

2013

The First Hundred Years of the Nebraska Public Health Laboratory: A Major Role Played in the Development of Public Health

Kristin Watkins

University of Nebraska Medical Center, kristin.watkins@unmc.edu

Peter C. Iwen

University of Nebraska Medical Center, piwen@unmc.edu

Anthony R. Sambol

University of Nebraska Medical Center, asambol@unmc.edu

Follow this and additional works at: https://digitalcommons.unmc.edu/coph_history_papers



Part of the [Public Health Commons](#)

Recommended Citation

Watkins, Kristin; Iwen, Peter C.; and Sambol, Anthony R., "The First Hundred Years of the Nebraska Public Health Laboratory: A Major Role Played in the Development of Public Health" (2013). *History of the College of Public Health: Papers and Posters*. 1.

https://digitalcommons.unmc.edu/coph_history_papers/1

This Article is brought to you for free and open access by the History of the College of Public Health at DigitalCommons@UNMC. It has been accepted for inclusion in History of the College of Public Health: Papers and Posters by an authorized administrator of DigitalCommons@UNMC. For more information, please contact digitalcommons@unmc.edu.

The First Hundred Years of the Nebraska Public Health Laboratory: A Major Role Played in the Development of Public Health

By Kristin Watkins, MBA, Peter Iwen, PhD, Tony Sambol, MS

Introduction/Background

Public health laboratories are the invisible key to public health. These laboratories have played a significant role in the health of the community since their inception in the late 1800s. They provide confirmation of disease outbreaks and statistics on the health and welfare of the people, with more recent activities in the detection of biological and chemical agents of terrorism. However, the history of these laboratories is mostly unknown. For instance, a recent brief historical account of the Nebraska Department of Health and Human Services did not include information on the state public health laboratory in the timeline of historical events (Nebraska Department of Health and Human Services, p.1). On the eve of the 100th anniversary of the inception of what is now known as the Nebraska Public Health Laboratory (NPHL), we feel compelled to provide this historical account in recognition of the importance of the laboratory to preserve the health of Nebraskans. Charles Rosen, a noted medical historian, wrote that “the public health laboratory service[s]...[is of] enormous value to the community [and] cannot be exaggerated. The responsibility of the government to protect the health of the people is concretely exemplified in the public health laboratory” (Rosen, p. 311).

Methods

This report traced the history of the NPHL from the beginning of public health legislation in Nebraska in 1891 to the present time. Both national and state historical data were used as primary source documents to provide data. These documents included field notes from public health inspectors, disease-reporting databases collected by the state health department,

newspaper articles, and a variety of government documents pertaining to guidelines surrounding reportable diseases and procedures for specimen collection, as well as proper testing techniques. The annual reports of the State of Nebraska Department of Health were also a key resource.

Much of the primary source data was obtained from the Nebraska State Historical Society (NSHS), the official archival organization for the State of Nebraska. Since records were kept inconsistently, gaps in information were present requiring the information to be pieced together from multiple sources. The official disease reporting records and annual reports from the Nebraska Department of Health and Human Services were supplemented with newspaper and journal articles, especially pertaining to the situations surrounding disease outbreaks and legislation.

Findings

National data supports that public health laboratories (PHLs) first originated on the east coast, initially in response to major outbreaks of cholera and diphtheria in urban areas in the late 1880s. New York, Rhode Island, Massachusetts, and Michigan were the first states to set up what were then called “bacteriological laboratories.” These laboratories concentrated on the development of antitoxins for deadly diseases such as diphtheria and cholera, and also focused on the testing of water, milk and food as vehicles for disease transmission (Duffy *Sanitarians*, p.193-5; Rosen, p. 309-10). The first documented public health “hygienic” laboratory was established in 1887 by the United States Public Health Service on Staten Island in New York City. Its purpose was to study cholera, yellow fever, and the bacteriological content of surrounding waters. This island was an ideal vantage point in which to study the health of immigrants and seamen. Due to its national importance, the Staten Island hygienic laboratory

was subsequently moved to Washington, D.C. in 1891, eventually moving to a new freestanding facility completed in 1904. This new laboratory provided traveling capabilities where equipment was taken to a potential outbreak site and utilized (Mullan, p. 36). In 1892, the laboratory for the New York City Health Department was developed in response to a cholera outbreak. This was the first recorded laboratory to fully utilize specimens for public health purposes, as opposed to the prior laboratories who focused on the development of antitoxins and vaccines. This was done because public health physician Dr. Herman M. Biggs (1859-1923) included a small diagnostic laboratory as part of the outbreak investigation. Dr. Biggs identified the positive fiscal effect of specimen usage during the diphtheria outbreak that occurred in New York City in 1893. That same year, the New York City diagnostic laboratory was put in the charge of Dr. William H. Park (1863-1939), a young physician. He led the effort to utilize diagnostics in the New York area. Along with Biggs, Park recognized the tangible benefit to the community to control diphtheria and other bacteriological diseases, both fiscally and in the enhancement of the overall health of the people. Park discovered that laboratory testing to diagnose diphtheria, and then following up with disinfection and quarantine of positive cases, was less expensive than disinfecting and quarantining homes of all suspected cases. Thus, the late 1800's ushered in the era of diagnostic testing in the public health laboratories (Rosen, p. 309-10; Duffy *Sanitarians*, p. 194-5).

Nebraska achieved statehood in 1867, and in 1868 the legislature authorized cities of 3,000 or more to establish local boards of health due to the advocating of area physicians. The role of these local boards was "to secure the city and the inhabitants thereof from the evils of contagious, malignant, and infectious diseases" (Long, p. 214; Tyler, p. 130-1). At that time, no formal state health department existed, and it was not until 1891 that the State of Nebraska

established the first statewide Board of Health, headquartered in Lincoln. This board was run by the Governor, Attorney General, and the Superintendent of Public Instruction (Consolidated Statutes of Nebraska 1891, p. 737). They were responsible for oversight of the School for the Deaf in Omaha (established in 1869), the School for the Blind in Nebraska City (established in 1875), the Nebraska State Reform School for Juvenile Offenders in Kearney (established in 1879), the Nebraska Asylum for the Insane in Lincoln (established in 1870), the State Penitentiary in Lincoln (established in 1869), and the office of the State Health Inspector (established in 1903) (Nebraska Department of Health and Human Services, p. 1). At that time, the PHL had not yet been established.

Historical records from the State Health Inspector's Office from the early 1900's provided clues to the types of medical services available in Nebraska prior to the official establishment of the first PHL. These services included administration of the quarantine laws and providing specimen collection devices for sampling of patient specimens for analysis. With no state PHL available, the analysis of specimens collected was conducted at the Department of Pathology at the University of Nebraska in Lincoln (Waite, 1909). The Inspector's Office also provided a guidebook in 1907 to advise inspectors with their duties such as a listing of regulations for quarantine, how to care for patients with infectious diseases, and the rules for reporting births and deaths (Department of Public Health and Vital Statistics, p. 1).

