

# Hospital-treated psychosis and suicide in a rural community (1877–2005). Part 1: Incidence rates

Andersen JE, Hynnekleiv T. Hospital-treated psychosis and suicide in a rural community (1877–2005). Part 1: Incidence rates.

**Objective:** To calculate the incidence rates of hospital-treated psychosis and suicide in historical cohorts of a small rural community in southeast Norway, and to compare the local findings with the national ones.

**Method:** We have carried out a longitudinal epidemiological study, reviewing the patient records at the mental hospitals of people born in the rural community after 1845. Based on these records, we have constructed a local register of psychosis and suicide in this population. The local incidence rates of psychosis and suicide have been compared with the national ones.

**Results:** The overall local incidence rates of psychosis and suicide were similar to the national ones. The local rates of schizophrenia dropped considerably after World War II.

**Conclusion:** The overall local incidence rates of psychosis and suicide seem to be representative for the country at large despite frequent endogamy. The recent drop in the incidence rate of schizophrenia seems to be in agreement with several international studies.

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Key words: cohort study; incidence study; psychotic disorders; suicide; schizophrenia

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## Significant outcomes:

- Identical findings of national and long term local incidence rates of severe mental disorders.
- Frequent endogamy in the local cohorts has not caused an increase in the incidence of severe mental disorders.
- Reduction in the local incidence rate of schizophrenia after World War Two.

## Limitations:

- The patient material could have been larger.
- Heavy reliance on the hospital diagnoses.
- The clinical criteria could have been more strictly defined.

## Introduction

Scandinavia has many small, stable and well-defined populations with reliable demographic data and evenly distributed public health services. Rural Scandinavia has therefore fostered many classical works of psychiatric epidemiology (1–5). This study has been carried out on the population in one such community. The development of its population is documented in three local genealogies (6–8), in two academic works of historical

demography (9, 10) and in four historical population censuses (11–14). Use of these sources has enabled us to construct an overview of named persons born in the community studied between 1580 and 1985.

The area was abandoned after a devastating plague in 1349. It was gradually resettled during the 15th century. In 1665 the community consisted of 52 farms, i.e. independent households, with less than 300 inhabitants (7). The community has about 1700 inhabitants today (8). Our work has

been confined to hospital-treated psychosis and suicide. We have obtained a near-complete overview of identified persons and their purported genetic family relations in the course of 340 years (6–8, 11–14). Pedigrees of named persons are traced for 12 generations in this way (15).

One of us (JEA) has worked as the sole psychiatrist in the area since 1986, mostly at the psychiatric out-patient clinic of Tynset General Hospital, serving the rural community studied. Historical demographic data have been pieced together with clinical information derived from patient records. The authors have jointly traced the records of people in the community in the archives of the three mental hospitals (Gaustad, Rotvoll and Sanderud) where people from the rural community could have been admitted, and in the archive of the psychiatric out-patient clinic at Tynset. The oldest patient record included is dated 1877, and the last one included is dated 2005, thus covering the mental hospital era in Norway. There were no electronic registration systems at the hospitals according to the local geography until fairly recently, and to find the relevant journals the authors checked every admitted patient's address at each hospital by reading the protocols or lists on patient admissions from this period.

Aims of the study

The aims of this longitudinal study are to examine the incidence rates of psychosis and suicide in this small rural community and to examine whether the incidence rates are representative of Norway at large.

Material and methods

The procedures

Systematic registrations of psychosis in Norway were carried out in a national register from 1926 to 1935 (16, 17). Suicide has been systematically registered since 1826 (18). We have compared the local incidence of psychosis per 1000 and the local incidence of suicide per 100 000 in six 20-year birth cohorts within each of the four historical cohorts with the corresponding national calculations.

The population

The community investigated is located in a valley in the county of Hedmark, Norway (Fig. 1). We have defined its population by applying available local genealogies and historical population censuses (6–8, 11–14). These sources contain informa-

- ▲ Gaustad hospital, established 1855
- Rotvoll hospital, established 1872
- Sanderud hospital, established 1908
- ▼ Psychiatric out-patient clinic at Tynset General Hospital, established 1986
- ▨ The county of Hedmark
- ▩ The community studied

