## ABSTRACT

**INTRODUCTION:** Annual psychiatric admission records compiled by Statistics Norway (Norges Offisielle Statistikk) between 1872 and 1929 represent a rare, systematically collected archive of Norwegian mental health history. This project builds directly on a recently published data descriptor (Hegvik et al., 2025) that introduced a structured dataset of historical mental health incidence in Norway using optical character recognition and manual curation. The present pipeline was developed independently and in parallel, extending that work through an AI-assisted extraction approach and an expanded institution and diagnostic taxonomy.

**AIM:** To develop a reproducible, multi-stage data pipeline that transforms scanned historical psychiatric admission tables into a validated, tidy dataset and to characterize the resulting data in terms of institutional coverage, diagnostic taxonomy, temporal scope, and sex distribution.

**METHODS:** A three-stage pipeline was developed. First, a large language model (Gemini 2.0 Flash) extracted the structural skeleton of each annual table from scanned PDFs using a standardized prompt. Second, all numeric values and footnote markers were entered manually via a custom R Shiny validation application. Third, a final R script standardized naming conventions, removed aggregate rows, and exported a single long-format CSV.

**RESULTS:** The pipeline produced a dataset of 58,302 admission records spanning 58 years (1872–1929), 30 institutions, and 51 diagnostic labels. Dementia (n=17,919), Melancholia (n=10,674), and Mania (n=6,858) were the most frequently recorded diagnoses. Male admissions accounted for 51.9% of the overall total. Annual admissions grew from 550 in 1872 to 1,940 in 1929.

**DISCUSSION:** This dataset constitutes a complementary structured compilation of Norwegian psychiatric admission statistics for this era and demonstrates that AI-assisted extraction combined with systematic human validation can recover high-quality data from degraded historical sources. The dataset and pipeline code are openly available at https://github.com/jakebharmon/norge-historical-data.

# Conditions in Norwegian Psychiatric Facilities 1872-1929

by

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A Capstone Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

**MASTER OF PUBLIC HEALTH**

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## Author's Statement Page

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Jake Harmon

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## TABLE OF CONTENTS

## LIST OF FIGURES

# INTRODUCTION

## 1.1 Background

The history of psychiatry in Norway during the late nineteenth and early twentieth centuries is preserved in a remarkable, if largely inaccessible, archive: the annual tabulations of psychiatric admissions published by the Norwegian government under the series Norges Offisielle Statistikk (NOS). These reports, compiled from 1872 through 1929 by the institution that would eventually become Statistics Norway (Statistisk Sentralbyrå, SSB), provide a systematic census of patients admitted to major Norwegian asylums each year, broken down by institution, diagnostic category, and sex. Despite covering nearly six decades of national mental health data, the records exist exclusively as scanned printed documents.

A recently published data descriptor in Scientific Data (Hegvik et al., 2025) introduced a structured dataset of historical mental health incidence in Norway drawn from these same NOS sources, covering 29 facilities across the 1872–1929 period. That project employed optical character recognition (OCR) using ABBYY FineReader, followed by manual validation and harmonization, and mapped historical diagnoses to Bertillon's International Classification of Causes of Death. The present project was developed independently and in parallel, using a distinct methodological approach — large language model (LLM) structural extraction combined with a purpose-built R Shiny validation interface — and extends the institutional coverage to 30 facilities. Together,

these two complementary efforts make Norwegian psychiatric admission statistics from this period available for quantitative research for the first time.

This capstone project describes the design, implementation, and output of a three-stage data pipeline developed to produce a complementary structured version of these records. The pipeline combines LLM-assisted structural extraction, systematic human validation via an interactive application, and programmatic quality-controlled export. The result is a publicly available, reproducible dataset of 58,302 admission records spanning 58 years, 30 institutions, and 51 diagnostic labels.

### 1.2 Definitions

Several terms are used throughout this paper in specific technical or historical senses that warrant explicit definition.

**Asylum / Psychiatric institution.** State-recognized inpatient psychiatric facilities that reported admission statistics to the Norwegian central government. Facilities varied considerably in size and mission, ranging from large state asylums (e.g., Gaustad, Rotvoll) to smaller municipal or private institutions.

**Admission.** An individual admission event recorded in a given year (Indkomne/Innkomne). The unit does not track individuals across years; a patient re-admitted in multiple years appears as separate records.

**Diagnosis / Patient status.** The row labels of the source admission tables, ranging from specific clinical diagnoses (e.g., Paralysis generalis, Epilepsia) to broader descriptive categories (e.g., Til observasjon — under observation).