In 1910, Abraham Flexner, an educational theorist and founder of a private high school in Kentucky, wrote a national report commissioned by the Carnegie Foundation entitled "Medical Education in the United States and Canada," which would forever change education for physicians in the United States (Flexner, p. 1; Beck, p. 2139). A consequence of this report was medical education reform in many states which opened the door for other concepts in health to

progress, to include the predecessor to the PHL. One advocate of this reform movement was Francis Long, MD, a medical practitioner in Nebraska in the late 1800s through the early 1900s. In his memoirs, Dr. Long recalls that a “state laboratory” had begun in 1912 at the University of Nebraska in Lincoln, before being sanctioned by state legislation. He reported that having these laboratory services “has added a much valued aid to the medical profession of Nebraska” (Long, p. 216-7).

In 1909, an extensive study was published in the national *Hygienic Laboratory Bulletin*, regarding an outbreak of typhoid fever in Omaha, Nebraska (Lumsden, p. 7). Subsequently, Dr. Herbert H. Waite, a faculty member at the University of Nebraska in Lincoln, published a similar article about the typhoid fever outbreaks in Lincoln during 1911 and 1912 (Waite 1913, p. 15). At that same time, a national movement occurred in the U.S. to encourage states to support “bacteriological laboratories” as a means to control costs related to outbreaks of cholera, diphtheria, and typhoid fever, which appeared widely in urban areas. To foster this movement for the development of public health laboratories at the state level, Dr. Oscar Dowling, president of the Louisiana State Board of Health, participated in a health train activity in 1912 to promote public health and the understanding of bacteriology throughout his home state of Louisiana. His educational activity was supported by the national Public Health Service (Duffy *From Humors*, p. 336-7). With the success of this activity, Dr. Dowling was asked to bring his message to other states to help advocate for public health, especially in rural areas. His “Health Train” arrived in Lincoln, Nebraska in February, 1913, to a crowd of more than 6,000 people, even though the temperatures were frigid at the time. This activity also occurred at the time of the joint annual meeting of the state conference of local and state health officials in Lincoln. The main purpose of the “Health Train” was to directly influence state legislation to advocate for the establishment of

a state-supported bacteriological laboratory (*Lincoln Daily Star, Nebraska State Journal*, 1913). This activity, in combination with legislative efforts, led to a revision of the Nebraska state statutes on April 21, 1913 (Article XIII, section 141) which enabled the State Board of Health to develop a bacteriological and pathological laboratory in Lincoln. This laboratory was dedicated to “conducting and carrying on microscopical, bacteriological and other scientific investigations and tests...to be used exclusively for the public benefit” (Revised Statutes, p. 2853). Although approved in 1913, the official announcement of the first state “bacteriological laboratory” in Nebraska did not occur until February, 1914, by way of a Nebraska State Board of Health Bulletin (Nebraska State Board of Health, 1914). In this publication, William F. Wild, MD, was illustrated on the cover as the “Director, Bacteriological Laboratory” (Nebraska State Board of Health, 1914). In the announcement, the State Board of Health acknowledged the success of last year’s conference of health officials and the assistance of Dr. Dowling and the “celebrated Health Train of Louisiana” (Nebraska State Board of Health, 1914). The bulletin also provided an editorial describing the addition of the state laboratory and included information that a special notice was sent to all physicians, health boards, and health officers in the state explaining fully the benefits of the laboratory. Unfortunately, this notice was not preserved in the Nebraska historical records nor could it be located through other means. The editorial further describes the conference that took place in Lincoln during 1913 and highlighted speeches made on different issues pertaining to public health. One speech given by University of Nebraska Lincoln faculty member Dr. Herbert H. Waite described the public health benefits of such a laboratory, which led to a unanimous vote in the legislature to establish the state laboratory (Nebraska State Board of Health 1914, p. 5-7). Prior to 1913 all public health laboratory testing was conducted without formal sanctioning in laboratories at the State University at Lincoln. Following the legislative

establishment of the first state bacteriological laboratory, patient and environmental testing was apparently conducted in the State Capitol building (referred to as the Statehouse at that time). This location of the laboratory was not officially divulged until 1970, in a report from Nebraska Department of Health (State of Nebraska Department of Health 1970-71, p. 14).

During the early period after the establishment of the “bacteriological laboratory” in Nebraska in 1913, the laws governing state health were confusing. At the 34th session of the Nebraska Legislature in 1915, Governor John H. Morehead issued the following statement:

“Having observed the work in the bacteriological laboratory for nearly two years, and having to do with the law governing this work. I am convinced that the present law is very bunglesome. As it stands today, there is no one in control [of the laboratory]. The supervisor has a double set of officers over him, without being directly responsible to anybody. This law ought to be so amended as to take this bureau entirely out of the jurisdiction of the board of secretaries of the State Board of Health, and place it under the direction of the Board of Health proper” (Morehead, p.5).

Although official reports and bulletins of the State Board of Health listed Dr. Wild as the Bacteriological Laboratory Director, a November 1918 biennial report of the Nebraska’s Attorney General, listed Dr. Wild as a “Health Officer.” In addition, the roster for the biennial report listed staff that included an epidemiologist, bacteriologist, sanitary engineer, statistician, laboratory assistant, three stenographers and a clerk. There was no director position mentioned. This documentation provided insight into how the laboratory grew by the types of staff added (Reed, p. xv).

From 1891 to 1918, the Nebraska State Board of Health was responsible for multiple aspects of the public's health, but as exemplified by Governor Morehead's 1915 quote, the system was inefficient and confusing. In 1918, the State Board of Health was abolished and replaced by the Department of Health. In 1919, the Department of Health was abolished and the Department of Public Welfare was established. This department was composed of the Bureau of Child Welfare, the Board of Charities and Corrections, the Bureau of Health, the Bureau of Pardons and Paroles, the Racing Commission, and the Bureau of Licensing of Boxing (Nebraska Department of Health and Human Services, p. 2). At that time, all laws specifically relating to the state bacteriological laboratory were abolished and the laboratory, now referred to as the "State Public Health Laboratory," began to operate under administrative rather than legislative authorization, where the laboratory remains today (Coto, p. 5). The biennial report of the Department of Public Welfare (November, 1920) listed the following divisions for the Bureau of Health: Division of Epidemiology, Division of Vital Statistics, Division of Laboratories, Division of Venereal Disease, and Division of Sanitary Engineering. The Division of Laboratories appeared to be the only division under administrative control although no documentation could be found to attest to this. In this biennial report, the PHL is described thus, "[t]he amount of work in the Division of Laboratories has been increased more than threefold and work so carefully done that the results obtained are seldom questioned" (Department of Public Welfare 1920, p. 6).