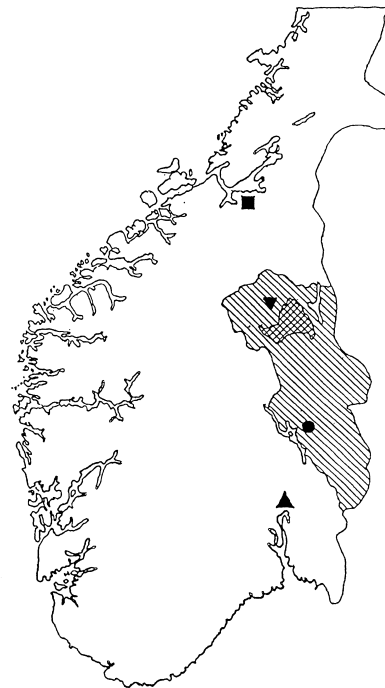


Fig. 1. A map of south-east Norway with the county of Hedmark including the community studied and the four mental health facilities.

tion about the families and households in the community. They also contain information of the year of birth and eventual death of identified persons. Their purported genetic relationships and their whereabouts are known from 1580 to 1985. We have included totally 2920 named persons in the cohort study. They were born in the community studied between 1846 and 1965. Each person had, by definition, at least one grandparent born in the community. The emigration from the community was considerable, particularly to the USA between 1879 and 1914, while the migration to the community was negligible.

The mental health institutions

The mentally ill of the community have been referred to four mental health institutions at different stages. Gaustad Hospital in Oslo served as a national institution from 1855. Rotvoll Hospital, outside Trondheim, served a more northern part of Norway from 1872. Sanderud Hospital,

near Hamar, served the county of Hedmark from 1908. The psychiatric out-patient clinic at Tynset General Hospital has served the northern part of Hedmark since 1986 (Fig. 1). We have traced and assessed 86 patient records indicating psychotic disorders at the four mental health institutions according to the inclusion criteria. They were admitted to mental hospitals for the first time between 1877 and 2005. Based on these records and the genealogies (7), we have constructed a register of severe mental disorders and intentional self-harm (18, 19) in the community. People, who were born in the community and left the county of Hedmark have been excluded as they may have been admitted to other than the four mental health institutions mentioned.

The local case registers and the historical cohorts

We have constructed case registers of hospital-treated psychosis and suicide in four well-defined historical cohorts of the local community. All these cohorts comprise persons born after 1845. The first

cohort consists of 2183 named persons born in the community before 1925 (Table 1). They have generated 22 cases of organic mental disorders between 1914 and 2005 (19). The second cohort consists of 2580 persons born in the community before 1946 (Table 3). They have generated 39 cases of schizophrenia between 1877 and 1976 (19). The third cohort consists of 2838 named persons born in the community before 1959 (Table 5). They have generated 25 cases of affective, acute and transient psychosis between 1886 and 2004 (19). And finally, the fourth cohort consists of 2920 identified persons born in the community before 1965 (Table 7). They committed fatal or near-fatal acts of intentional self-harm between 1880 and 2004 (19).

The diagnostic categories

Clinical diagnosis is a key factor, and we have relied heavily on the diagnostic judgements of the former colleagues. The first author (JEA) systematically read every patient record, and those

