Hospital Records as a Source on Morbidity and Mortality in the Past. Copenhagen's Epidemic Hospital and its Patient Journals, 1879 to 1910

By Mads Perner, Zitta Barrella Harboe and Maarten van Wijhe

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Hospital Records as a Source on Morbidity and Mortality in the Past

Copenhagen's Epidemic Hospital and its Patient Journals, 1879 to 1910

Mads Perner — Roskilde University, Denmark
Zitta Barrella Harboe — Copenhagen University Hospital, Nordsjælland & Statens Serum Institut & University of Copenhagen, Denmark
Maarten van Wijhe — Roskilde University, Denmark

ABSTRACT

Individual-level patient hospital records add a new dimension to conventional historical analysis of disease patterns based on mortality records. In this paper we examine patient journals from the Blegdam Hospital in Copenhagen and discuss how they contribute to our understanding of morbidity and mortality at the turn of the 20th century. These records are fully preserved since the hospital's opening in 1879 and include information on the dates of admission and discharge, name, sex and age of the patient, diagnoses, and a journal of medical procedures and patient follow-up during their hospital stay until discharge or death. Such records provide an additional angle to studying causes of death, where the period leading up to death including symptoms and treatment can be explored. The records are kept at the Copenhagen City Archives, have now been digitized from 1879 through 1910, and are currently being transcribed as part of the PID-scapes (2025–2028) and Paper Trails projects (2026–2027). The collection has, to our knowledge, not been the subject of academic research since it was deposited in the archive. In this paper we demonstrate their potential, explore the sources in detail, inventory their content and quality, and describe their historical context.

Keywords: Mortality decline, Morbidity, Epidemic disease, Hospital records, Individual level data

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1 INTRODUCTION

Mortality statistics are a cornerstone of historical demography. For a long time, the field has relied on vital records, either at the individual or aggregate level, to provide data on deaths. As such, mortality rates and life expectancy have been the most accessible proxies for population health in the past. This is reflected also in the major database projects that have emerged following advances in digital data storage and computational power in the last few decades, as there has been a focus on mortality records and most recently on causes of death. Less attention has been paid to morbidity, especially at the individual-level, as an additional source to elucidate health outcomes during the epidemiologic transition (Harris, 2016). In this paper, we describe a newly digitized source, the patient journals from the Blegdam Hospital in Copenhagen (1879–1910). The patient journals rival modern-day registers in terms of their detail, and they provide a new, promising angle on medicine, disease and death during the mortality transition. We use them to shed light on the period of morbidity up until death and examine the extent to which these circumstances were reflected in mortality records.

Recent advances in research on the mortality transition have focused on detailing causes-of-death, as they can illuminate the specific disease patterns shaping the mortality environment of past societies (Alter & Carmichael, 1996; Janssens & Devos, 2022; Risse, 1997). In 19th-century Europe, we now know, infectious diseases dominated the mortality profile: around half of all deaths were caused directly by infections, whereas chronic illnesses like heart disease or cancer were relatively minor contributors (Reid et al., 2015; Wolleswinkel-van den Bosch et al., 1997). Cause-specific mortality trends thus provide critical insight into the shift from a disease regime of "pandemics of infection" to one where chronic degenerative diseases become the primary causes of death, as first described by Omran (1971), whose model of the transition, however, has been criticized for treating mortality changes as effectively representing morbidity trends (Riley & Alter, 1989). The promise of cause-of-death data is that it adds a qualitative dimension beyond the quantitative fact of fewer people dying, but it comes with its own challenges, for example that of attribution: a death was usually only attributed to a single cause, often by a physician who had not treated the deceased, which leaves us with little or no information about the conditions that led to their death. This issue is partly, but not entirely, resolvable by examining cases where multiple causes have been recorded for a single death.

It remains that mortality is a limited metric, as it by definition records the endpoint of health failures (death), which is often taken as a proxy for the prevalence of illness. Rising life expectancy can obscure substantial morbidity if the population lives longer but spends extended periods in poor health. It also limits our understanding of the causes behind changes in demographic outcomes. One example is the declining infectious disease mortality; while the decline in mortality is well-established, it is less clear whether it happened because the population survived infections better (higher resistance) or because the same diseases were no longer circulating (lower exposure). Ideally, we should measure both morbidity and mortality rather than the latter alone, to reveal a more complete picture of the burden of disease. Death rates can fall even as sickness rates remain high. Alter and Riley (1989) demonstrated this using British Friendly Society records: during the mortality decline, age-specific morbidity rose even as mortality fell, not because people fell sick more often, but because individual episodes became more prolonged. Those who would previously have died instead survived their illnesses, but at the cost of extended periods of ill health (Riley, 1997; Riley & Alter, 1996). An alternative interpretation of this "real" increase in sickness is that it is rather an inflation caused by a change in the cultural context, since lower mortality would also lower the threshold for being ill (Johansson, 1991). In this context, being ill meant "too ill to work," as historical morbidity analyses are often based on sickness claims by employed workers (Edwards et al., 2003). Recent work using such records in Scandinavia and Britain has extended the patterns first identified by Alter and Riley: in early 20th-century Sweden, for instance, women faced fewer but longer sickness episodes than men, a difference shaped by gendered work conditions and reproductive experience (Andersson et al., 2023). Sickness claims have been one of the few accessible sources on illness in the past, but they are not without challenges. Since they are naturally linked to the working population, fewer claims were made in times of poor job security, leading to measurement error in the rate of morbidity (Green et al., 2024). Additionally, once mortality had declined considerably, medical care was available to larger parts of the population, leading to higher rates of diagnosis (Castenbrandt, 2018).

Hospital patient journals are another set of morbidity sources for studying the burden of disease. They exemplify how we can enrich cause-specific mortality analysis with auxiliary sources, in this case individual-level patient journals from the Blegdam epidemic hospital in Copenhagen. As most historical

work has sought to understand the social and cultural significance of hospitals from an institutional perspective, little attention has been paid to the individual patients admitted to the hospitals and the medical, demographic and socioeconomic information recorded in their journals (Porter, 1985). Part of the reason is that detailed individual level records are not always preserved, and when they are, they can be very time consuming to treat empirically. Still, there are several examples in the literature of patient-focused, data-driven medical history. In an early example, patient records from Sundsvall were linked to parish registers to study life histories and survival post-hospitalization, showing that in the 19th century, the life expectancy after hospitalization was highly dependent on the disease one had been treated for (Brändström & Broström, 1989). Another example is from a recent study by Diepgrond and Riswick (2025), where a much larger sample from the *Binnengasthuis* in Amsterdam was used to demonstrate how in-hospital mortality risk was highly variable depending on timing, admission policy and the socio-economic composition of the patient body. The use of patient data in these and other cases, have allowed scholars to nuance the popular notion that for the majority of the 19th century, hospitals served mainly as "gateways to death" where chiefly the poor were admitted to die in the absence of effective medical treatment (Derosas & Munno, 2022; Diepgrond & Riswick, 2025; Dumănescu & Hegedűs, 2025).

The Blegdam Hospital is a promising case in several respects. For one, its patient records have been completely preserved at the Copenhagen City Archives. They have been digitized as part of the archive's efforts to make its collections publicly accessible and are currently being transcribed as part of the PID-scapes and Paper Trails projects.[1] From its establishment, the hospital had adopted the journal format of its predecessor, the epidemic ward at *Kommunehospitalet*, which had departed from tabular patient records, where each patient was limited to a single row annotation in a ledger. Admissions were instead recorded in an individual folded file, combining personal information, diagnosis, medical history, and treatment notes. For extended stays, additional sheets of paper could be added to the file. This format has preserved a much more detailed account of each case of illness, which helps expand the scope of inquiry for historical demographers and epidemiologists. We argue that there are two angles from which these journals can enhance our understanding of the mortality transition: quantitatively, by using them to measure changes in disease incidence, the case-fatality ratio, and other statistical approaches to determinants of death; and qualitatively, by following the notes left in the journals by treating clinicians, often written in the weeks and days prior to death or recovery. The latter can shed new light on diagnosis, treatment (if any), co-morbidities and other contextual information on the circumstances leading up to a patient's death or recovery. Overall, the journals can help us partly reconstruct the past disease environment that mortality statistics alone can only hint at.