**Long-format dataset.** A tidy table in which each row represents one cell of the original source table: one year, one institution, one diagnosis, and one sex category.

**JSON skeleton.** An intermediate file produced by the AI extraction stage encoding the structural dimensions of a source table (institutions, diagnoses, sex, year) without numeric values, which are subsequently entered by human review.

### 1.3 Research Questions

This capstone is structured around three overarching research questions:

1. Can a reproducible multi-stage pipeline reliably recover structured quantitative data from scanned historical psychiatric admission tables? This question concerns pipeline feasibility and data integrity.

2. What does the resulting dataset reveal about the scale, institutional geography, and diagnostic composition of Norwegian psychiatric admissions between 1872 and 1929?

3. How did admission volumes, diagnostic patterns, and sex distribution change over the 58-year period?

# REVIEW OF THE LITERATURE

## 2.1 Historical Psychiatric Records and Data Recovery

The recovery of historical health data from archival sources has a substantial precedent in epidemiology and public health history. Large-scale historical data recovery projects have reconstructed mortality patterns from parish registers, infectious disease burden from notifiable disease reports, and hospital admissions from handwritten ledgers. These efforts have consistently demonstrated that historical administrative records, despite their imperfections, contain quantitative information of lasting scientific value.

The digitization of psychiatric records poses particular challenges. Unlike mortality statistics, which often used standardized forms from an early date, psychiatric admission data varied widely in structure and nomenclature across institutions and over time. The diagnostic categories employed in nineteenth-century records frequently do not map directly onto modern classifications, and the labels themselves shifted as psychiatric theory evolved. Furthermore, the tables in which admission data were recorded were often complex multi-axis structures — institutions as columns, diagnoses as rows, sex as sub-columns — that resist automated extraction without substantial manual review.

Hegvik et al. (2025) published a structured dataset of historical mental health incidence in Norway drawing on these same NOS source materials, covering 29 facilities from 1872 to 1929. Their pipeline employed OCR using ABBYY FineReader, manual correction, name harmonization, and mapping of historical diagnostic terms to Bertillon's classification. The present project was developed as a complementary effort: using a different extraction method (LLM-based structural parsing rather than OCR) and a different validation interface (a custom Shiny application), and retaining the original

diagnostic labels rather than harmonizing to a standard classification. The two datasets together offer researchers multiple angles of access to the same underlying archive.

### 2.2 AI-Assisted Extraction from Historical Documents

A critical limitation of fully automated extraction is the difficulty of validating accuracy without independent reference data. For novel historical records, ground-truth datasets rarely exist. This underscores the importance of hybrid approaches in which automated extraction generates a structural template that is subsequently populated and verified by human review. The Hegvik et al. (2025) approach — OCR for initial extraction, manual correction thereafter — reflects the same logic from a different starting technology. The present pipeline inverts the emphasis: the LLM handles structural parsing (at which it excels), while humans handle all numerical transcription (at which they are reliable and auditable).

R Shiny, the web application framework used in the validation stage, has established itself as a flexible tool for data entry and interactive validation in research workflows. Its ability to render dynamic, spreadsheet-like interfaces using packages such as rhandsontable makes it well suited to structured data entry tasks.

# METHODS AND PROCEDURES

## 3.1 Context of Study

This project is a historical data recovery and pipeline development study. It does not involve human subjects research: no patients were recruited, no surveys were administered, and no personally identifiable information was accessed. The source materials are published government statistical reports in the public domain, available through Statistics Norway's historical publications archive (https://www.ssb.no/a/histstat/nos/).

## 3.2 Rationale of Study

The primary rationale is the transformation of an important but inaccessible historical archive into a format that can support quantitative research. While Hegvik et al. (2025) produced the first structured version of this dataset, the present pipeline offers a complementary product: it retains original diagnostic labels rather than mapping to an external classification, covers 30 facilities, and provides a fully open-source, reproducible codebase using freely available tools (R, Shiny, a commercially available LLM API). The methodological documentation may serve as a template for comparable digitization efforts in other national archives.

## 3.3 Data Source

The primary data source is the series of annual psychiatric reports published within Norges Offisielle Statistikk (NOS), compiled by the Norwegian central statistical office. Each annual report contains one or more tables enumerating newly admitted

patients (Indkomne or Innkomne) to Norwegian psychiatric institutions for that calendar year, cross-classified by institution, diagnostic category, and sex (male: Md.; female: Kv.). Reports from 1872 through 1929 were downloaded as PDF files from SSB's publicly available historical statistics archive.