Table 1. Organic mental disorders – the 1846–1925 historical cohort

No.	Case id./year of first admission	Age at first adm./last discharge	No. of stays	Year of final discharge	The original hospital diagnoses at final discharge	Final ICD-10 diagnosis
01	C1/1921	62/62	1	1921	Dementia senilis	F00.0
02	C1/1924	62/67	1	1929	Dementia senilis	F00.0
03	C1/1930	69/71	1	1932	Dementia senilis	F00.1
Incidence per 1000 for the period 1846–1865: $[3/(507 \times 50.64)] \times 1000 = 0.12$						
01	C1/1914	48/55	1	1921	Vitium organie cerebri	F06.9
02	C1/1940	66/66	1	1940	Psychosis <i>ex vitio</i> cerebri	F06.9
03	C2/1967	83/83	1	1967	Psychosis senilis	F00.1
04	C1/1974	89/89	1	1974	Dementia senilis	F00.1
Incidence per 1000 for the period 1866–1885: $[4/(488 \times 52.31)] \times 1000 = 0.16$						
01	C1/1965	79/79	1	1965	Psychosis arteriosclerotica	F01.9
02	C1/1967	76/76	1	1967	Psychosis arteriosclerotica	F01.9
03	C1/1969	66/68	3	1971	Psychosis arteriosclerotica	F01.9
04	C1/1970	75/75	1	1970	Psychosis senilis	F00.1
05	C2/1970	72/72	1	1970	Psychosis arteriosclerotica	F01.9
06	C1/1971	78/79	2	1972	Psychosis arteriosclerotica	F01.9
07	C1/1972	76/78	2	1974	Psychosis senilis	F00.1
08	C1/1973	86/86	1	1973	Reactive psychosis*	F06.0*
09	C1/1985	88/88	1	1985	Psychosis cum morbo infectionis	F06.9
10	C1/1994	91/91	1	1994	Dementia in Alzheimer's disease	F00.1
Incidence per 1000 for the period 1886–1905: $[10/(577 \times 58.27)] \times 1000 = 0.30$						
01	C2/1974	61/61	1	1974	Psychosis e morbis cerebri aliis	F06.9
02	C1/1986	69/70	2	1987	Dementia senilis	F00.1
03	C1/1996	73/73	1	1996	Dementia in Alzheimer's disease	F00.1
04	C1/1999	78/78	1	1999	Vascular dementia	F01.9
05	C1/2005	80/80	1	2005	Dementia in Alzheimer's disease	F00.1
Incidence per 1000 for the period 1906–1925: $(5/608 \times 67.26) \times 1000 = 0.12$ .						
Incidence per 1000 for the entire period 1846–1925: $(22/2180 \times 59.99) \times 1000 = 0.168224$ .						

Twelve men and 10 women were diagnosed with organic mental disorders in the elderly at their final discharge. They were admitted for the first time between 1914 and 2005. They were recruited from a population of totally 2183 persons born in the community studied between 1846 and 1925. One of the diagnoses was revised (C1/1973), cf. Appendix. The mean age at first admission was 74.17 years for men and 73.7 years for women (specification of gender has been omitted in this and other tables and the vignettes due to confidentiality).

The estimated incidence is 0.17 per 1000.

\*Revised by the authors.

Table 2. A national overview of senile psychosis

Male			Female		
No. of cells	Age groups	Incidence per 100 000	No. of cells	Age groups	Incidence per 100 000
			12	36–40	0.1
01	41–45	0.1	13	41–45	0.7
02	46–50	1.9	14	46–50	3.0
03	51–55	4.7	15	51–55	8.7
04	56–60	12.3	16	56–60	16.0
05	61–65	20.3	17	61–65	27.9
06	66–70	31.8	18	66–70	34.1
07	71–75	36.7	19	71–75	33.9
08	76–80	35.4	20	76–80	30.2
09	81–85	30.0	21	81–85	29.9
10	86–90	13.6	22	86–90	25.3
11	91–95	7.5	23	91–95	8.4
Sum	41–95	194.3	Sum	41–95	219.2

Rates of senile psychosis per 100 000 according to age and gender. The patients were admitted for the first time between 1926 and 1935 and recruited from a population of 2.8 million. We have converted the original incidence figures of senile psychosis of The national case register and found an overall incidence of 0.18 per 1000. Adapted from Ødegaard (16).

Sum of incidences in males and females: 412.5

Total no. of cells: 23

$412.5/23 \Rightarrow 17.934/100 = 0.17934$

Average incidence per 1000: 0.18.

patient records with original diagnoses that were not obvious were presented for the second author (TH) for discussion. We agreed on revising nine of the 86 original diagnoses at the final discharge from the hospitals. These cases were revised according to the following main criteria: severity, lifelong observation of symptoms and similar mental disorders in close relatives (cf. Appendix with clinical vignettes). In most of the cases, we have had the possibility to observe symptoms and outcome in a lifelong perspective usually not available to our former colleagues.

The concept of organic mental disorders of this cohort study is comparable with the concept of senile psychosis of the national case register. Both concepts are covered by F00–F09 of the ICD-10 (19). The concept of schizophrenia is very similar in both studies and comparable with the concept covered by F20.0–F20.9 of the ICD-10 (19). The concept of other non-organic psychotic disorders comprise acute, transient and affective psychosis in the local birth cohort study, and are comparable with manic depression and psychosis *ex constitutione* in the national case register. These concepts are equivalent to the diagnoses F23, F30.2, F31.2, F31.5, F32.3 and F33.3 of ICD-10 (19). Two cases of serious suicide attempts were added to 17 cases of intentional self-harm. These categories are covered by X60–X84 of the ICD-10 (19). Two of the patients with a psychosis did commit suicide.

They were, consequently, registered in both categories.