In this paper we place most emphasis on the first three decades of the Blegdam Hospital's function, from 1879 to 1910. This choice is pragmatic and driven by the permissions on the use of data currently involved in the Paper Trails project, as Danish and European laws limit the free management and free scrutiny of digitized historical sources containing personal data (Databeskyttelsesloven, 2018; Straffeloven, 2013). The cut-off at 1910 was chosen to comply with these legislations. On a positive note, we suspect that the main research interest of historical demographers in relation to these journals is the mortality decline of the late 19th century, and since the decline in Copenhagen was already quite advanced by 1910, the period covered by our project should be sufficient for that purpose. There is another consideration beyond strictly legal constraints, which is that working with individual-level medical records of identifiable, and often vulnerable, patients raises ethical questions of consent and privacy that historians have only recently begun to address systematically (Meyer & Moncrieff, 2021). For this reason, we refer to patients without their names when they are presented as cases in the article.

This article proceeds as follows. Section 2 outlines the history of Copenhagen's hospitals leading up to the establishment of the Blegdam Hospital in 1879, situates its development within the bacteriological

1 The archive of the Blegdam Hospital is accessible through arkivfinder.dk, which provides an overview of its structure as well as links for digitized materials. The archival reference for the pre-1915 patient journals is Blegdamshospitalet, Epidemisk afdelings arkiv, Epidemisk afd. 1879–1914, Patientjournaler (Epid. afd.), from here onwards "Blegdam Hospital, Patient journals". When referring to specific parts of the collection, we consistently cite the Starbas unit no., which is a unique identifier that links physical and digital material within the archive. Pages refer to the numbering in the digitized records. For an overview of the full collection of Blegdam patient journals, including links to the digitized material, see https://arkivfinder.dk/kbharkiv/serie/2a4e0ad6-9de3-42c2-9028-5652594ee5a9.

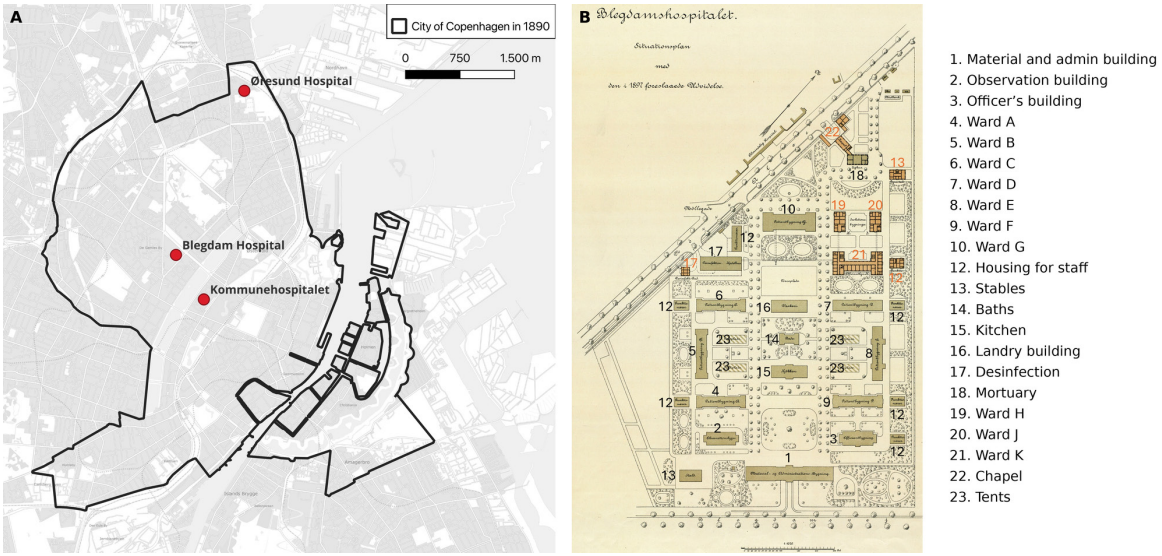
revolution that transformed hospital practice in the period, and characterizes its patient body using data from annual reports. Section 3 introduces the individual-level patient records, their structure and contents and, drawing on a sample of 80 journals linked to the Copenhagen Burial Records, examines what they add to cause-of-death analysis beyond what mortality sources alone can capture. We also look at three examples that showcase the level of detail captured within the patient journals. We conclude by considering the broader potential of hospital patient journals as a source for the history of disease and health.

2 HISTORICAL CONTEXT

2.1 ESTABLISHMENT OF THE BLEGDAM HOSPITAL

By the mid-19th century, Copenhagen's two main hospitals, *Frederiks Hospital* and *Almindelig Hospital*, mainly functioned as a form of poor relief, their purpose being to maintain a fit-to-work population rather than to cure disease as such (Vallgårda, 1985, pp. 31–33). The cholera epidemic of 1853, which had killed just under 4% of the city's total population, exposed the limits of this system, as both institutions were overwhelmed, partly through in-hospital transmission caused by the indiscriminate mixing of patients (Hübertz, 1855, p. 39). The epidemic prompted the municipality to approve an entirely new hospital in 1855. This hospital, *Kommunehospitalet*, which opened in 1863, included a dedicated ward for epidemic diseases such as cholera and smallpox, housed in a separate building to limit transmission, though its capacity of just 42 beds quickly proved insufficient. In 1871–1872, near-simultaneous outbreaks of exanthematic typhus and smallpox forced the improvised use of a suburban villa and a charitable workhouse as temporary extensions of the epidemic ward, which convinced the city's chief physician that a purpose-built epidemic hospital was urgently needed (Schleisner, 1872, p. 121). A municipal commission established in 1872–1873 concluded the same, and two new hospitals were planned: Øresund Hospital (Danish: *Øresundshospitalet*), a quarantine facility near the harbour, and the larger Blegdam Hospital (Danish: *Blegdamhospitalet*), closer to the city. As Figure 1 shows, Blegdam lay at the outskirts of the central city, next to Nørrebro, a district developed since the 1860s to house the growing working class, while Øresund lay further out still, near the water, where arriving cases of smallpox and cholera could be received and isolated at a distance from the city. Construction of the Blegdam Hospital began in July 1876 and it opened in 1879, with plans for additional buildings to be completed in 1884.

Figure 1 *Maps showing the location of Kommunehospitalet and the Blegdam and Øresund Hospitals in the city (left), and the grounds of the Blegdam Hospital itself around 1897 (right), including expansions added in the period 1898–1899 (orange)*



Sources: OpenStreetMap, Royal Danish Library, KBK K enk. lok., Blegdamshospital-0-1897/1. Annotation our own.

The Blegdam Hospital was designed as a pavilion hospital with wards and buildings spatially separated from each other with the purpose to allow for isolation to minimize the risk of transmission between patients. Part of its design finds its origins in miasmatic thinking, where fresh air could circulate in and between the buildings. However, it also marked a return to isolation policy, which had been the standard way of dealing with non-endemic diseases in Denmark until it was replaced by a short-stinted period of miasmatic hegemony during the 1850s (Bonderup, 1994). Blegdam was the first Danish example of a hospital that combined isolation with treatment, built for sudden outbreaks of "imported" diseases such as cholera, dysentery or smallpox. It was meant to remain empty and ready for immediate use only when a large and difficult to control epidemic broke out (Kjøbenhavns Magistrat, 1904, p. 21). The need to dedicate an entire hospital to the isolation of patients with specific diseases reflects in part the sense of urgency felt in the city's administration. In the first five years since its establishment, it served this purpose, but relatively few patients were admitted; fewer than 2,000 in the first five years (HB 1880–1885). By 1884, in the absence of a major, externally introduced epidemic, it was decided that the hospital should also house patients suffering from "endemic" infections such as scarlet fever, diphtheria and croup, measles and erysipelas, which had until that point been treated at *Kommunehospitalet* (HB 1885, pp. 275–276). For the remainder of the 19th century, patients with these diseases made up most occupants of the Blegdam Hospital.