The 1922 biennial report from the Department of Public Welfare indicated that the Division of Laboratories had to be expanded due to the ever-growing volume of work. Laboratory testing at the state PHL had increased from 1,300 tests in 1918 to over 24,000 tests in

1921. This testing was free to the public “thus giving to every person in the State the best of laboratory service” (Department of Public Welfare 1922, p. 10).

The 1928 and 1930 biennial reports provided insight into the growth and plateauing of the PHL system. The former report indicated that 30,208 tests had been performed in 1927 and that for the first nine months of 1928, 24,910 tests had been performed. This report was the first to have an extensive narrative about the laboratory (three pages), detailing its purpose, the shortage of properly trained personnel, the types of tests conducted, and statistics on the types of tests performed. Also reported in 1928 was the opening of a branch PHL in Scottsbluff. This laboratory employed one individual and tested 720 human specimens during its first year of operation. The 1928 report highlighted that testing was still free and hinted that this may be the cause of a certain amount of angst among the staff and state officials, as the laboratory was now performing so many tests.

The 1930 biennial report detailed 35,293 tests in 1929 and 35,072 in 1930. Tests at that time were divided into five major categories: Wasserman tests (to assist in the diagnosis and treatment of syphilis); gonorrhea smears; cultures for diphtheria; tests on water, sewage, and ice; and “all tests for other specimens”. The Scottsbluff branch laboratory was closed in 1930. The state laboratory noted a drop in the number of tests performed that year, considered due partly to the loss of an employee and the closing of the Scottsbluff branch laboratory, which was likely closed due to financial constraints. Also noted in this report was that the success of the laboratory had been due to the dedication of the employees who stayed extra hours without being asked to do so, likely without additional compensation (Department of Public Welfare Report 1928, p.43-45; Department of Public Welfare Report 1930, p. 9). Both reports from 1928 and

1930 pleaded for funding to expand the trained workforce to meet the growing demand for laboratory testing.

In 1933, Governor Charles W. Bryan worked with the legislature and rearranged administrative agencies to create departments involved with agriculture and inspection, labor, health, roads and irrigation, and banking and insurance (Olson, p. 293-4). The Nebraska State Department of Health at that time contained the Bureau of Health, Bureau of Vital Statistics, Division of Child Hygiene, Division of Laboratories, Division of Sanitation, Division of Contagious Diseases, and the Bureau of Examining Boards (Nebraska State Historical Society, p. 1). The state PHL remained under the Division of Laboratories, although there was no information available on specific laboratory responsibilities. The scope of laboratory testing appeared unchanged from prior years with changes only in the administrative structure.

During the 1930s, the Bureau of Health provided documentation for a change in antiseptic practices. Dr. Long, a Nebraska physician, reported a change to replace fumigation of patients and patient's environment with antiseptic practices. The chemicals used for fumigation were not identified, but the antiseptic practices described included bathing the patient in a solution of bi-chloride of mercury (one to 5,000 parts water) being careful not to get the chemical into the patient's mouth or eyes, burning materials in the sick room that was of no special value but had come in contact with the patient (e.g., newspapers, clothes, wooden toys), and washing linens and washable clothing in a disinfectant solution that included at least one half hour soak in either a 2% liquor cresolis compound USP, a 5% solution of carbolic acid or an equivalent disinfectant. Linens were boiled for an additional half hour and blankets were disinfected by exposure to open air and direct sunlight for three to four days, totaling at least 24 hours exposure. The woodwork, furniture and walls of the room occupied by a sick patient were

washed by the cresolis and carbolic acid solutions, with the decision of repainting and re-wallpapering being left to the discretion of the local board of health (Long, p. 216). Although these practices did not have any direct effect upon the state PHL, they did provide a sense for how health practices were changing during the period.

In pamphlets from 1942 and 1945, the Nebraska State Department of Health issued new rules and regulations relating to public health (State of Nebraska Dept. of Health, 1942, 1945). These pamphlets contained extensive information about diseases that were reportable to the state and the procedures for reporting these diseases. The pamphlets also contained specific guidelines for disinfecting environments that could potentially be contaminated by causative agents of infectious diseases, and rules and regulations for quarantining and placarding homes and businesses where disease outbreaks had occurred. Neither of these reports contained information about the process for collecting and laboratory testing of clinical specimens.

In 1943, the Assistant Surgeon General of the United States, along with a colleague from the U.S. Public Health Service, issued a series of reports regarding the status of public health in the U.S. (Mountin, 1943). These reports focused on information pertaining to all agencies of the state government working together to address a particular health problem. The reports only addressed programs conducted and funded by state agencies and did not reflect any local or voluntary public health agencies. One report specifically addressed the role of the state PHL. The main roles of these laboratories were to provide otherwise unavailable diagnostic services to physicians and hospital staff, as well as the testing of drinking water and milk. The report focused on the similarities among state's functionality but did not address specific procedures, administration, or how expenses were paid (Mountin, p. 249-50; 264-7).

By 1952, the PHL in Nebraska was noted to provide supplies necessary for testing specimens, such as culture tubes and media. Additionally, the laboratory accepted specimens through the mail, although at times the submission was not properly done, as evidenced by personal correspondence between health providers and the office of the PHL director. The director also began a tracking process of who received materials from the laboratory, with the intent that extra specimen tubes and immunization material be returned to the laboratory, so they could be utilized by others (Vose, 1952).

A major incident that impacted state public health laboratories was the outbreak of poliomyelitis that occurred in the U.S. in the early 1950s. This outbreak especially affected areas in the Midwest, with Nebraska experiencing the most severe outbreak of polio ever recorded history (Bancroft, 836). The press and radio in other states documented the severity of Nebraska's outbreak, and the state health department received inquiries from places like Texas about Nebraska's status (Rogers, to Larsen, 1952). Records from the Nebraska State Health Department showed the peak of 857 cases occurred in September 1952, but declined dramatically in the months following this peak (State of Nebraska, 1952). The decrease in cases was attributed to improvements in sanitation and the natural course of the disease through the seasons (eMedtv, website). In the midst of the outbreak, the health department received requests from health care providers for a revised version of "Rules and Regulations Relating to Public Health." This report had been issued periodically since the early 1900's and provided information on health laws, reportable diseases, quarantine, and school health (State of Nebraska Department of Health, 1945, p. 2). This report had not updated since 1945; the Health Department expressed regret in not being able to fulfill the request to update this document due to the demands associated with the polio outbreak (Rogers, to Devers, 1952). Eventually, the

report was updated in 1954. The revisions included were to make regulations more uniform, to abolish placarding for communicable diseases, and to eliminate quarantine for minor communicable diseases such as chicken pox, as it was found to be ineffective (State of Nebraska Department of Health, 1954, p. 2; 18-9).