The calculations of incidence

These calculations depend on mortality–life tables. Calculations of life expectancy at birth began in Norway in 1846 (20). The denominator data are ‘person–time’: the number of persons in each of the four cohorts multiplied by their respective mean values of life expectancy at birth, i.e. by the time spent in the population (21). The nominator data are made up by the number of cases in each of the four diagnostic categories in the four historical cohorts.

Formal approvals

The National Data Inspectorate, The Board of Health, and The Regional (South) Research Ethics Committee in Norway have approved the study.

## Results

The local 1846–1865 birth cohort

Approximately 507 persons were born in the community during this period. Their median life expectancy at birth was 50.64 years (20). Three of them had organic mental disorders. This generates an incidence rate of 0.12 per 1000 (Table 1). Four of them were diagnosed with schizophrenia. This gives a rate of 0.16 per 1000 (Table 3). Only one was diagnosed with other non-organic psychosis, which gives a rate of 0.04 per 1000 (Table 5). Two of the 507 committed suicide between 1880 and 1890, which generates a local rate of 7.8 per 100 000 (Table 7). The national average was 6.7 per 100 000 in the years between 1880 and 1890 (18).

The local 1866–1885 birth cohort

Approximately 488 named persons were born in the community during this period. Their median life expectancy was 52.31 years (20). Four of them were diagnosed with organic mental disorders, which gives an incidence rate of 0.16 per 1000 (Table 1). Eleven of them were diagnosed with schizophrenia, which gives a rate of 0.43 per 1000 (Table 3). Five of them were diagnosed with other non-organic psychosis, which generates an incidence rate of 0.20 per 1000 (Table 5). One of the 488 committed suicide in 1915, which gives a local rate of 3.9 per 100 000 (Table 7). The national rate was 5.9 per 100 000 in 1915 (18).

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Table 3. Schizophrenia – the 1846–1946 historical cohort

No.	Case id./year of first adm.	Age at first adm./last discharge	No. of stays	Year of final discharge	The original hospital diagnoses at final discharge	Final ICD-10 diagnosis
01	C1/1877	22/23	1	1878	Dementia	F20.9
02	C1/1878	33/42	2	1887	Dementia	F20.9
03	C1/1890	40/46	2	1896	Dementia	F20.9
04	C1/1898	42/44	1	1900	Alcoholismus chronicus*	F20.9
Incidence per 1000 for the period 1846–1865: $[4/(507 \times 50.64)] \times 1000 = 0.16$						
01	C1/1899	22/24	1	1901	Mania*	F20.9
02	C1/1905	28/31	2	1908	Dementia praecox (Catatonia)	F20.2
03	C2/1910	37/43	1	1916	Dementia paranoidis	F20.0
04	C1/1911	34/37	1	1914	Dementia praecox	F20.9
05	C1/1912	34/76	2	1955	Schizophrenia (Paranoid)	F20.0
06	C1/1915	35/37	1	1917	Dementia praecox	F20.9
07	C1/1916	34/34	2	1916	Dementia praecox	F20.9
08	C1/1917	41/57	1	1933	Paranoia*	F20.0
09	C2/1921	40/65	1	1946	Schizophrenia	F20.9
10	C3/1921	38/71	1	1954	Schizophrenia	F20.9
11	C1/1927	57/58	1	1928	Dementia paranoidis	F20.0
Incidence per 1000 for the period 1866–1885: $[11/(488 \times 52.31)] \times 1000 = 0.43$						
01	C1/1910	18/19	1	1911	Dementia praecox (Catatonia)	F20.2
02	C2/1918	24/27	1	1921	Dementia praecox (Catatonia)	F20.2
03	C1/1918	22/68	6	1964	Schizophrenia	F20.9
04	C2/1927	36/41	1	1932	Schizophrenia	F20.9
05	C1/1932	28/56	2	1960	Schizophrenia (Paranoid form)	F20.0
06	C1/1933	32/73	1	1974	Schizophrenia	F20.9
07	C1/1952	64/73	1	1963	Schizophrenia (Hebephrenia)	F20.1
08	C2/1952	54/64	2	1962	Schizophrenia (Paranoid form)	F20.0
Incidence per 1000 for the period 1886–1905: $[8/(577 \times 58.27)] \times 1000 = 0.24$						
01	C3/1952	34/43	2	1961	Schizophrenia	F20.9
02	C1/1954	46/64	2	1972	Schizophrenia	F20.9
03	C1/1959	53/63	3	1969	Schizophrenia (Paranoid form)	F20.0
04	C1/1960	54/57	4	1963	Schizophrenia (Paranoid form)	F20.0
05	C1/1962	54/66	2	1974	Schizophrenia (Paranoid form)	F20.0
06	C2/1962	50/55	2	1965	Schizophrenia	F20.9
07	C1/1964	49/68	2	1983	Psychosis paranoides*	F20.0
08	C2/1964	41/68	6	1991	Psychosis manio-depressiva*	F20.9
09	C3/1970	59/78	2	1989	Schizophrenia (Paranoid form)	F20.0
Incidence per 1000 for the period 1906–1925: $[9/(608 \times 67.26)] \times 1000 = 0.22$						
01	C1/1944	14/14	1	1944	Schizophrenia	F20.9
02	C2/1960	26/28	3	1962	Schizophrenia	F20.9
03	C1/1963	19/20	4	1964	Psychosis schizo-affectiva*	F20.9
04	C2/1969	27/49	6	1991	Schizophrenia (Paranoid form)	F20.0
05	C2/1973	40/49	3	1982	Exitatio reactiva*	F20.9
06	C1/1976	33/61	32	2004	Schizophrenia (Paranoid form)	F20.0
Incidence per 1000 for the period 1926–1945: $[6/(377 \times 72.34)] \times 1000 = 0.22$						
01	C2/1972	26/45	9	1991	Schizophrenia	F20.9
Incidence per 1000 for the period 1946–1965: $[1/(363 \times 75.29)] \times 1000 = 0.04$ .						
Incidence per 1000 for the entire period 1846–1946: $[39/(2580 \times 61.85)] \times 1000 = 0.24440$ .						