Within this change, the number of patients rapidly increased and expansion of the hospital was necessary. Initially, the Blegdam Hospital had a capacity of 116 beds across 30 halls. There was a central building that served as reception, materials storage, offices, and administration, a stable, an observation building, four patient buildings (denoted A, B, C and D, numbers 4–7 in Figure 1), a kitchen, a disinfection building, a laundry, and a mortuary. With the ever-increasing demand, however, the hospital was expanded considerably. Figure 1 presents the layout of the hospital in 1897 along with its planned expansion for the following years (buildings in orange). Two patient buildings (E and F, number 8 and 9 in Figure 1) as well as a so-called officer's hall (meant for hospitalized staff but in practice used as an extra isolation ward) were already added in 1884 (number 3, Figure 1), and in 1891, a two-story patient building (G, number 10, Figure 1), a bathhouse, a boiler house, and four smaller buildings for nurses had been build. Three two-story buildings for patients (H, J, K, numbers 19–21 in Figure 1), another building for nurses, and a disinfection- and bathhouse were to be added in 1899, and in 1901 a funeral chapel and a bacteriological laboratory with stables. Lastly, in 1909, two wooden barracks were erected. At this point, the standard capacity was 303 beds across 99 halls and single rooms, but the hospital had the option to temporarily expand capacity with an additional 114 beds in 12 large Döcker-style tents, which were practically used every year. During large outbreaks, capacity could be increased even further by placing additional beds in the wards, and by borrowing additional tents and barracks from other hospitals in the city.

The first decades of the hospital's functioning coincided with one of the most consequential transformations in the history of medicine. In the 1870s and 1880s, germ theory was consolidated as the dominant explanatory framework for infectious disease, driven by Pasteur's work on fermentation and vaccine development, and above all by Koch's identification of the specific bacterial agents behind tuberculosis (1882) and cholera (1883). The "bacteriological revolution" which followed was not instantaneous but gradually shifted the ways in which diseases were understood, diagnosed and treated (Schlich, 2012; Worboys, 2007). In terms of diagnosis, the laboratory tests allowed physicians to confirm or refute clinical symptoms already from the early 1890s, which was particularly helpful for diseases with almost interchangeable symptoms in the early stages of disease, such as diphtheria and scarlatina. In the years that followed, bacteriological tests also came to govern decisions beyond diagnosis, as test results were actively used to determine how patients should be distributed across Copenhagen's hospitals, and to establish when a patient was sufficiently free of infection to be discharged or transferred. The construction of a permanent bacteriological laboratory in 1901 highlights the centralized incorporation of these new technologies on the hospital grounds, close to the patients and staff.[2]

2.2 CHARACTERIZATION OF THE PATIENTS

The general functioning of the various hospitals in Copenhagen is already relatively well-documented in aggregate reports. With a wave of registration policies introduced in 1875, *Sundhedskollegiet* (Royal College of Health) introduced a schema for the reporting of "statistical data associated with the functions of the

2 Prior to the permanent laboratory, bacteria were cultured at other laboratories in the city. Fibiger, in his dissertation (1895), mentions working across the university's medical-bacteriological laboratory, as well as the laboratories of the military hospital *Garnisonshospitalet* and the veterinarian school *Landbohøjskolen* (p. i; 55).

hospitals" in Denmark.[3] The main purpose was, purely based on the information requested, to monitor their capacity. Each hospital had to report data such as their number of beds, number of patients throughout the year, total number of patient days spent at the hospital, and the average daily number of patients. The spectrum of diseases seen in the hospital was also recorded. These aggregated statistics were collected and published in an annual book series *Hospitalsberetningerne* (HB).[4] We have digitized a range of the statistics reported in these sources, such as the total number of admissions, diagnoses and hospital ward occupation.

Figure 2A shows the monthly number of patients at the hospital compared to bed capacity, as stated in the hospital's reports. The dashed lines highlight the extended capacity brought about during crises, when existing wards and tents were expanded with more beds. While it may seem that the capacity was sufficient most of the time, this was hardly the case in practice. For example, in 1887, there were 180 beds distributed across 52 halls in 12 wards, an observation building, and an officer's building. An additional 37 beds were available in five tents. Each building was split into wards in order to separate patients by disease and minimize spread. There would often be turnover within each ward; in 1887 for example, Ward C1 was used first for patients with diphtheria, then for erysipelas (a skin infection), and finally for scarlet fever (HB 1888, pp. 156–158). In between the ward was emptied for cleaning, disinfection, and airing. The combination of isolated wards and periods of disinfection meant that the capacity of 217 beds was mostly theoretical; empty beds could not always be filled since diseases could not be mixed, and thus the effective capacity was somewhat lower. Patients often had to wait, were redirected or refused admission, a notable point which is partly obscured by the descriptive statistics. To follow the example of 1887, the hospital's occupation was "not too heavy" in mid-1887 when measles broke out, but there was still not enough space to accommodate measles patients out of fear that they would cause an outbreak among existing patients. It was exempted from admitting measles patients, and later that year, from admitting erysipelas cases as well. Physician-in-chief Sørensen elaborated in the annual report that even though admittance appeared to be below maximum capacity, most wards were in use for the entire year, and any increase in capacity would come at the cost of "making fewer distinctions between the simple and complicated cases than would be advisable." There were several wards dedicated to diphtheria cases of varying complexity (including an entire ward for croup), as well as one specifically for diphtheria and scarlet fever cross-infections (HB 1888, pp. 167–168).

Throughout 1887, a total of 299 patients were referred from Blegdam to the Øresund Hospital, 281 with measles and 18 with erysipelas. The problem seemed to persist, as several years later, in 1890, Sørensen notes that quite a few patients may never have been admitted to any hospital:

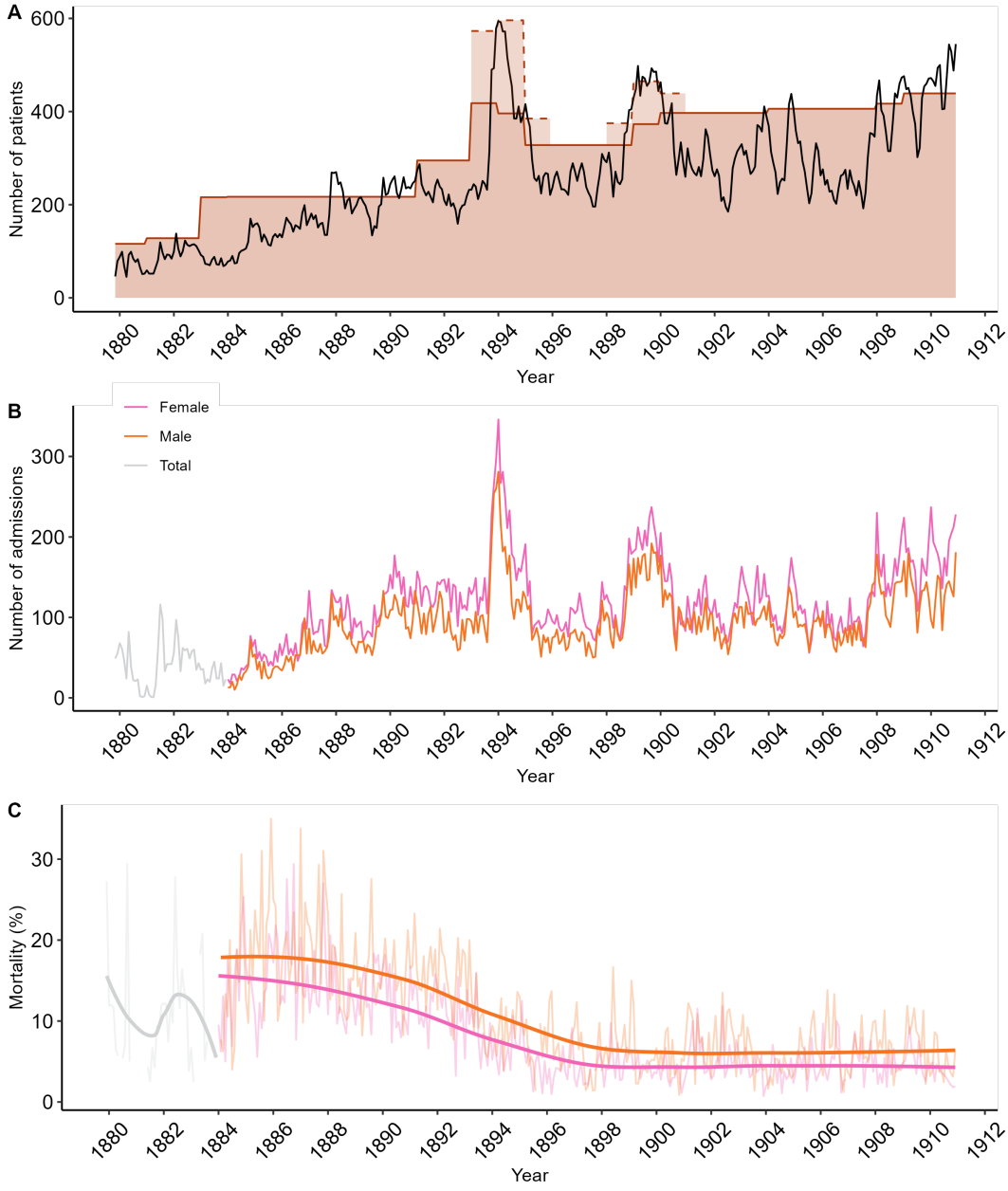
> These figures do not even represent all those who, according to the regulations, should have been admitted to the hospital. For measles patients there was, as in previous years, no space, and for the first time in the hospital's history, a not insignificant number of scarlet fever patients had to be partly rejected, partly set to wait until space became available in the autumn. (HB 1891, p. 166; translation our own)

Following the 1884 shift to treat a broader range of disease, the Blegdam Hospital was supposed to admit measles cases, but in reality, there was rarely any space for them. Across the period between 1879 and 1910, only 2,179 measles patients, 3.1% of the total patient body, were ever treated there. As Figure 2A illustrates, the hospital was almost always functioning at near full capacity, and while the hospitals of Copenhagen did coordinate the allocation of patients between them, it seems that there was still not capacity for everyone requiring treatment. The number of hospital admissions should thus not be seen as a reflection of disease burden, but of a reflection of hospital capacity and admission policy. The questions that remain, then, are who and how many were left out to fend for themselves, and what the composition of the patient body at the hospital was. While some were turned away at the door, a far larger number of people never sought institutional care at all. Worboys (2021) calls them the "non-patients," whose illnesses were managed or endured at home and who leave no trace in records like these. The first question lies outside the scope of this paper; in the following sections we instead characterize the recorded patient body from a more quantitative standpoint.

3 *Sundhedskollegiet* was the principal state organ for health governance in Denmark, established in 1803 and dissolved in 1909. It was the supervisory authority over the medicinal system, public health measures, and professional oversight, operating initially under the Danish Chancellery and from 1848 under the Ministry of Justice. Its functions were transferred to the Danish Health Authority (*Sundhedsstyrelsen*) in 1909.

4 As the publisher and titles of these publications have changed over time, we refer to these sources using the abbreviation "HB" and they appear as so in the list of references.

Figure 2 *Patient data from the Blegdam Hospital, 1879–1910*



Notes: A: Total monthly patients concurrently admitted along bed capacity (in red). Dotted lines indicate temporary capacity. B: Monthly admissions by sex; no sex-stratification was made prior to 1884. C: In-hospital mortality expressed as a percentage of admissions along with a smoothed trend line.

Source: HB 1880–1911.

Figure 2B already hints at one possible bias in patient admission. It shows the monthly number of admissions by sex for the period 1879 to 1910, during which a total of 71,951 patients were admitted, of which more females were admitted than males. The sex ratio for the entire period was 1.26 females per male (IQR: 1.14–1.4) and this was relatively constant. The number of admissions fluctuated somewhat over the year, with most admissions from November to January. Generally, there was a median of slightly over 200 admissions in the fall and winter months, and slightly under 200 in the spring and summer months. That there was no stronger seasonal fluctuation is likely because, as illustrated earlier, the hospital was always operating near maximum capacity. There was no shortage of patients no matter the time of year. In-hospital mortality, expressed as a percentage of admissions, was 10.2% for children, 5.4% for men and only 2.5% for women, indicating an excess mortality of males, at least among adults. Since the statistical publication groups all children together, we were at this point unable to study the sex-specific mortality rate below age 15. However, the consistently higher mortality rate of males observed in the entire patient body (Figure 2C), combined with the fact that children made up a majority of admissions, seems to

indicate that excess male mortality also existed among children. This gap in mortality risk is not a surprising finding on its own, as the female survival advantage is a common feature of high mortality environments, particularly among children (Perner et al., 2022, p. 681). Rather, it is notable that females were more often hospitalized, as it points to either a real difference in morbidity or a culturally inflated hospitalization rate.