### 3.4 Stage 1: AI-Assisted Structural Extraction

For each year's PDF, the relevant table page was submitted to Gemini 2.0 Flash (Google DeepMind, 2024) via a standardized extraction prompt. The prompt instructed the model to identify and return the structural dimensions of the table: the list of institutions appearing in the column headers, the list of diagnostic categories appearing in the row labels (including hierarchical parent–child relationships), and the year of the report. The model was explicitly instructed not to populate numeric values, yielding a JSON object containing only the structural skeleton.

Separating structural extraction from value entry was a deliberate design choice motivated by the distinct error profiles of each task. LLMs are effective at identifying and labeling structural elements of tables but are prone to hallucination when asked to transcribe specific numeric values from low-resolution or complex printed tables. By limiting the AI's role to structural parsing, the pipeline exploited model strengths while avoiding the most consequential source of error.

### 3.5 Stage 2: Human Validation via R Shiny Application

All numeric values were entered manually using a custom validation application developed in R Shiny (Chang et al., 2023; R Core Team, 2024). The application supported two import modes: Dimensions Mode (loading a raw JSON skeleton for fresh

entry) and Resume Mode (loading a previously saved file for correction or completion). The entry interface consisted of two synchronized grids rendered using the rhandsontable package (Owen, 2018): a Data Grid accepting only integer values, and a Footnote Grid accepting non-numeric markers corresponding to annotations in the source table. Institution and diagnosis names could be edited globally within the application, with changes propagating instantly across both grids.

### 3.6 Stage 3: Export and Quality Control

A final R script (combine.R) merged all verified JSON files into a single dataset and applied standardization procedures. The script applied a name-mapping lookup to standardize institution and diagnosis labels across years, filtered aggregate subtotal rows, and verified annual totals against independently proofed reference counts before export. The final output (cleaned_long_dataset.csv) contains one row per year–institution–diagnosis–sex combination with six columns: year, institution, patient_status, sex, value, and footnote_marker.

# RESULTS

## 4.1 Dataset Overview

The completed pipeline produced a dataset of 58,302 individual admission records spanning 58 years (1872–1929), with each record representing a unique combination of year, institution, diagnostic category, and sex. After merging orthographic variants and truncated labels identified during post-processing audit, the dataset contains 30 unique institution names and 51 unique diagnostic labels. Cells with no admissions recorded in the source table are coded as NA rather than zero.

Total annual admissions grew from 550 in 1872 to 1,940 in 1929, a 3.5-fold increase reflecting the expansion of the asylum system and increased institutionalization rates. Male patients accounted for 30,288 admissions (51.9%) and female patients for 28,014 (48.1%).

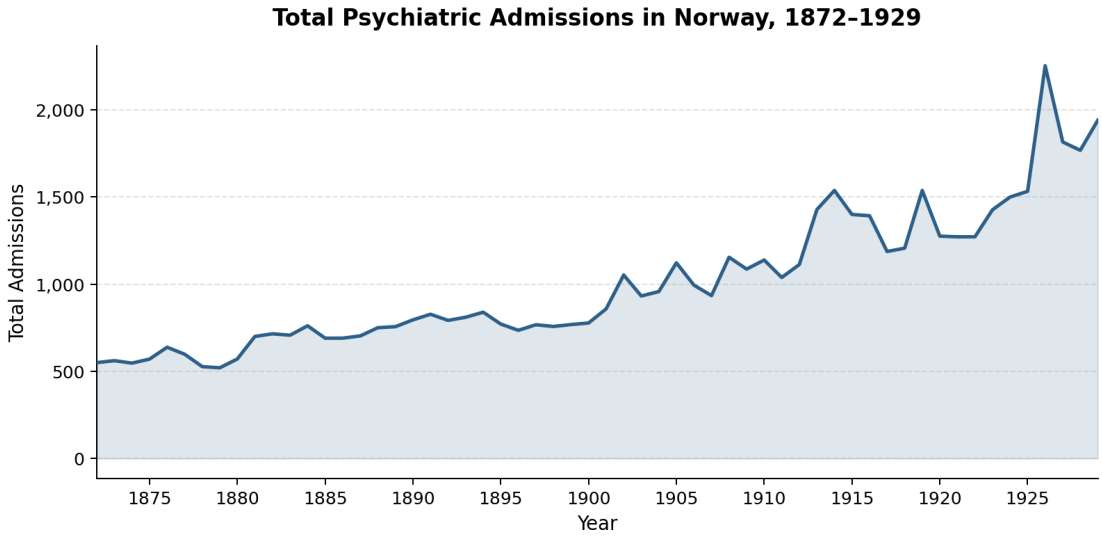


*Figure 4.1. Total psychiatric admissions recorded across all Norwegian institutions, 1872–1929.*