Twenty-three men and 16 women in the historical cohort were diagnosed with schizophrenia at their final discharge (or after a revision). These patients were admitted for the first time between 1877 and 1976. Seven of their diagnoses at last discharge were revised. The patients were recruited from a population of 2580 born in the community studied between 1846 and 1946. The mean age at first admission in this category was 38.7 years for men and 34.4 years for women.

The estimated incidence per 1000 is 0.24.

\*Revised by the authors.

### The local 1886–1905 birth cohort

Approximately 577 persons were born in the community during this period. Their median life expectancy was 58.27 years (20). Ten of them were diagnosed with organic mental disorders, which yields an incidence rate of 0.30 per 1000 (Table 1). Eight of them were diagnosed with schizophrenia, which gives a rate of 0.24 per 1000 (Table 3). Four of them were diagnosed with other non-organic

psychosis, which gives a rate of 0.12 per 1000 (Table 5). One of the 577 committed suicide in 1940, which gives a local incidence rate of 3.0 per 100 000 (Table 7). The national rate was 7.1 per 100 000 in 1940 (18).

### The local 1906–1925 birth cohort

Approximately 608 persons were born in the community during the period. Their median life



Table 4. A national overview of schizophrenia

Male			Female		
No. of cells	Age of onset	Incid-ence per 100 000	No. of cells	Age of onset	Incidence per 100 000
01	10–11	1.1	16	10–11	1.4
02	12–14	8.3	17	12–14	6.8
03	15–17	31.2	18	15–17	22.9
04	18–20	54.2	19	18–20	40.1
05	21–25	73.6	20	21–25	47.3
06	26–30	70.0	21	26–30	52.7
07	31–35	50.5	22	31–35	48.6
08	36–40	35.3	23	36–40	41.6
09	41–45	22.5	24	41–45	34.5
10	46–50	17.0	25	46–50	29.9
11	51–55	11.9	26	51–55	15.6
12	56–60	5.5	27	56–60	9.0
13	61–65	3.3	28	61–65	5.1
14	66–70	2.0	29	66–70	1.4
15	71–75	0.2	30	71–75	1.7
	76–80		31	76–80	0.3
Sum		386.6	Sum		358.9

Rates of schizophrenia per 100 000 according to age and gender. The patients were admitted for the first time between 1926 and 1935 and recruited from a population of 2.8 million. We have converted the original incidence figures of the national case register and found an overall incidence of 0.24 per 1000. Adapted from Ødegaard (16).

Sum of incidences in males and females: 745.5.

Total number of cells: 31.

$745.5/31 \Rightarrow 24.048/100 = 0.24048$ .