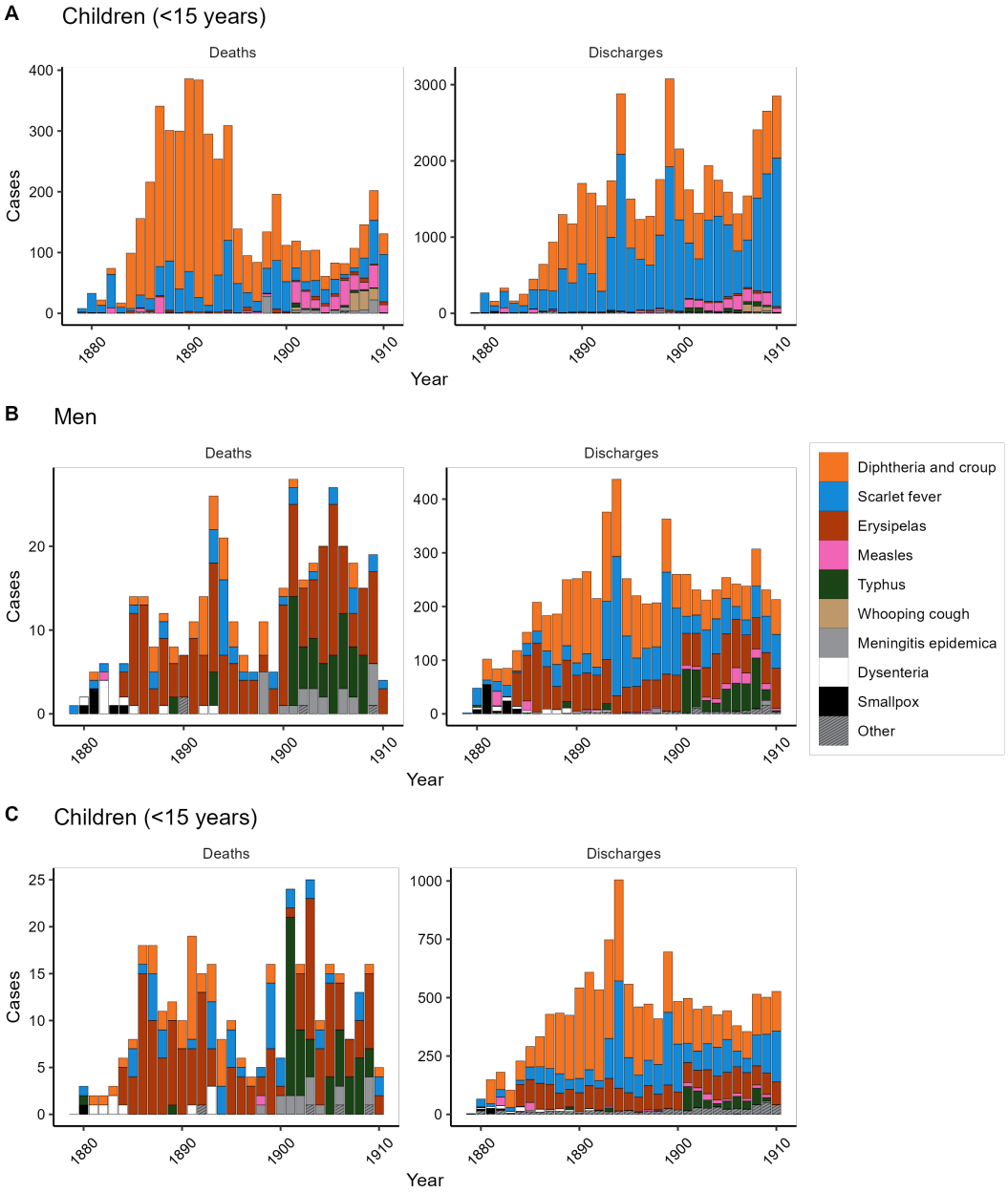
The mortality rate did not fall steadily but rose and then declined (Figure 2C). It climbed to a peak in the mid-to-late 1880s — a median of 14.3% (IQR: 12.2–18.3%) for females and 19.4% (IQR: 12.4–23.6%) for males between 1884 and 1887 — before dropping to 4.1% (IQR: 3.0–5.6%) and 6.1% (IQR: 4.1–8.3%) respectively after 1900. Both the rise and the fall track the diphtheria and croup epidemic that lingered in the city from the mid-1880s to the mid-1890s (Hoff, 1900, pp. 7–8). This is what we would expect from the composition of the patient body: as shown below, diphtheria and croup caused most deaths at the hospital, so the overall mortality rate largely followed the course of that epidemic. The rise also coincides with the 1884 decision to admit these endemic diseases, which brought deadly and then-untreatable diphtheria and croup into the hospital, increasing mortality. We see a similar pattern in the average length of stay for those that died, which dropped from an average of around 10 days before 1884, to around 7 days between 1884 and 1893, after which it increased again to 10 to 15 days. For those that survived, the average days at the hospital fluctuated between around 25 and 40 days. Generally speaking, those that died had a relatively short stay at the hospital compared to those that were eventually discharged. The reason is currently unclear, but we can speculate that the state in which they arrived at the hospital, was considerably worse than those that would survive. Indeed, it is not rare to find notes in the journals stating "hopeless" or "moribundus", indicating that these patients were already dying when they arrived. Such cases may reflect that some patients waited too long to go to the hospital or were prevented from doing so in some way, either by their social economic circumstances, or perhaps due to a fear for the hospital. It may also be a sign that their disease progressed so rapidly that by the time they arrived, nothing could be done.

The declining mortality in the hospitals may also be a consequence of the number of available beds; while mortality generally declines and the number of beds concurrently increases, it is very likely that also less severe cases would be admitted. This would be reflected by a lowering of the overall in-hospital mortality rates. The patient journals do provide information on the severity of disease at admission, and thus we can, in due time, get closer to the reason of the declining mortality, whether it was a consequence of admission practices, improvements in nutrition, changes in the diseases themselves, or changes in social economic circumstances of the population of Copenhagen.

The annual reports also give information on the various discharge diagnoses and causes-of-death (Figure 3). The discharge diagnoses of children under 15 years-of-age (Figure 3A) were mostly diphtheria and croup (41.8%) as well as scarlet fever (51.8%). Deaths among children were primarily due to diphtheria and croup (65.5%), followed by scarlet fever (22.9%). This concentration of diphtheria and croup deaths among children, heaviest between the mid-1880s and mid-1890s, is what produced the rise and fall in the hospital's overall mortality noted above. The distributions were mostly similar between men and women (Figure 3B and C), but diphtheria and croup represented 34.1% for men and 46.5% for women, while scarlet fever was 25.5% and 24.8% respectively. Another main diagnosis among men and women was erysipelas, contributing with 26.6% and 18.2%. Deaths were however dominated by the latter, with 51.6% and 46.2% of all deaths among men and women respectively attributed to the disease. Diphtheria and croup are generally considered a childhood disease, so it is interesting to observe that it was also a common diagnosis among adults (at least in the hospital). Adults rarely died of diphtheria however, so this is a case where morbidity records shine, since mortality records would give the impression that diphtheria is mainly a childhood infection.

Overall, we can conclude that during the period of transition from 1879 to 1910, the hospital was in full use, operating year-round at near maximum capacity. The hospital was mainly a children's hospital and served in practice to deal with two major infectious diseases: diphtheria and croup, and scarlet fever, comprising together around 85% of all discharge diagnoses. In that perspective, the Blegdam Hospital treated a narrow range of patients, dominated by children with diphtheria, croup and scarlet fever. Its staff would have built up considerable experience with these particular diseases, even if their training is not something we can document directly. It is also clear that the utilization of the hospital as it was initially intended, as an isolation hospital only to be used during outbreaks of epidemic diseases, was quickly superseded by the reality of Copenhagen's disease landscape at the time. There was a constant need for beds to house the many sick in the populace.

Figure 3 *Diagnoses of discharged patients and in-hospital deaths in the Blegdam hospital, 1879–1910, for children (A), men (B), and women (C), respectively.*



Note different y-axis scales.

Source: HB 1880–1911.

3 THE BLEGDAM HOSPITAL PATIENT RECORDS

In this section we outline the structure and contents of the Blegdam Patient journals. We will also explore the specific content using three cases, pragmatically selected as they are exemplary for the level of detail that is contained in the journals, and we use them to highlight the utility these sources have for historical research.

3.1 STRUCTURE OF THE SOURCES

The journals consist of individual sheets of handwritten notes for every patient admitted to the Hospital. These sheets were collected by the hospital's record keeping office, and up to 1915 they were ordered by the month of release or death and bound into books. Each book starts with tabulations of the patients by name, as well as an overview of the number of patients by diagnosis for that month. After this

introductory section, notes on each patient are found, in alphabetical order by last name, with all deaths occurring either at the start or at the end of the book. Figure 4 illustrates the first two pages of three cases we will use as examples. The individual journals' front page includes information on admission and discharge dates, patient information such as name, occupation or household position, age, and address. The bottom right corner contains the name of the practitioner who referred the patient to hospital, as well as the initial diagnosis given by them. In the top right corner, we find what we might call the "full" diagnosis, which lists all the main symptoms observed at admission and throughout the stay, sometimes including notes on treatments and interventions. Past the front page, the contents of the journals appear as unstructured text, although they tend to follow a certain format: first, a description of the patient's history prior to arrival; then, the physician's assessment of the clinical symptoms and the general condition of the patient, including in many cases their nutritional status and any prior infections. Occasionally, this description includes a drawing detailing the location and extent of symptoms such as pseudomembranes in cases of diphtheria. The remaining pages consists of notes ordered by day made by the attending physician and include symptoms, treatments and operations, notes on the patient's behaviour, and temperature measurements, often many per day and charted on a separate sheet.

Set against the types of hospital sources that are most common in historical demography, the clinical depth of the Blegdam journals is unusual. Existing publications build on serial admission, discharge and death registers, for instance the Belgian university hospitals studied by Horrent et al. (1994), or the Amsterdam Binnengasthuis register used by Diepgrond and Riswick (2025) discussed above. These registers can be rich in socio-demographic context, but they collapse the medical case into a single diagnostic column, sometimes vague or indeterminate. The Blegdam journals invert this balance with the layered diagnostic record and a day-by-day account of the patient's health, which makes them considerably richer for studying morbidity and the circumstances leading up to death. The Blegdam journals are not one of a kind, as similar records survive in other archives, but they are, to our knowledge, the first such body of clinical patient records to be brought systematically into historical demography and epidemiology.