## 4.2 Institutions and Geographic Coverage

The dataset encompasses 30 institutions representing the major Norwegian psychiatric facilities active during the study period. The largest single contributor was Gaustad (n=10,983), the flagship state asylum near Oslo, followed by Rotvoll in Trondheim (n=8,009) and Eg in Kristiansand (n=5,961). Together these three institutions account for approximately 43% of all recorded admissions. A complete listing of all institutions with their total admissions and active years is provided in Appendix B.

### 4.3 Diagnostic Taxonomy

The 51 unique diagnostic labels in the cleaned dataset reflect the evolution of psychiatric nomenclature across the 58-year period. Three diagnoses dominate the record: Dementia (n=17,919), Melancholia (n=10,674), and Mania (n=6,858), together accounting for approximately 60% of all admissions. All three are broad categorical diagnoses used in nineteenth-century psychiatry to encompass a wide range of presentations that would be subdivided under modern systems.

The dataset documents the introduction of newer diagnostic categories over time. Dementia præcox, Schizophrenia (n=3,613) first appears in the 1910s and grew rapidly through the 1920s. Alcohol-related diagnoses (Alcoholismus, Delirium tremens) were present throughout the period. The appearance of Norwegian-language labels in later decades reflects the broader shift from Latin to vernacular clinical language. A complete listing of all diagnoses is provided in Appendix C.

### 4.4 Temporal Trends in Admissions

Annual total admissions rose from 550 in 1872 to a period high of 1,940 in 1929 (Figure 4.1). Growth was relatively gradual through the 1870s and 1880s, accelerated in

the 1890s and 1900s as new institutions opened, and showed some variability in the 1910s, possibly reflecting disruptions associated with the First World War. The 1920s show a resumption of growth consistent with continued expansion of the institutional network. The growth in total admissions reflects a combination of true increases in institutionalization rates, population growth, and the addition of new institutions to the reporting system.

### 4.5 Sex Distribution

Male patients (Md.) accounted for 30,288 admissions (51.9%) and female patients (Kv.) for 28,014 (48.1%) over the full period. Figure 4.2 shows the year-by-year composition of admissions by sex. The male-to-female ratio remained notably stable across the full 58-year span, hovering between 51% and 54% male throughout. This consistency is striking given the substantial changes in diagnostic composition and institutional structure over the same period.

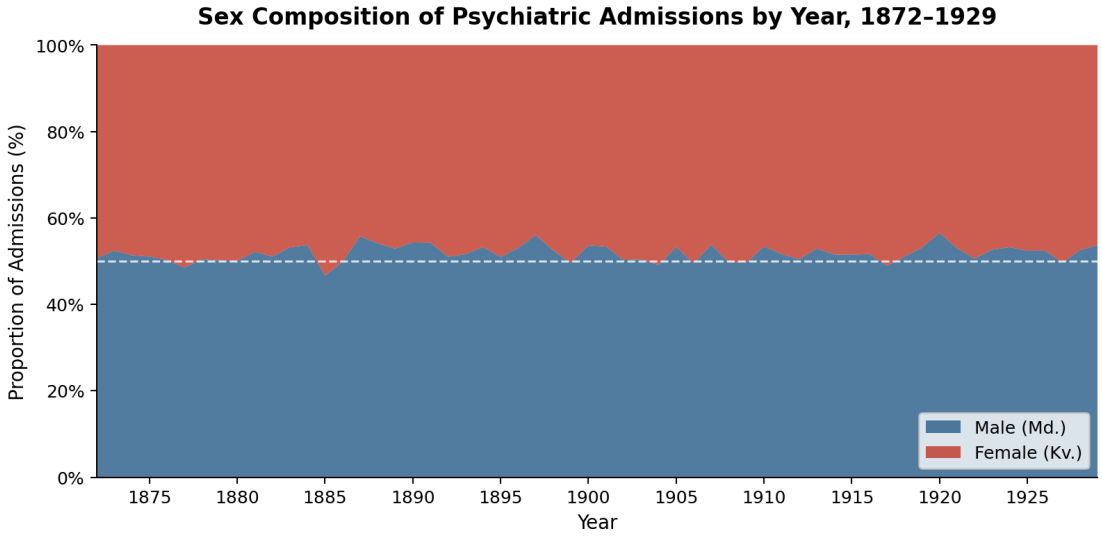


*Figure 4.2. Sex composition of psychiatric admissions by year, 1872–1929. The dashed line marks the 50% threshold.*