A study published in 1957 detailed an occurrence of a polio outbreak in Huskerville, a community created for married veterans of World War II (Bancroft, p. 836-47). This community was located eight miles west of Lincoln, Nebraska which today is now part of the west end of Lincoln. Of the population of 1,142 in Huskerville, at least 35 children, or 3% of the population, contracted polio. These children were all from one geographic section of the village while other geographic sections had no cases of polio. Lancaster County, where Huskerville was located, had the second highest county rate of polio in the nation in 1952, with 200 cases per 100,000 people, or .2% of the population. The only county higher was Woodbury County, Iowa, with 358 cases per 100,000 people. In Huskerville, laboratory testing revealed that contaminated water was the source of human exposure to the poliovirus and it was suggested that this was how poliomyelitis was spread, leading to the outbreak. This article discussed techniques for laboratory testing and water testing during the outbreak, but nothing conclusive was revealed. Serologic testing conducted in 1954 that examined neutralizing antibodies in infected patients showed a high incidence of the virus. No information was available on the role of the state laboratory during this investigation; however, the laboratory was apparently involved in water testing, as well as serologic testing of patients for poliomyelitis in the state (Bancroft, p. 836-47).

Between 1959 and 1961, a biennial report from the State of Nebraska Department of Health provided insight into the challenges that the laboratory faced during this period. The report detailed continued limitations on laboratory space and an ongoing struggle to staff the

laboratory with adequately qualified personnel. Several new programs had been added but service was also maintained for the more established responsibilities. In 1959, the U.S. Congress gave state health departments, including Nebraska, general health funds to expand health services in areas not previously covered adequately. The funds enabled the PHL to employ more personnel, as well as initiate additional investigative programs to study water pollution control activities. These programs lead to improved coordination between the state Division of Laboratories and the Division of Sanitation. These two divisions examined health issues such as arthropod-borne encephalitis, showing cooperation between the entomologist in the Division of Sanitation with the public health veterinarian from the Communicable Disease Control Division. Although no human outbreaks were recognized, the collaboration between these divisions set a precedent for future investigations. (State of Nebraska Department of Health, 1959, p. 7-8).

The Nebraska Public Health Plan biennial report from 1959 to 1961 was one of the few historical articles uncovered that provided first-hand documentation of laboratory techniques (State of Nebraska Department of Health, 1959, p. 8-9). This plan included details of new diagnostic procedures such as fluorescent staining techniques and fluorescent tagging of antibodies, specifically for use to detect for rabies, brucellosis, and tularemia. Plans to expand the laboratory's services in the field of culture and microscopic identification of fungi, aligning with their receipt of an increased number of specimens from the respiratory tract, were included. The need for special assistance in this area to diagnose the etiology of the infections was noted. The report also indicated that the laboratory was now responsible for radiological health activities. Included in the plan was the creation of a position for a Coordinator of Atomic Energy, who would investigate various aspects and effects of natural and manmade ionizing radiation on members of the community (State of Nebraska Department of Health, 1959, p. 8-9).

From 1970 to 1980, annual reports from the Nebraska State Department of Health transformed from providing basic reporting information on diseases and statistics into sophisticated marketing tools for the health department. The 1970–71 report provided a brief history of the state PHL, emphasizing growth from one staff member in 1913 to 25 in 1970, and indicating that 10% of the testing services were conducted in the satellite laboratory in Scottsbluff. This satellite laboratory, which originally opened in 1928, was closed in 1930. No documentation could be found to indicate when this laboratory re-opened, and earlier state documents had not noted that it had closed and re-opened. However the report noted, “At present, the staff, including four at Scottsbluff, is composed of six bacteriologists, five chemists, five technicians, four assistants, and four office workers” (State of Nebraska Department of Health 1970-71, p. 14). The 25th member was the laboratory director. This report mentioned that the laboratory had not been governed by any law since 1919, and that the Board of Health emphasized the need for laboratory services. Specific services were mentioned, like the requirement for serological tests for syphilis before marriage and during pregnancy which was available free of charge. The report also designates that there were, “...other, generally inclusive sections of the law that indicate health laboratory support” (State of Nebraska Department of Health 1970-71, p. 14). During this time, human clinical specimens from physicians, clinics, and hospitals accounted for more than half of the testing load at the state PHL in Lincoln, with water quality testing of both public and private water sources accounting for another significant portion of laboratory testing. The report from 1971 suggested that Douglas (includes the city of Omaha), Hall (includes the city of Grand Island), and Lancaster (includes the city of Lincoln) counties were providing laboratory testing for their own counties, with the state PHL testing greater than

420 municipal water supplies and the Scottsbluff laboratory testing 90 additional water supplies per month.

Beginning in the 1970s, the PHL also performed environmental pollution control testing in the environmental laboratory section. The PHL also conducted alcohol tests on both breath and bodily fluids for law enforcement agencies. The phenylketonuria screen was the only test included in newborn screening which also began around this time. Other testing at the state included chemical analysis for narcotic, hallucinogenic, and other controlled substances from patient's serum. Some pre-marital and pre-natal testing in the state was performed by the state PHL, but most was done in private laboratories. The Division of Laboratories was tasked with monitoring the laboratories that conducted this testing. A chart in the 1970-71 report showed that annual testing at the state PHL increased from 2,179 tests in 1915 to 150,916 tests in 1970, giving the reader a distinct sense for the magnitude of the growth of the laboratory during its first 50 years (State of Nebraska Department of Health 1970-71, p. 15).

The 1971 report also made a declaration about the control of communicable diseases which was relevant at that time, as no communicable disease had ever been eradicated. One discussion was the concept of "uninformed persons" to measure disease by counting only specific cases and expressing that time and energy spent on the control of these communicable diseases led to a decrease in the cases of these diseases over the time period. In one sense that was true, but only in as much as they had implemented prevention strategies to mitigate the diseases. The article stated that, "...the decrease in these diseases (diphtheria, smallpox, typhoid fever, etc.) was the result of increased time and energy devoted to such programs as immunizations; control of food, water, and milk; improvement in environmental sanitation; health education, legal requirements for prenatal and premarital serological testing; screening for

tuberculosis; supervision of typhoid carriers, and intensive epidemiological investigation of reported cases of communicable diseases” (State of Nebraska Department of Health 1970-71, p. 53). The state PHL certainly played a key role in many of these strategies.

While the 1970 – 71 annual report gave an extensive overview of the work conducted at the state PHL and the process involved in communicable disease control, the 1980 annual report only had a brief discussion of the laboratory and communicable disease surveillance. This report described the services provided by the health department for the public, and presented organizational charts complete with photographs of the Governor and upper level officers. This report also gave some details about the movement of the laboratory from the State Capital building to a free standing facility in Lincoln in 1973. By 1980, laboratory staff had been reduced to 23 individuals, and some testing had been alleviated due to budget cutbacks. These cuts must have begun earlier in the decade, as the report indicates testing levels increased 3.5% between 1979 and 1980. The branch laboratory in Scottsbluff had also changed focus and now only tested drinking water (Nebraska Department of Health 1980, p. 6; Health Resources Guide).