The structure of the front pages is highly consistent over time, making them ideal for both automatic transcription and time series analysis. The unstructured nature of the rest of the journals' contents, however, along with high frequency of medical terms and abbreviations, makes for a more difficult transcription process, and one more prone to inaccuracies. As such, the section below focuses mainly on the wealth of information contained on the front pages, which is then supplemented by examples from the unstructured notes within.

3.2 ANALYTICAL POTENTIAL OF THE STRUCTURED FRONT PAGE

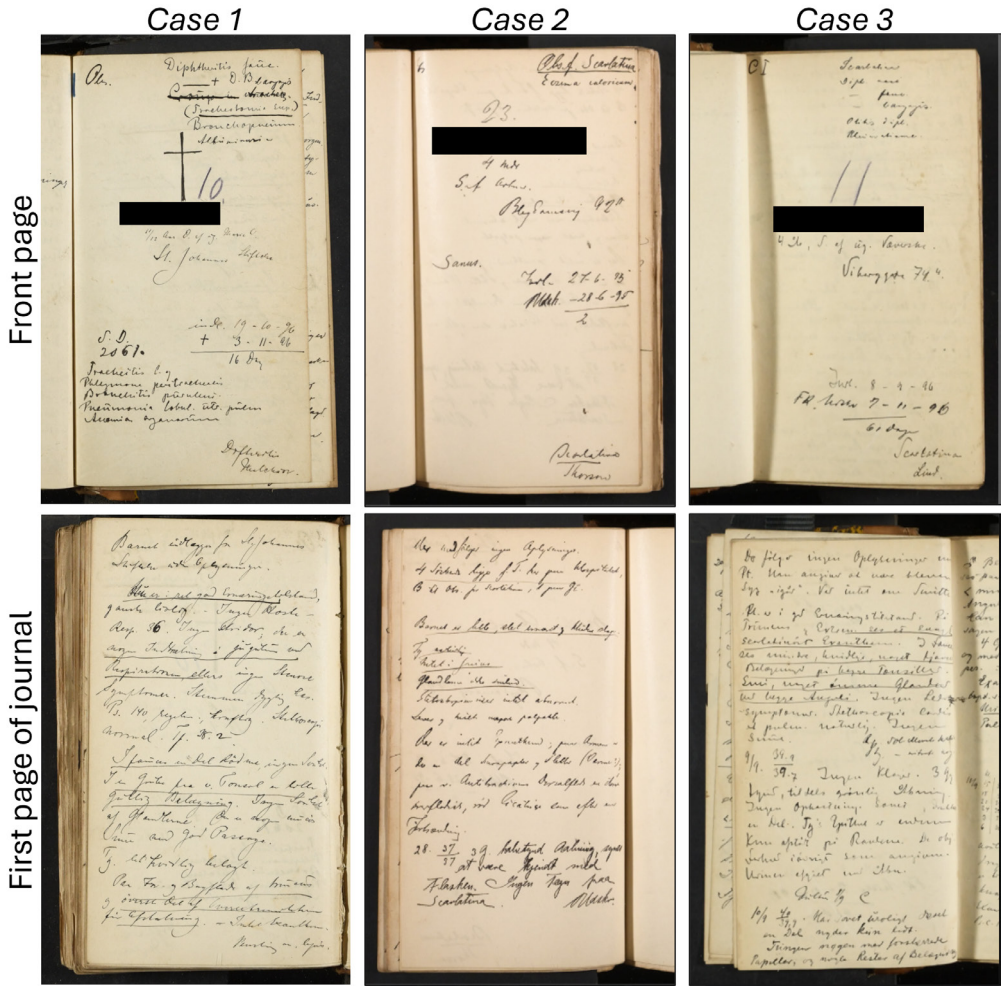
From a morbidity and cause of death perspective, the frontpage diagnoses form the most interesting part. A full list of diagnoses exists for all deceased patients, and when an autopsy was performed, which happened in roughly 60% of cases, the journal contains a third, more extensive "dissection diagnosis" as well. The value of these data is that in contrast to the cause(s) of death recorded on a death certificate, which is often void of any context, the patient journals were all recorded by physicians who had attended to and studied the patients prior to their death. They therefore provide a rare insight into the circumstances surrounding the illness and which details did or did not end up in the cause of death registration. This is particularly relevant in the case of Copenhagen where the most commonly used source for cause of death data from the time, the Copenhagen Burial Records, were copied from the death certificate and were thus already one step further away from the death event (Københavns Stadsarkiv, 2024; Revuelta-Eugercios et al., 2022).

To establish a sample for direct comparison between the two sources, we linked a sample of 80 records consisting of all patients that died between May 15th, 1896 and May 14th, 1897. This selection is not random, as many of these patients were part of a clinical trial taking place at the hospital at the time. The trial aimed to evaluate the efficacy of serum treatment for diphtheria, and we are conducting a case study of it in a separate paper. However, even if the sample is not representative of the period 1879–1910, the journals are very typical for the period: most childhood deaths were from diphtheria, which was the most deadly infectious disease among children in the city in the late 1880s and early 1890s, and as bacteriology was advancing, physicians were becoming able to microscopically test for the disease and distinguish it from infections with similar initial symptoms, such as scarlet fever. The traces of this development appear in the journals with small additions such as "+ D. B." to the list of diagnoses in the top right corner of the front page, which denote the presence of diphtheria bacteria in throat swabs (as in Figure 4, Case 1). The linked sample helps us understand how variations in diagnosis, co-infections and degree of severity of the infection transferred to the death certificate (and

subsequently to the burial record). Of the 80 journals, we were able to successfully link 77 (96%) to a burial in the Copenhagen Burial Records based on the name, age, address and date of death.

While both causes of death and the patients' referral diagnoses are usually very short and concise, the full diagnoses can be quite extensive and often list all symptoms of disease observed in the patient. It is initially simplest, then, to group the sample based on the cause of death: of the 77 burials, 31 (40%) died of diphtheria, while another 19 (~25%) died of croup, diphtheria crouposa or other variations of the two terms. Finding these in combination is not surprising, as croup and diphtheria were strongly related in the 19th century, the former being a common complication of the latter, and they were used interchangeably until physicians increasingly began to distinguish between them from the 1880s (Fibiger, 1895). Comparing the cause of death among those that died strictly of either diphtheria or croup to the referral diagnosis, we find a perfect correspondence. While the journals typically contain some additional information on the infection's location in the throat, it is in line with the nomenclature and registrational practice of the time that the cause of death should simply state the disease in general terms. The 1875 nomenclature, which was followed with only minor changes until the 1930s, contained 115 causes, nosologically grouped into nine categories, among them "epidemic diseases", which contained both diphtheria and croup under their vernacular labels, "malignant throat illness" and "throat cough" (Ludvigsen et al., 2023, p. 15; Villefrance Perner, 2023, p. 36). Apart from the 50 burials mentioned above, 22 records (~29%) contain in addition to diphtheria or croup some third disease such as measles, pneumonia, bronchitis, or tuberculosis. These co-infections only rarely appear in the referral diagnosis and would likely have developed only after hospitalization.

Figure 4 *Front page and first page of patient journals of three cases*



Notes: Case 1 was hospitalized for diphtheria on October 19th and died on November 3rd, 1896; Case 2 was hospitalized for scarlet fever from June 27th to June 28th, 1895; and Case 3 was also hospitalized for scarlet fever but on September 8th to November 7th, 1896. The front pages (top) contain their personal data along with a clinical summary, while the first page of the contents (bottom) describes their health status and symptoms upon arrival at the hospital.

Source: see Footnotes 5, 6 and 9.