# DISCUSSION AND CONCLUSION

## 5.1 Summary of Findings

This project successfully developed and executed a three-stage pipeline for recovering structured quantitative data from scanned historical psychiatric admission records. Applied to Norwegian NOS reports from 1872 to 1929, the pipeline produced a validated dataset of 58,302 records across 30 institutions and 51 diagnostic categories. Together with the recently published Hegvik et al. (2025) dataset — developed independently using a complementary methodology — these resources make Norwegian historical psychiatric admissions available for quantitative analysis for the first time.

Key substantive findings include the dominance of broad categorical diagnoses (Dementia, Melancholia, Mania) in the early decades; the introduction and rapid growth of newer diagnostic categories such as Dementia præcox, Schizophrenia in the early twentieth century; a stable male predominance in admissions across the entire period; and a 3.5-fold increase in annual admissions reflecting the expansion of the institutional system.

## 5.2 Study Strengths and Limitations

The primary strength of this project is its systematic approach to a previously intractable data recovery challenge. By separating AI-assisted structural extraction from human numerical validation, the pipeline exploited complementary strengths of both approaches. The built-in audit comparing annual totals against independently verified reference counts provides a quantitative quality control mechanism absent from purely

manual transcription efforts. The fully open-source codebase enables replication and adaptation.

Several limitations should be noted. First, the data reflect institutional admissions rather than population prevalence; admission rates per 100,000 population cannot be computed without linking to census data. Second, diagnostic categories were assigned by treating physicians using the nosological frameworks of their time, which differ substantially from contemporary classifications. Third, while name standardization was applied in the export stage and subsequently audited, some minor variants may remain. Fourth, the magnitude of AI extraction errors requiring manual correction was not systematically tracked. Finally, unlike Hegvik et al. (2025), this project does not map historical diagnoses to a standard external classification, which limits direct comparability with modern epidemiological data.

### 5.3 Implications of Findings

The dataset created by this project opens several avenues for future research. Most directly, it enables quantitative historical epidemiology of mental illness in Norway during a critical period of psychiatric development. By linking the dataset to Norwegian population census records, researchers could compute standardized admission rates and examine geographic and temporal variation in institutionalization. The dataset's retention of original diagnostic labels, in contrast to the Hegvik et al. (2025) Bertillon-mapped version, also supports analysis of nosological change on its own terms without the assumptions embedded in retrospective diagnostic mapping.

Beyond Norway, the pipeline methodology is directly applicable to comparable historical psychiatric archives in other Scandinavian countries and more broadly across

Europe and North America. The structured extraction prompt, the Shiny validation application, and the export script are all available in the project repository and can be adapted with minimal modification.

### 5.4 Conclusions

This project demonstrates that a carefully designed hybrid pipeline — combining LLM-assisted structural extraction with systematic human validation — can reliably recover high-quality quantitative data from scanned historical administrative records. Applied to Norwegian psychiatric admission statistics from 1872 to 1929, the pipeline produced a dataset of 58,302 records that complements the independently developed Hegvik et al. (2025) dataset and is freely available for historical, epidemiological, and comparative mental health research.

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## APPENDIX A: AI EXTRACTION PROMPT

The following prompt was submitted verbatim to Gemini 2.0 Flash for each year's PDF table page:

```
Task: Extract the structural coordinate map for a medical reporting table. You
must
dynamically identify rows and columns to account for year-over-year variations.

Data Target: Indkomne/Innkomne.

Extraction Rules:
  Title: Use the title of the table for the Title field.
  Year: Extract the year from the title.
  Dynamic Headers: Identify all Institutions found in the header row or first
column.
  Dynamic Rows: Identify all Patient Statuses/Diagnoses in the header row or
first column.
  Hierarchical Rows: If a row has a parent category and sub-categories (e.g.,
'Idiotismus'
    followed by 'congenitus'), format as Parent - Child.
  Sex Sub-columns: Every institution must be mapped against 'Md.', 'Kv.'.
EXCLUDE 'Tils.'.

Output Schema:
{
  "title": "Insert Title",
  "year": "Insert Year",
  "institutions": ["List all unique institutions found"],
  "diagnoses": ["List all unique diagnosis rows found, preserving hierarchy"],
  "sex": ["Md.", "Kv."]
}
```

