacent to the Wisconsin General Hospital and Medical School. The five-story building was dedicated on February 28, 1953, the same day that Watson and Crick announced

that they had determined the structure of DNA. The opening of this facility meant that the branch laboratories could be phased out. To help clinicians utilize its services, the WSLH distributed an instruction manual, which included information on obtaining mailing kits and a guide for submitting specimens.

During the late 1940s and 1950s, as Wisconsin recovered from World War II and the economy grew, there were pressures to expand health care services. New hospitals and clinics opened, others expanded, and more pathologists and technologists became available to perform clinical laboratory services. The activities of the WSLH were redirected accordingly. The Bacteriology Section changed its focus from primary isolations to referred cultures. The WSLH concentrated more and more on providing special diagnostic testing not available in private laboratories while continuing to serve the needs of other state agencies and local health departments. In 1958, both Drs Stovall and Nichols retired after long, distinguished careers. In recognition of Stovall's service to the physicians and citizens of Wisconsin, the Wisconsin Medical Society dedicated a commemorative arch in his honor at its headquarters.

Evans/Inhorn Eras
1959-1979

After Stovall's retirement, the University separated the administration of the WSLH from that of the University Hospital laboratories. Frank Larson, MD, was selected as director of the hospital laboratory. Alfred S. Evans, MD, was appointed the director of WSLH in addition to continuing his role as chairman of the Department of Preventive Medicine. Evans had been conducting re-



WSLH laboratorians performing bacteriology tests, circa 1915. Four years earlier, the State Hygienic Laboratory changed its name to the Wisconsin State Laboratory of Hygiene.

search in viral respiratory disease and hepatitis in laboratories within the WSLH building since coming to Madison from Yale University and a second tour of Army duty in Germany. His epidemiology background motivated him to utilize laboratory findings from the bacteriology and virology departments for studies of defined populations. To accomplish such research, he organized serum banks and introduced computer systems in the WSLH to recover demographic data. To enable an expanded research and development role, the WSLH Board approved a prepaid handling fee on certain tests. Evans initiated a laboratory newsletter, the first public health laboratory newsletter in the United States, to keep health workers and physicians better informed about current activities.

During the 1960s, many scientific advances were being made in microbiology. The WSLH recognized a responsibility to carry out feasibility studies in order to apply these laboratory developments to public health practice. To better support local laboratories, reference testing, workshops, quality

control assistance, and special testing services were expanded. Under Evans' leadership, training activities became a major focus of the WSLH. WSLH section chiefs were appointed faculty members in Preventive Medicine, enabling medical students to receive experience-based education. Courses in infectious disease epidemiology, chronic disease epidemiology, and public health practice were presented in the first three years of medical school.

During the early 1960s, many large programs were developed, often in partnership with the Division of Health. Prevention of rheumatic fever through rapid diagnosis of Group A streptococcal infection and penicillin therapy was launched in 1961. Water collection kits were made available to citizens who had private wells. Prenatal testing for Rh factor and infectious diseases were expanded. A radiation protection program was started to monitor nuclear power plants in the state. The Clinical Chemistry Section provided physicians with expanded glucose and cholesterol screening services. In 1962, the State Board of Health, in



A view of the 1940s WSLH tuberculosis laboratory where the State Lab provided TB testing to physicians, sanatoria and hospitals throughout Wisconsin.

cooperation with the WSLH, instituted a voluntary certification system for private laboratories, patterned after a New York state program. In communities or counties with certified laboratories that could provide services to all physicians, the WSLH discontinued its routine testing. As more trained personnel became available to staff hospital and clinic laboratories, the focus of the WSLH shifted to training, epidemiological surveys, and demonstration programs.

During this period, a Zoonosis Research Unit was established, with the focus on mosquito-borne encephalitis. Dr Wayne Thompson, a research veterinarian, carried out investigations that isolated and identified the La Crosse encephalitis virus. His subsequent epidemiological studies determined the over-wintering mechanism of this important agent. Stanley Inhorn, MD, who had recently completed a pathology residency, was appointed assistant director of the WSLH. His research in viral pathogenesis was diverted to a productive collaboration with faculty in pediatrics and medical genetics on the relationship between chromosomal abnormalities and

congenital defects and spontaneous abortion. At the time, fluorescent antibody techniques were finding greater application in the rapid diagnosis of rabies and other infectious diseases. Consequently, the WSLH redirected its resources to these and other specialized procedures in mycology, parasitology, serology, virology, and clinical chemistry.

In 1965, the Wisconsin Legislature passed the Water Resources Act that later established the Department of Resource Development to protect all waters of the state and to conserve land, air, wildlife, and other natural resources. Subsequently, the statutes were amended, directing the WSLH to furnish a complete laboratory service to the State Board of Health and the Department of Resource Development (later DNR). The WSLH would continue to make teaching facilities available to the University of Wisconsin and the two agencies. Each of the three entities would have two representatives on a WSLH administrative board. Also in 1965, a statute for Inborn Errors of Metabolism mandated the reporting of tests for phenylketonuria and other inborn errors of metabolism as may be designated by the Board of Health. Initially, the WSLH and the Milwaukee Health Department laboratory were designated to perform the Guthrie test.