Turning to the full diagnosis, complete with symptoms recorded at admission and during hospitalization, these are full of physiological and procedural detail that make a formal comparison to the causes of death more difficult. For instance, among burials where the cause of death is simply stated as diphtheria, the admission diagnosis often contains notes of albuminuria (indicating kidney disease), diathesis haemorrhagica (bleeding disorders), or extensive neurological symptoms ranging from paresis palati to fatal paralysis respirationis. These could be side effects of the serum therapy administered to diphtheria patients at this time, or complications of the disease itself. We also find other symptoms recorded that appeared after admission, and notes on surgical interventions such as tracheotomies in cases of croup with severe laryngotracheal stenosis. The journals can thus possibly provide insight into the rate of nosocomial infections. When the cause of death *does* point to a complicated case of diphtheria or croup, for instance by the presence of pneumonia or measles, we generally do find this stated in the full diagnosis as well.

To make this more tangible, in this and the following we present three cases (see Figure 4, where we show the front page and the first page of their journals). Case 1 exemplifies the above discussion and is the unfortunate story of an 11-month-old girl, daughter of an unmarried woman, who was admitted with symptoms of diphtheria on the 19th of October 1896, and died in the hospital after 16 days (Figure 4).[5] Her full diagnosis (top right) includes diphtheria in the throat and larynx, laryngitis, bronchopneumonia and albuminuria. The phrase "+ D.B." indicates that diphtheria bacteria were observed under the microscope, and it is also mentioned that a superior tracheotomy was performed. The autopsy report (bottom left) includes more details, such as tracheitis, phlegmone peritrachealis (infection around the trachea), bronchitis, lobular pneumonia, and anaemia organorum (anaemia of the organs). It should be clear that this patient died from a complicated case of diphtheria, and this is also reflected in her burial record, in which both diphtheria, croup and bronchopneumonia are recorded as causes of death. However, it is also clear that the death certificate only mentions a part of the events that led to her death. We will later return to this case and explore the journal in detail.

The structured parts of the patient journals also allow for examination of readmissions. Looking at the same example year, 1896, we examined all cases for reappearing patients by cross-checking names, ages and addresses, and while this initial investigation was crude to start with, we could verify that at least 13 patients, or about 0.7% of the 1,900 patients admitted in 1896, returned to the hospital at least once. Generally, these reappeared at the hospital with similar diagnoses, which may reflect reinfection, complications arisen after discharge, or misdiagnosis of either the initial or the readmission. The readmissions generally occurred within several months of the index admission and in this limited sample, none of the readmissions resulted in an in-hospital death. Nine of the 13 journals refer to the previous admission and thus confirm it to be a readmission. There is an interesting potential in identifying more of these cases over time, but it depends on linkage of journals within the dataset. Much of the information on the front page is prone to change over time, however, and if these are excluded, the linking method can only really build on the last name and a birth year estimated from the recorded age. That said, the readmissions are a promising window into the nascent development of follow-up care, and the short-, medium- and long-term impact of morbidity itself as well as medical interventions performed at the hospital.

To conclude in part, the frontpage information from the patient journals certainly has potential to significantly qualify cause of death analysis. For insights into more complicated cases of disease and nosocomial infections, an effort must be made to classify or extract information from the full diagnosis and disease progression of the patient, which is both rich and overwhelming in detail. In terms of the registrational practices behind the recording of the cause of death, we did not find a clear paper trail from the patient journal to the burial record (via a death certificate); the full diagnosis usually contains plenty of information that has been left out. The most likely explanation is that the cause of death has been recorded on a death certificate shortly after death, and probably by the same physician who closed the journal, as there is no clear sign of the information having been transferred from journal to death certificate.

3.3 THE UNSTRUCTURED SECTIONS

As noted above, the unstructured sections report on disease history and the general condition of the patient. It is worth keeping in mind whose account this is: the notes were written by the attending

5 Blegdam Hospital, Patient journals, unit no. 273104, pp. 1636–1646: https://kildeviser.kbharkiv.dk/?unit=273104&item=7402707.

physician, so even the patient's own history reaches us already filtered through the clinical encounter and the categories the hospital used to order its patients. The journals are revealing both for what they record and what they omit, and, as the cases below suggest, the unevenness of that detail is itself a kind of evidence. A typical patient description starts with 1. when symptoms began and what they entailed, 2. what (if known) the possible source of transmission has been, and 3. interestingly, if the child has previously had diseases like diphtheria, measles or scarlet fever. The latter, when compared to the diagnosis, may offer a measure of waning immunity and repeat infections (at least for bacterial infections), and may help answer questions on disease interactions, something rarely found in historical sources.

Apart from the medical information, the notes can also function as a source for socioeconomic data, and they provide us with insights into the living conditions of the city's marginalized populations. To highlight this point, we turn to Case 2, a 4-month-old male child, hospitalized on the 27th of June, 1895. The first page of the journal describes the patient as follows: "The infant is small, poorly nourished." It continues, stating that the patient had several other siblings admitted to the hospital at the same time, and that he "seems to be familiar with the bottle."[6] We learn several things from these statements, namely that the patient's siblings are also hospitalized, transmission within the household or another common source can be suspected, and that the infant was probably at least partially fed with a bottle or similar alternative method to breastfeeding. This is especially interesting as information on breastfeeding practices is not very common and may shed light on associations between nutritional status — in this case poor — and social economic background and their relation to in-hospital mortality.

It was possible to identify the four siblings of the infant. A six-year-old female and a two-year-old male were admitted on June 22nd followed by two male children aged four and eight, respectively, on the 26th, and finally the four-month-old on the 27th.[7] Each was admitted for scarlet fever and referred by the same physician. Their hospitalizations were generally short and below 11 days, with the notable exception of the second patient in the family, who remained in the hospital for 57 days. This case survived their ordeal at the hospital, as did all the siblings. We can contextualize the family even further using parish registers and the 1895 census, which tell the story of a young migrant family. The father was born in 1851 in Viborg, Jutland, and the mother was born outside of wedlock in Randers in 1859. They met each other on a farm in Viborg where they both worked and married in 1886 and seven months later, their first son was born. The young family moved to Copenhagen the following year, and grew to seven children in total by 1900.[8] There are two points to draw from this story. The five siblings were admitted over five days and referred by the same physician, which documents the spread of scarlet fever through one household. Further, the census and parish registers also place these admissions within a specific family history, as they were migrants, working-class, and frequently on the move within the city after settling there. This family proves little on its own, but it highlights the methodological potential. When applied across many patients, this kind of linkage would let us study morbidity alongside the social and demographic circumstances of those admitted.

This case above is a comparatively well-documented one, and many patients left far less behind. The amount and type of contextual information, for instance, varies quite a lot in the journals. For generally healthy children the comments are often limited to routine statements that they are "well-fed," for instance, and in the cases of critically ill patients, much of the contextual information has been left out to focus instead on clinically relevant information. There is another group of patients where information is sparse, not because of life-threatening illness, but because of what we presume to be the absence of dialogue with a parent or guardian. The last case is such an example and shows the journal of a four-year-old boy who was hospitalized on September 8th, 1896. The journal begins as follows: "No information is provided about the patient. He states that he became ill "yesterday". Nothing is known about the source of infection."[9] The patient's mother was an unmarried weaver, and the journal implicitly suggests that she was either not present, unable to talk to the admission office, did not have any information to add, or was simply not listened to. It is through cases like this

6 Blegdam Hospital, Patient journals, unit no. 273088, pp. 243–244 in the digitized record.

7 Blegdam Hospital, Patient journals, units no. 273088 (p. 193), 273089 (p. 105; 127), and 273090 (p. 197).

8 The family appears in the continually registered Copenhagen Police Register: Politiets registerblade. Station 7. Filmrulle 0006. Registerblad 1323 (id 2162505). https://kbharkiv.dk/permalink/post/17-909219. For the record of marriage see Danish National Archives, Gerning Sogn, Kontraministerialbog. https://arkivalieronline.rigsarkivet.dk/da/billedviser?bsid=364965#364965,70625001.