## APPENDIX B: ALL INSTITUTIONS (CLEANED)

The following table lists all 30 institutions in the cleaned dataset, sorted by total admission count.

| Institution | Total Admissions | First Year | Last Year |
|---|---|---|---|
| Gaustad | 10,983 | 1872 | 1929 |
| Rotvoll | 8,009 | 1872 | 1929 |
| Eg | 5,961 | 1881 | 1929 |
| Neevengården | 4,784 | 1891 | 1929 |
| Dikemark | 3,584 | 1905 | 1929 |
| Rønvik | 2,971 | 1902 | 1929 |
| Kristiania | 2,306 | 1872 | 1908 |
| Rosenberg | 2,110 | 1872 | 1929 |
| Dedichens | 1,696 | 1901 | 1929 |
| Dale | 1,546 | 1913 | 1929 |
| Valen | 1,522 | 1910 | 1929 |
| Sanderud | 1,386 | 1908 | 1929 |
| Møllendal | 1,317 | 1872 | 1929 |
| Østmarken | 1,275 | 1919 | 1929 |
| Prestsæter | 1,092 | 1913 | 1929 |
| Trondhjem | 1,001 | 1872 | 1919 |
| Lier | 1,001 | 1926 | 1929 |
| Veum | 970 | 1914 | 1929 |
| Blakstad | 950 | 1904 | 1929 |
| Opdøl | 926 | 1913 | 1929 |
| Oslo | 528 | 1872 | 1925 |
| Kristiansand | 423 | 1872 | 1929 |
| Bergen | 419 | 1872 | 1890 |
| Faret | 405 | 1918 | 1929 |
| Bratsberg | 381 | 1909 | 1917 |
| Reitgjerdet | 344 | 1923 | 1929 |
| Fastings Minde | 150 | 1918 | 1923 |
| Kriminalasylet | 133 | 1895 | 1929 |
| Stavanger | 82 | 1872 | 1893 |
| Oslo hospitals | 47 | 1926 | 1929 |

## APPENDIX C: ALL DIAGNOSES (CLEANED)

The following table lists all 51 diagnostic labels in the cleaned dataset, sorted by total admission count.

| Diagnosis / Patient Status | Total Admissions |
|---|---|
| Dementia | 17,919 |
| Melancholia | 10,674 |
| Mania | 6,858 |
| Dementia præcox, Schizophrenia | 3,613 |
| Insania periodica | 2,514 |
| Amentia | 2,371 |
| Paranoia | 1,495 |
| Insania manico-melancholica | 1,401 |
| Paralysis generalis | 1,352 |
| Idiotia (imbecillitas) | 756 |
| Alcoholismus | 626 |
| Insania paranoides | 579 |
| Insania periodica - degenerativa | 556 |
| Insania hysterica | 544 |
| Insania periodica - hysterica | 538 |
| Insania degenerativa | 537 |
| Insania ex constitutione | 517 |
| Monomania | 469 |
| Idiotia et insania ex imbecillitate | 403 |
| Insania periodica - epileptica | 374 |
| Dementia senilis | 371 |
| Insania epileptica | 354 |
| Idiotia | 336 |
| Insania syfilogenes | 331 |
| Epilepsia | 299 |
| Vitia organica cerebri | 186 |
| Idiotismus - congenitus | 177 |
| Melancholia cum stupore | 160 |
| Delirium tremens | 157 |
| Idiotismus - acquisitus | 138 |
| Insania periodica - neurasthenica | 114 |
| Insania periodica - hypochondrica | 110 |

| | |
|---|---|
| Insania alcoholica | 105 |
| Insania hypochondrica | 104 |
| Insania ex vitio cerebri | 92 |
| Monomania Paranoia | 77 |
| Hysteria | 57 |
| Insania neurasthenica | 54 |
| Insaniae aliae vel generis incerti | 54 |
| Hypochondria | 26 |
| Vitia cerebri | 10 |
| Alcoholismus chron | 8 |
| Annen sinnssygdom | 7 |
| Hemiplegia | 4 |
| Dementia - acuta | 4 |
| Stupiditas | 2 |
| Ikke sinnssyk | 2 |
| Tumor cerebri | 1 |
| Intoxicatio morphino-cocainic | 1 |
| Morbus nullus | 1 |