Although the 1971 annual report provided extensive statistical information on laboratory testing and disease incidence, the 1980 report provided less statistical information and instead took on a narrative character. The disease control section began with the story of a young boy who stuck his arms in the cage of a carnival bear and sustained fractures to both forearms. Rabies prevention was discussed in context to this exposure incident indicating. The health department worked with a veterinarian to monitor the bear over time for rabies and subsequently the bear was determined to be rabies free and the boy was spared rabies prevention treatment. A follow up discussion on the actual occurrences of rabies in animals in Nebraska was presented. The next focus of the 1980 report was the issue of hospital-acquired or nosocomial infections. This

appeared to be the first time this topic was mentioned in the annual reports. Since the discipline of infection control did not evolve as an organized movement until the 1970's, the lack of a discussion about hospital-acquired infections was not surprising. The 1980 report also describes Nebraska's infection control efforts to be independent among hospitals. A statewide conference held in 1980 led to the development of a steering committee to address the always present but newly emphasized concern over hospital acquired infections. Additionally, this report discussed tuberculosis, but showed the disease to be decreasing, providing statistics that illuminated a once-prevalent disease reduced to 30 cases during the previous year. Interestingly, Nebraska had the lowest new case-rate of tuberculosis in the United States for 1979, with only 1.9% cases per 100,000 population.

The 1980 annual report provided a table showing morbidity from venereal diseases in Nebraska from 1969 to 1979. Gonorrhea cases peaked to greater than 5,000 cases in 1975 and then declined to the level of 1970 (approximately 3,500 cases). The report credits federal funding used to control and test for gonorrhea, providing culture media, and processing free of charge to facilities routinely doing pelvic examinations. Syphilis declined from 398 cases in 1969 to 40 cases in 1979, due in part to penicillin therapy (Nebraska Department of Health 1980, p. 14-15; American Chemical Society, website).

The 1980 annual report also provided a section dedicated to immunization, a program that had begun in 1969, but was still maturing. The immunization program was "designed to prevent diphtheria, measles, mumps, pertussis, poliomyelitis, rubella, tetanus, and their complications." The program had five main focuses: assessment of immunization levels, outbreak control, mass campaign capability (they had 20 jet injectors and 10 trained people at the State health department to provide immunizations), information and education and vaccine

storage and distribution (Nebraska Department of Health 1980, p. 16). Although the vaccine program existed prior to the 1970-71 annual report, the 1980 report is the first detailed mention of this program.

In 1985, the Nebraska Department of Health requested that an external review of the state PHL be conducted by the Centers for Disease Control and Prevention (CDC). This review focused on four areas: cost accounting, workload and staffing assessment, organization, and automatic data processing. The follow up report provided numerous recommendations concerning the state laboratory. Although automatic data processing was determined to be satisfactory, the process of cost accounting to determine the actual cost of laboratory testing needed to be updated. Adjustments were made to cost accounting to make the systems more efficient and to quantify the actual costs of each laboratory test. The CDC also recommended an administrative change in structure to the PHL. The current structure had the Division of Laboratories with administrative oversight by the Deputy Director of Administration. The CDC report suggested a new organizational chart with the Division of Laboratories reporting to the Deputy Director of Programs, who subsequently reported directly to the Director of Health. This alignment would place the laboratory as a partner with the bureaus of Community Health Services, Medical Services and Grants, and Health Protection, instead of with accounting, grants management and other administrative divisions that were overseen by the Deputy Director of Administration. Additionally, a new name was suggested for the state PHL, the – “Health and Environmental Laboratory.” The CDC report suggested that the name change was more relevant to how the laboratory supported multiple program areas to include dental health, sexually transmitted diseases (STDs), tuberculosis, immunization, maternal and child health, public and private water, indoor air quality, and radiation control. The CDC report also provided

information on how laboratory testing was distributed among multiple agencies to include the state PHL, the affiliated hospital laboratory at the University of Nebraska Medical Center (UNMC), other private hospital laboratories, and local public health laboratories within certain county jurisdictions. One surprise in the report was the amount of state funded testing that was not conducted at the PHL, but instead subcontracted to various public and private laboratories. For instance, 50% of the laboratory testing for STDs was performed by other laboratories. Of this, 30% of the testing went to public laboratories at three local health departments, 15% was conducted by private laboratories, and 5% was sent to reference laboratories outside the state. The out-state testing was done mostly on human specimens from the western portion of the state, as the Scottsbluff laboratory was only testing water. To maintain the integrity of specimens, the distance for submission was shorter to reach other states than to access the state laboratory in Lincoln. The CDC noted that the utilization bordering state labs was “typical for a statewide network” to maintain the integrity of specimens. (Centers for Disease Control and Prevention 1986, p. 6).

The CDC report also provided documentation that laboratories at UNMC were frequently used to test patient specimens for state pay samples. This included most of the testing for viral vaccine-preventable diseases such as measles, mumps, rubella, and hepatitis B. Additionally, only 20% of the maternal child health testing for phenylketonuria and primary hyperthyroidism was conducted at the state PHL in Lincoln, with other public and private laboratories testing the remaining samples. However, the state laboratory was testing 90% of the water samples, a sharp contrast to the low percentages of human specimens tested. The CDC report suggested that the decreased cost per test, not the quality of service, was the major factor for using the state PHL in Nebraska. The CDC also added that increased pricing without enhancing the quality of service

may have program officials looking elsewhere for mandated and discretionary testing. (Centers for Disease Control and Prevention 1986, p. 1-9).

At the time of the CDC review, the laboratory budget did not provide for replacing broken or outmoded equipment while there was a continued need for specialized equipment required to fulfill testing requests by the state Department of Health. Although some of the equipment could be shared across analytical divisions (disease control and prevention, analytical chemistry, and environmental health), contamination of samples was a concern. Additionally, testing volumes would need to be evaluated (Centers for Disease Control and Prevention 1986, p. 21-26; 34).