In 1966, Evans accepted an offer from Yale University to become Director of the World Health Organization Regional Serum Reference Bank and the John Rodman Paul Professor in the School of Public Health. He was succeeded as director by Inhorn, who had been serving for six years as the assistant director. Inhorn was faced immediately with issues related to the passage of Medicare in 1966 and the Clinical Laboratory Improvement Act of 1967 (CLIA). As a consult-

ant to the Department of Health, Education, and Welfare (HEW) and the Communicable Disease Center (CDC), he participated in the development of regulations and standards for independent clinical laboratories and hospital-based laboratories. As Medicare legislation mandated that state-operated or state-approved proficiency testing programs cover the full range of laboratory specialties, the Board of Health, in conjunction with the WSLH, embarked on an expanded state laboratory certification plan. (An article on page 54 describes the evolution of the proficiency testing program started at this time.) The Medicare legislation also prompted Wisconsin to merge the Departments of Health and Public Welfare into the Department of Health and Family Services.

In the 1970s, as laboratory sciences continued to provide more diagnostic opportunities, the WSLH expanded its menu of tests to support public health providers and medical practitioners alike. Toxicology services grew to include testing for drugs of abuse. Microbiology added capabilities in mycoplasma diagnosis and virology, requiring enlargement of laboratory animal colonies and tissue culture facilities. To respond to advancements in diagnostic serology, an Immunology Section was created. This new section developed enhanced testing panels for sexually transmitted diseases, prenatal screening, infectious mononucleosis, and respiratory tract infections.

The Federal Clean Water Act of 1972 was directed toward the control of pollution from increasing industrial contamination. The WSLH, benefiting again from the resources provided by UW scientists, became a leader in environmental testing. Noteworthy were the efforts to reverse the effects of polychlorinated

biphenyls (PCBs) on the environment. Coordination with DNR field staff was crucial in this effort. Environmental chemistry testing also expanded in the 1970s as a result of the passage of a major revision of the Clean Air Act in 1970.

During the Johnson administration, a President's Commission determined that the major causes of death in the United States were no longer the infectious scourges of the past. Heart disease, cancer, and strokes now accounted for 70 percent of all deaths, and new measures were needed to conquer these modern plagues. Senate hearings in 1966 gathered information from medical schools, state departments of health, manufacturers, clinics, and scientific associations. The Wisconsin Board of Health reported on its 25-year experience in collaboration with the WSLH in screening for tuberculosis, and later hypertension, diabetes, and cervical cancer. Subsequently, a decision was made to expand the Board of Health program without charge to Wisconsin citizens by utilizing five buses that would cover the entire state every four years. Autoanalyzer technology permitted the addition of 10 chemistry tests to the screening protocol. Up to 10 percent of participants with abnormal findings were referred to the patients' physicians; two out of three of these individuals were found to have a significant disease condition. The success of this program in the 1970s and the changing patterns of disease redirected some of WSLH's resources into laboratory fields other than microbiology. However, in 1976, two epidemics, the Swine Flu scare and Legionnaires' Disease, indicated that infectious agents were still potential health threats. In 1978, Inhorn accepted the chairmanship of the Department of Pathology, and in 1979, he stepped down as WSLH director.



During its early years, WSLH laboratory personnel made most reagents in-house. Many of them are pictured on the shelves of this late 1930s photograph of the water chemistry lab.

Laessig and the Current Era: 1980-Present

Ronald H. Laessig, PhD, the assistant director and chief, Clinical Chemistry, was appointed director after Inhorn resigned. With his experience in analytic chemistry, Laessig was well suited to facing the challenges of the 1980s and 1990s, as more demands were being placed on the WSLH for environmental testing and toxicology services for coroners in a period of rapidly changing health care systems, revolutions in science and technology, and changing concepts in laboratory quality assurance. As a dramatic reminder that contagious diseases were not irrelevant, cases of opportunistic infections in healthy young men were recognized in 1981 as representing a new epidemic called AIDS. This emerging infectious disease became the most dominant world-wide epidemic of the latter part of the 20th century, one that would challenge both the public health and medical resources of the state and nation.

During these latter decades of the 20th century, other events at the national level helped to shape program development at the WSLH. The war on drugs of abuse created a demand for increased toxicology services.

Parent-consumer groups became a force for expanding newborn screening programs. Recognition of the importance of chlamydia and other sexually transmitted infections changed the direction of STD testing. Creation of the Environmental Protection Agency, the Occupational Safety and Health Administration, and reorganization of CDC had major effects on the WSLH and other public health laboratories.

The rapidly changing public health scenario of the latter part of the 20th century has continued into the new millennium. Control of infectious diseases now has to contend with emergence of exotic agents such as West Nile virus, as well as resurgence of antibiotic-resistant microorganisms. Recent world events have demonstrated that America faces the threat of bioterrorism. In his article on page 15, Dr Laessig discusses the current and future roles of the WSLH. Other articles in this issue describe a number of major public health laboratory programs that have evolved through the decades to provide support for coordinated disease control efforts in Wisconsin—the 100-year legacy of the Wisconsin State Laboratory of Hygiene.



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