9 Blegdam Hospital, Patient journals, unit no. 273104, pp. 96–97: https://kildeviser.kbharkiv.dk/?unit=273104&item=7401292.

that the journals can also speak to the social history of medicine, where scholars have increasingly read institutional records of the poor against the grain, treating silence in the records as evidence of unequal encounters rather than neutral gaps in documentation (Carter & King, 2021; Hanley & Meyer, 2021). There are several other examples of similar journals that begin like this one, and it is common among them that only a single parent, or none at all, is mentioned in the journal. It is possible that many of these are foster care children; they are numerous in the city's census and burial records, but entirely absent (as a category at least) in the journals. If they are registered under their parent here, it would explain the lack of information. In any case, the absence of information during the intake functions as "informed missing data" where the absence of information is both a socioeconomic marker and might also be associated with a certain health outcome. From a treatment and isolation perspective, the lack of disease history is not likely to have improved a patient's chances of survival.

In terms of mortality, we return to the first case of the 11-month-old girl to exemplify the wealth of information a full journal can contain. Her intake information mentions that she was admitted without further information (like Case 3) from *Sanks Johannes Stiftelse* (a charitable institution), and she was in a fairly good nutritional status and quite lively. The following details our understanding of the clinical progression of the patient as detailed in the patient's journal.

The initial clinical features were consistent with tonsillopharyngeal diphtheria, characterized by a small unilateral tonsillar pseudomembrane and hoarseness. Microscopy confirmed the presence of diphtheria bacilli ("+ D.B."). On the second day of admission, the patient developed rapidly progressive stridor during the morning hours, with evolving laryngeal stenosis (a narrowing of the airways). An urgent superior tracheostomy was performed later that afternoon under chloroform anaesthesia. Following tracheostomy, the patient was respiratory stabilized but remained febrile. On day four, clinical deterioration occurred with tachypnea, tachycardia, and examination with a stethoscope gave rise to a suspected right-sided pneumonia characterized by a "dampened" and "crackling sound." In the subsequent days, additional complications emerged, including skin desquamation, conjunctivitis, and progressive local wound complications at the tracheostomy site with evidence of secretion retention and a clinical description suggestive of a possible paratracheal abscess or fistula development. Several investigations were performed to rule out a passage between the trachea and oesophagus, but none were found. However, liquid continued to drain out of the tracheal tube during and after feeding. Tube feeding was attempted on day 13 without success. By day 14, worsening dysphagia and suspected aspiration indicated progressive pharyngo-laryngeal dysfunction (this suggests diphtheria-associated neurological complications). On day 15, the patient became somnolent with severe tachycardia (pulse approximately 200 beats per minute) and marked tachypnea, consistent with advanced respiratory insufficiency. On day 16, the pulse became irregular and weak (possibly due to toxic diphtheritic myocarditis). Her general condition at this time was described as lethargic. Despite supportive care, the patient continued to deteriorate and died on 3 November 1896, after 16 days of hospitalization.

The recorded hospital diagnoses on the front page match those included in the day-to-day notes, with interesting addition of "albuminuria," which is not mentioned elsewhere. The autopsy report described tracheitis, phlegmone peritrachealis, bronchitis, lobular pneumonia, and anaemia organorum. The burial record likewise listed diphtheria, croup, and bronchopneumonia as causes of death, but as is clear from the clinical notes and disease progression, it is a severely abridged version of the sequence of events leading up to death. One may suspect whether complications of the tracheostomy, that without the detailed records would go unnoticed, have contributed to the course of the disease.

This case depicts a tragic story which was unfortunately not uncommon at the time. It also exemplifies the complexity of clinical details contain in the journals, which enhance our understanding of the cause of death and help us unfold the attempts made in the hospital to save the patient's life. While the surgery initially showed to improve symptoms it may also have led to complications, which may have contributed to the patient's further decline. This, and the other examples highlighted here, showcase the rich data on morbidity contained in the journals. Furthermore, they contain information that can inform on social inequalities and the specific ways in which the lower classes were disadvantaged both at home and upon meeting with healthcare institutions in the late 19th century.

4 CONCLUSION

Patient journals such as those from the Blegdam Hospital present a new and enticing avenue of research in historical demography, as they can provide insights into the epidemiologic transition that are not achievable through mortality records alone. The hospital grew out of mid-19th century fears of imported disease, but by the end of the century, it functioned mainly to isolate and treat endemic childhood diseases such as scarlet fever and diphtheria. Even though this was not the original intent, it reflects the relatively pragmatic approach that guided the hospital's admissions throughout its first several decades. Together with the city's other public hospitals, it adapted to the unpredictable nature of infectious disease. A good example of this is the redirection of measles cases from Blegdam to the Øresund Hospital at times when their isolation would not have been possible.

The journals contain a wealth of information for both quantitative and qualitative analysis. The front pages hold demographic, socioeconomic and clinical data, and the unstructured notes hold detailed disease histories. When we compared our small sample to the individual-level Copenhagen Burial Records, the recorded cause of death was generally well-aligned across the two sources. What the journals add, however, is complexity as well as a record of morbidity and not only of death. Our patient Case 1 is a good example: she appears in the burial records as a death from diphtheria and bronchopneumonia, but her journal describes a 16-day sequence of complications, several of them following the tracheotomy, which the death certificate does not reflect. The same gap shows up in the aggregate data, where diphtheria was a common diagnosis among the adults admitted to Blegdam but rarely killed them; going by mortality alone, one would think it was almost exclusively a childhood disease. Read as a morbidity source, the journals tell us how ill a patient was, how long the illness lasted, and which complications and treatments followed.

This leads to the question we raised at the outset and which still remains largely unsettled. The mortality decline was accompanied by what looks like a rise in morbidity, which has been read either as a real effect, with patients surviving longer in illness (Alter & Riley, 1989), or as an artefact of a lower threshold for feeling or reporting sickness (Johansson, 1991). The evidence usually brought to this question comes from sickness claims, which treat illness as the inability to work and mostly cover employed adults. Hospital journals measure morbidity differently, through severity and complications, and they do so for some groups that the claim records miss, especially children and to some degree also women. We cannot settle the question here, but a source of this kind gives another measure of morbidity that could, once available at scale, help reframe the discussion.

The Blegdam Hospital journals are also a record of medicine in transition. The decades we are currently transcribing cover the onset of the bacteriological revolution, and the notes register its arrival directly: for example through the "+ D.B." added once diphtheria bacteria had been found under the microscope, and through the gradual replacement of surgical interventions such as tracheotomy with serum therapy from the around mid-1890s. Using this information, the journals can also speak to broader questions of cause and effect during the mortality decline. Because they record both treatments and their outcomes, they can help us judge when and to what extent medical interventions improved survival from infectious disease.

None of this is to say that working with the journals is straightforward. What we present here is an introduction to the source rather than an analysis, but it is worth being clear about the limitations that research with the data would have to deal with. Blegdam was a specialized epidemic hospital whose patients were mostly children suffering from a handful of infectious diseases, so its patient body is not a cross-section of the city's sick, nor of hospital patients in general, and this makes generalisations problematic. The journals also record only those who were admitted, and as we have shown, admission was governed as much by capacity and policy as by need, so the source is silent on those who were turned away or never sought hospital care at all. On a practical level, the unstructured notes are dense with medical terms and abbreviations and are hard to transcribe accurately. Once they are machine-readable, they present a new challenge in the form of text mining and structuring that information at scale. These are not reasons to avoid the source, but they set the terms on which it can be used.

As individual-level data sources become increasingly digitized, linked and interoperable, we expect that patient journals like the ones presented here can become an even more valuable resource in the future. The personal information contained on the frontpages is equal in detail to that found in Danish censuses and burial records, and the promise of linking patient journals to those sources and creating

life-course histories pre- and post-hospitalization appears increasingly realistic. At present, over 22,000 front pages from 1889 to 1897 have been transcribed with a promising variable-level accuracy. A full transcribed register will become available as an individual-level dataset within the next few years.

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