During the time of the CDC audit, numerous internal memorandums and both internal and external reports describing the PHL indicated that Nebraska was not immune to the political and economic policies of the federal government under the Reagan administration. One effect of the then described “Reaganomics” was greater scrutiny over healthcare spending, and the transference of federal expenses to state agencies (Milio, p. 66). Following an internal review of the 1986 CDC report, Arturo Coto, Disease Surveillance Coordinator at the Nebraska Department of Health wrote a follow up report entitled “Fees for Public Health Laboratory Tests and Services: An Approach” to provide a broad overview of the origin of the PHL and the evolution of their purpose. An evaluation of fees-for-services provided clues that funding for the state PHL in Nebraska was problematic. The report indicated that some state legislatures at that time had expectations that the PHL could become self-sustaining. However, this was problematic since laboratory services were performed under the auspices of public health and welfare, not under a for-profit model. Evidence was presented by the CDC that some states charged no fees, especially for testing relating to infectious disease outbreaks and epidemiology. Additionally,

concerns about a fee-for-service laboratory testing suggested a reduction of accessibility of public health programs for underserved populations. The Coto report articulated the concerns of the laboratory, to include: budgetary strain, lack of modern equipment, reduction in trained staff (to include the closing of the Scottsbluff branch of the lab in 1983 due to budget constraints), reduction in services, and the need for technical personnel to conduct administrative duties. These concerns were grounded in the fact that the laboratory was expected to provide superior results to benefit the public's health. Initial fee-for-service testing was incorporated into the environmental laboratory in 1987 for the evaluation of water, to test blood alcohol levels, and finally for the determinations of controlled substances and drugs in body fluids. Subsequently, funds collected for this testing went to the state Department of Health to help sustain the PHL since direct state funding by legislative action was being decreased (Coto, p. 1-8; Appendix A).

The Coto report made a case for centralizing laboratory services in Nebraska. This was based on studies conducted in the state a year before that would increase services and reduce costs. Also noted in the report was the increased regulatory demands placed by the federal Environmental Protection Agency (EPA) that required the laboratory to have an automated accessioning and reporting system. These new expectations of the laboratory would require legislative action to allow for the laboratory to charge for services as a means to become self-sustaining. A case was also made to clearly define the mission of the PHL, to provide clearer direction for the enterprise, and to preserve the contribution the laboratory had made to controlling disease, thus preserving the health of Nebraskans. A plea was made to the health department administration for laboratory testing to be funded by state tax dollars under a set of parameters defined, primarily based upon the impact to the greater good, as well as instances in which the laboratory would be appropriate to charge fees for services (Coto, p. 10-23).

Following this report in 1986, the Nebraska Health Division of Laboratories formulated a plan to address the state PHLs future. This plan included a mission for the laboratory, a clarification of the laboratory's role, and a framework of near and long-term goals. The plan clearly stated that the laboratory was not to take on the role of a private laboratory in regards to a fee structure, but to retain the initial intent to focus on the preservation of the public's health. The plan called for top quality results, state of the art technology, and appropriate turnaround times for test results. A network structure was developed for the participation of other Nebraska laboratories currently doing testing of state specimens. This network included the standardization of testing protocols and procedures within the network of laboratories. The idea of database management as a component of the laboratory process was also introduced, providing insight and record keep capabilities not previously in place. The goal of the plan was to have all parts completed by June 1988. The plan provided measures of accomplishment, concrete ideas that could be benchmarks of success with a defined outlined of the process for the next two years and the appropriate steps that needed to be taken (Nebraska Department of Health 1986, p. 1-9).

Finally, a laboratory technical safety review of all state PHLs located in Lincoln was completed by the CDC in 1987, as requested by the Deputy Director of the Nebraska Department of Health. This review provided documentation of the existing facility, a free standing two-story building constructed in 1973. This structure housed three state agencies and their respective laboratories: the Departments of Agriculture, Environmental Control, and Health, as well as the State Patrol offices. A description of the topography of the land was also provided in this document, describing loading docks at the basement levels, located on the south side of the building. The agricultural and health laboratories had space on both levels, while the environmental control lab only had space in the basement level. All laboratories had secure entry

mechanisms and required either a key or a combination code for access. The spaces were described as well maintained, but small and crowded. All laboratory supervisors expressed concern over the safety of the property, and ventilation was identified as a major concern for the facility. The report indicated that, “should there be a spill of an infectious agent or hazardous material in a positively pressurized laboratory, the contaminated air could move throughout the rest of the building” (Centers for Disease Control and Prevention 1987, p. 2). The report noted that the areas of greatest concern in the laboratory were the tuberculosis suite in the health laboratory and the brucellosis suite in the agricultural laboratory. Both areas reported high temperatures and poor ventilation, as well as mitigation methods currently employed (ceiling fans and leaving the door open) that could actually spread harmful organisms throughout the laboratory complex. Efforts were made to correct errors immediately. The reality was that the building had insufficient ventilation capacity and space to conduct all the laboratory testing needed (Centers for Disease Control and Prevention 1987, p. 1-6).

In prepared testimony for a legislative study committee hearing on laboratory issues dated October 7, 1987, Dr. Gregg Wright, Director of Health for Nebraska, described that lack of funding was a major issue for the laboratory. Of interest during this testimony was the disclosure that laboratory personnel in the three laboratory sections had risen to 25, a level of staffing not reached since the early 1970's. The testimony also provided a discussion of the new hazards managed by the lab, to include the monitoring of environmental contaminants surrounding the two nuclear facilities in the state, and the recent inadvertent discovery of three hazardous waste sites in Nebraska with contaminated ground water during routine water testing (Nebraska Department of Health 1987, p. 1-2).

A draft narrative job evaluation of the Director of Laboratories from 1987 also provided clues to the short-term success of the new laboratory plan. The feedback provided by the soon to be departing Deputy Director, indicated that all three of the laboratories met with challenges and worked hard to put the new systems the CDC recommended in place. Fiscal scrutiny brought revelations as to how money was actually spent for the operation of the laboratories, though no specific details were included in the evaluation. The division director clearly put great effort into aligning the budgetary process, as well as data systems, leadership training for staff, and the laboratory process (Macy, p. 1-2).

From a historical narrative, a significant gap existed in information available about the state PHL between the years 1987 to 1997. The next written documentation comes in 1997 from a timeline presented in a document entitled “Nebraska Department of Health and Human Services History.” At that time, the Department of Health was reconfigured to become the Department of Nebraska Health and Human Services System consisting of three agencies: Finance and Support, Regulation and Licensure, and Health and Human Services (Nebraska Department of Health and Human Services, p. 6). That same year, the Division of Laboratories separated laboratory testing between human and the agricultural/environmental testing. The human testing portion of the laboratory was moved to the UNMC campus in Omaha and subsequently became known as the Nebraska Public Health Laboratory (NPHL) while the agricultural and environmental laboratories remained in Lincoln and was known as the Nebraska Public Health Environmental Laboratory (NPHEL) and the Food and Drug Administration (FDA) Laboratory, respectively. The Veterinary Diagnostic Center continues to operate on the UNL campus. Additionally, the NPHL Omaha was not only assigned to test human specimens, but in 1999, a special section was created to test specimens considered to be a biohazardous

threat. Today, the NPHL on the UNMC campus consists of two separate laboratories, one associated where testing of human specimens are performed located at the affiliated hospital laboratory and a separate facility on campus where environmental testing for West Nile virus in mosquitoes, powders, and clinical specimens for suspected terrorism events, and epidemiological testing to include Salmonella serotyping and DNA fingerprinting for isolates collected from patient specimens that are associated with food contamination (*Salmonella*, *Listeria*, and shigatoxin positive *E. coli*), and influenza testing for the Nebraska surveillance program and for WHO global surveillance program (Sambol, et. al, 234). Specimen accessioning for all the laboratories on the UNMC campus is accomplished through NPHL Client Services, an extension of the Regional Pathology Laboratory.

The NPHL continues to have a solid collaborative partnership among the State Department of Health and Human Services, UNMC, and The Nebraska Medical Center. The mission statement of the laboratory is: “Dedicated to protecting the health and safety of Nebraskans through diagnostic laboratory science, technology, and education” (Sambol, 2010). Following establishment of the NPHL on the UNMC campus, personnel in the laboratory became involved with the Association of Public Health Laboratories (APHL) which was reorganized and renamed in 1998. In 2000, the APHL published a white paper called, “Core Functions and Capabilities of State Public Health Laboratories” which outlined the main functions and capabilities that PHLs should have to best serve the community (Inhorn, p. 5). This document provided a framework and a national benchmark for all PHLs and provided the NPHL with information to develop a concrete structure with which to expand for the future.

In 1999, through an initiative from APHL, the CDC and the Federal Bureau of Investigation (FBI), the Laboratory Response Network (LRN) was created which empowered all

state PHLs to create a specialized section of the laboratory for the handling and testing of biological hazards. The terrorist attacks of September 11, 2001, as well as the anthrax attacks occurring soon after, opened the flood gates to the need for testing of environmental samples perceived as containing a biothreat agent. These attacks against the United States led to heightened awareness about such threats and created a new and expanded emphasis and need for PHLs across the country. During this time, personnel at NPHL were asked by the U.S. Postal Service to provide guidance in their examination of the anthrax laden letters. This arrangement was made possible partly through continuing collaboration with the national programs put in place by the APHL for the testing of biothreat agents. The involvement in these events and the increased financial support of the federal government enabled the NPHL to expand their services, subsequently founding a chemical branch within the laboratory. This section, which is now known as the Special Pathogens branch of the NPHL, continues to operate under the guidance and support of the CDC (Sambol, 2010).

Prior to the terroristic events of 2001, only a handful of local public health departments, focused around state population centers, were present in Nebraska (i.e., Douglas, Lancaster, and Dakota counties). The State Health Department served the remaining geographic areas of the state, a relatively inefficient way of meeting the needs of the public. The heightened the awareness of the need for emergency preparedness and response capabilities at a local level became known after the 2001 terroristic events. As a means to address this weakness in public health, the Nebraska legislature in 2002, allocated tobacco settlement money through LB692, to help fund local health departments to cover the population of the entire state, 93 counties in all. (Palm, 2008). These new health departments developed working relationships with not only the State Health Department, but also with the NPHL to decrease the vulnerability of the state to

disease outbreaks, natural disasters and their aftermath, and any event that could harm citizens (i.e., chemical spill on the railroad tracks). As the health departments expanded locally, so did the laboratory network system put in place nationally by the APHL and locally by personnel at the NPHL. This system was expanded to provide security assets to conduct rapid detection of biological, chemical, radiological and other public health threats. Thus, the terroristic attacks of 2001 had brought among other things, the laboratory testing to the forefront of public attention and highlighted for many the importance of public health testing (Astles 2010, 21).

Since moving to the Omaha campus, the NPHL continues to expand, and today the laboratory employs at least 400 people, 250 of them full time, in more than six different divisions. The laboratory is fully integrated into the UNMC system with testing performed in multiple locations across campus. The Special Pathogens section of the NPHL has been licensed by the College of American Pathologists for the testing of human specimens in a variety of assays and by the CDC as a Select Agent-approved laboratory to identify and possess agents that may be associated with a bioterrorism event. Additionally, the NPHL has engaged in multiple activities with researchers at UNMC, mostly in the area around the genetic characterization of *Francisella tularensis* (Larsen, 2786). The laboratory continues to expand with colleagues in multiple departments and colleges on the UNMC campus. Much of the future activities of the laboratory are dependent on funding opportunities, but the momentum of the laboratory continues in a positive direction and the activities involved will continue to advance public health within the state of Nebraska. Future activities for the NPHL include in-state training on antimicrobial susceptibility testing (AST), shipping and packaging of clinical specimens for reference testing, and remote diagnostic capabilities through the STATPack system that is already operational in 37 sites.

Conclusion

The challenges of tracing a laboratory's history are many and can prove to be a difficult puzzle to solve. Many gaps exist and without predecessors leaving records, historical accounts can only be compiled by looking at multiple documents and piecing together information left behind. The importance of compiling this data will provide insight into the importance the PHL has played over time and help to define the significant role the PHL will play in the future.

Bibliography

(1913, Feb 20, 21). *Lincoln Daily Star*.

(1913, Feb 20, 21, 22). *Nebraska State Journal*.

American Chemical Society. *Discovery of penicillin*. Retrieved 9/3/2012, from http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_ARTICLEMAIN&node_id=926&content_id=CTP_004451&use_sec=true&sec_url_var=region1#P15_1225.

Astles, J. R., White, V. A., & Williams, L. O. (2010). Origins and development of the national laboratory system for public health testing. *Public Health Reports*, 125(Suppl 2), 18.

Bancroft, P. M., Engelhard, W. E., & Evans, C. A. (1957). Poliomyelitis in Huskerville (Lincoln) Nebraska. *Journal of the American Medical Association*, 164(8), 836.

Beck, A. H. (2004). The Flexner report and the standardization of American medical education. *JAMA: The Journal of the American Medical Association*, 291(17), 2139-2140.

Centers for Disease Control and Prevention. (1986). *CDC Recommendation/State laboratory*. Atlanta, Georgia: Centers for Disease Control and Prevention.

Centers for Disease Control and Prevention. (1987). *Technical Safety Review of the Nebraska Laboratory Facility*. Atlanta, Georgia: Centers for Disease Control and Prevention.

Consolidated Statutes of Nebraska 1891. (1891) Public Health, Chapter 42.

Coto, A. (1986). *Fees for public health laboratory tests and services: An approach*. Nebraska: Nebraska Department of Health.

Crawford, J. (1942). *Rules and regulations relating to public health*. Nebraska: State of Nebraska.

Department of Public Health and Vital Statistics. (1907). *Regulations for the quarantine, care and disinfection of contagious diseases, and rules for the reporting of births and deaths*. Nebraska: Nebraska State Board of Health.

Department of Public Welfare. (1920). *Report of the department of public welfare* (Biennial). Nebraska: Department of Public Welfare

Department of Public Welfare. (1922). *Report of the department of public welfare* (Biennial). Nebraska: Department of Public Welfare.

Department of Public Welfare. (1928). *Report of the department of public welfare* (Biennial). Nebraska: Department of Public Welfare.

- Department of Public Welfare. (1930). *Report of the department of public welfare* (Biennia)l. Nebraska: Department of Public Welfare.
- Duffy, J. (1992). *The sanitarians: A history of American public health*. Univ of Illinois Pr.
- Duffy, J. (1993). *From humors to medical science: A history of American medicine*. Univ of Illinois Pr.
- eMedtv. (2008). *Polio history*. Retrieved 11/4/2012, from <http://polio.emedtv.com/polio/polio-history.html>.
- Federal Bureau of Investigation. *Amerithrax or anthrax investigation*. Retrieved 9/9/2012, from <http://www.fbi.gov/about-us/history/famous-cases/anthrax-amerithrax>.
- Flexner, A. (2002). Medical education in the United States and Canada. *Bulletin of the World Health Organization*, 80(7), 594-602.
- Inhorn, S. L., Astles, J. R., Gradus, S., Malmberg, V., Snippes, P. M., Wilcke Jr, B. W., et al. (2010). The state public health laboratory system. *Public Health Reports*, 125(Suppl 2), 4.
- Larson, M. A., Fey, P. D., Bartling, A. M., Iwen, P. C., Dempsey, M. P., Francesconi, S. C., et al. (2011). Francisella tularensis molecular typing using differential insertion sequence amplification. *Journal of Clinical Microbiology*, 49(8), 2786-2797.
- Long, F. A. (1937). A prairie doctor of the eighties. *Norfolk, Nebraska: Huse*.
- Lumsden, L. (1910). Report on an outbreak of typhoid fever at Omaha, Nebraska (1909-1910). *Hygienic Laboratory*, (72), 7-52.
- Macy, B. (1987). to Blosser J., *Draft narrative evaluation*. Nebraska: Nebraska Department of Health.
- Milio, N. (1984). Chains of impact from Reaganomics on primary care policies. *Public Health Nursing (Boston, Mass.)*, 1(2), 65-73.
- Morehead, J. H. (1915). to Nebraska Legislature, *Message of John H. Morehead governor of Nebraska to the 34th legislative session*. Nebraska.
- Mountin, J. W., & Flook, E. (1943). Distribution of health services in the structure of state government. *Public Health Reports*, 58(7) 249-78.
- Mullan, F. (1989). *Plagues and politics: The story of the United States public health service*. Basic Books New York.
- National September 11 Memorial and Museum. (2012). *FAQ about 9/11*. Retrieved 9/9/2012, from <http://www.911memorial.org/faq-about-911>.

- Nebraska Department of Health. (1980). *1980 annual report*. Nebraska: Nebraska Department of Health.
- Nebraska Department of Health. (1986). *Department of health division of laboratories plan*. Nebraska: Nebraska Department of Health.
- Nebraska Department of Health. (1987). from Wright D., *Prepared testimony for study committee hearing on laboratory issues*. Nebraska.
- Nebraska Department of Health and Human Services. (2011). *History*. Retrieved 7/13/2012, from <http://dhhs.ne.gov/Documents/HHSS-history-thru-2011.pdf>.
- Nebraska State Board of Health. (1914). *Notice* (Bulletin No. Three). Nebraska: Nebraska State Board of Health.
- Nebraska State Historical Society. *Health department, Nebraska* (Finding Aid RG027.2). Nebraska: Nebraska State Historical Society.
- Olson, J. C., & Naugle, R. C. (1997). *History of Nebraska*. Univ of Nebraska Pr.
- Palm, D. & Svoboda, C. (2008). A regional approach to organizing local public health systems and the impact on emergency preparedness: the Nebraska experience. *Public Health Reports*, 123(4).
- Reed, W. E. (1918). *Report of the attorney general of the state of Nebraska for the biennium ending November 30, 1918*. Nebraska: State of Nebraska.
- Revised Statutes of the State of Nebraska; Bacteriological and Pathological Laboratory, Article XIII (1913).
- Rogers, E. (1952). to W. I. Devers. *Correspondence*. Nebraska.
- Rogers, E. (1952). to G. B. Larsen. *Correspondence*. Nebraska.
- Rosen, G. (1993). *A history of public health*. Johns Hopkins Univ Pr.
- Sambol, A. (2010). The Nebraska public health laboratory: Biosecurity preparedness and meeting other public health needs-a decade in review. (Slide Presentation). Omaha, Nebraska.
- Sambol, A. R., Iwen, P. C., Pieretti, M., Basu, S., Levi, M. H., Gilonske, K. D., et al. (2010). Validation of the cepheid xpert flu A real time RT-PCR detection panel for emergency use authorization. *Journal of Clinical Virology*, 48(4), 234-238.
- State Health Inspector. (1909). *Correspondence* to Dr. G. H. Marvel. Nebraska.

- State Health Inspector. (1909). *Correspondence* to Dr. F. C. Zoll. Nebraska.
- State Health Inspector. (1910). *Correspondence* to Dr. F. B. Evans. Nebraska.
- State Health Inspector. (1910). *Correspondence* to Dr. R. C. Panter. Nebraska.
- State Health Inspector. (1910). *Correspondence* to Dr G.E. Pennington. Nebraska.
- State Health Inspector. (1910). *Semi-annual report to the state board of health*. Nebraska.
- State of Nebraska. (1920). *Report of the department of public welfare* (Biannual). Nebraska: State of Nebraska.
- State of Nebraska. (1952). *Classification of communicable disease*. Nebraska: State of Nebraska.
- State of Nebraska Department of Health. (1942). *Rules and regulations relating to public health*. Nebraska: State of Nebraska Department of Health.
- State of Nebraska Department of Health. (1945). *Rules and regulations relating to public health*. Nebraska: State of Nebraska Department of Health.
- State of Nebraska Department of Health. (1954). *Rules and regulations relating to public health*. Nebraska: State of Nebraska Department of Health.
- State of Nebraska Department of Health. (1959). *Nebraska public health plan*. Nebraska: State of Nebraska Department of Health.
- State of Nebraska Department of Health. (1971). *State of Nebraska department of health 1970-71 annual report*. Nebraska: State of Nebraska Department of Health.
- Tyler, A. F., & Auerbach, E. F. (1977). *History of medicine in Nebraska*. Evansville, IN: Unigraphic, Inc.
- Vose, L. (1952). *Correspondence* to J. B. Redfield. Nebraska.
- Wagner, W. M. (1987). *Technical safety review of the Nebraska state laboratory facility*. Atlanta, Georgia: Centers for Disease Control and Prevention.
- Waite, H. H. (1909). to Dr. WH Wilson. *Correspondence*. Nebraska.
- Waite, H. H. (1913). Two Lincoln (Nebraska) typhoid fever epidemics of 1911 and 1912. *Journal of Infectious Diseases*, 12(1), 15-38.
- Wikipedia. (2012). *Association of public health laboratories-history*. Retrieved 9/9/2012, from http://en.wikipedia.org/wiki/Association_of_Public_Health_Laboratories.