Average incidence per 1000: 0.24.

expectancy was 67.26 years (20). Five of them were diagnosed with organic mental disorders, which gives a rate of 0.12 per 1000 (Table 1). Nine of them were diagnosed with schizophrenia, which yields a rate of 0.22 per 1000 (Table 3). Another five were diagnosed with other non-organic psychosis, which generates an incidence rate of 0.12 per 1000 (Table 5). Six of them committed suicide between 1936 and 1989, which gives a local rate of 14.7 per 100 000 (Table 7). The national average was 8.8 per 100 000 in the years between 1936 and 1989 (18).

#### The local 1926–1945 birth cohort

Approximately 377 persons were born in the community during the period. Their median life expectancy was 72.34 years (20). None of them was diagnosed with organic mental disorders. Six of them had schizophrenia, which generates a rate of 0.22 per 1000 (Table 3). Five of them were diagnosed with other non-organic psychosis, which yields a rate of 0.18 per 1000 (Table 5). Four of them committed suicide between 1964 and 1993, which also gives a local rate of 14.7 per 100 000 (Table 7). The national average was 13.1 per 100 000 in the years between 1964 and 1994 (18, 22).

#### The local 1946–1965 birth cohort

Approximately 363 identified persons were born in the community during the period. Their median life expectancy was 75.29 years (20). None of them were diagnosed with organic mental disorders. Only one of them was diagnosed with schizophrenia. This gives a rate of 0.04 per 1000 (Table 3). Five of them were diagnosed with other non-organic psychosis, which also gives an incidence rate of 0.18 per 1000 (Table 5). Three of them committed suicide and two made serious suicide attempts expecting death between 1970 and 2004. These five cases result in a rate of 18.3 per 100 000 (Table 7). The national average was 12.6 per 100 000 in the years between 1970 and 2004 (18, 22).

#### The total local historical cohort

Approximately 2183 persons were born in the community between 1846 and 1925. Their median life expectancy was 59.99 years (20). Twenty-two of them were diagnosed with organic mental disorders, which gives a rate of 0.17 per 1000 (Table 1). Approximately 2580 named persons were born in the community between 1846 and 1946. Their median life expectancy was 61.85 years (20). Thirty-nine of them were diagnosed with schizophrenia. This gives a rate of 0.24 per 1000 (Table 3). Approximately 2838 persons were born between 1846 and 1959. Their median life expectancy was 62.56 years (20). Twenty-five of them were diagnosed with other non-organic psychosis, which gives an incidence rate of 0.14 per 1000 (Table 5). Approximately 2920 identified persons were born between 1846 and 1965. Their median life expectancy was 62.66 years (20). Seventeen committed suicide and two made serious suicide attempts between 1880 and 2004. These 17 cases result in a rate of 9.3 per 100 000 (Table 7). The national average was 8.2 per 100 000 in the years between 1880 and 2004 (18, 22).

#### The national case register of psychosis in Norway: 1926–1935

The entire population of Norway was 2.8 million in 1930. Approximately 14 231 mentally ill were admitted to mental hospitals between 1926 and 1935 according to the cumulative national case register (16, 17). The national incidence of organic mental disorders or senile psychosis was 0.18 per 1000 (Table 2). The national incidence of schizophrenia was 0.24 per 1000 (Table 4). The national incidence of other non-organic psychosis or manic depression and psychosis *ex constitutione* was 0.13 per 1000 (Table 6).

Table 5. Other non-organic psychosis – the 1846–1959 historical cohort

No.	Case id./year of first admission	Age at first adm./last discharge	No. of stays	Year of final discharge	The original hospital diagnoses at final discharge	Final ICD-10 diagnosis
01	C2/1911	62/62	1	1911	Melancholia	F32.3
Incidence per 1000 for the period 1846–1865: $[1/(507 \times 50.64)] \times 1000 = 0.04$						
01	C1/1886	19/19	1	1886	Mania	F30.9
02	C1/1900	32/32	1	1900	Melancholia	F32.3
03	C1/1903	32/32	1	1903	Melancholia	F32.3
04	C4/1921	46/46	1	1921	Amentia	F23.9
05	C1/1938	64/65	1	1939	Psychosis manio-melancholica	F32.3
Incidence per 1000 for the period 1866–1885: $[5/(488 \times 52.31)] \times 1000 = 0.20$						
01	C2/1912	16/16	1	1912	Melancholia	F32.3
02	C1/1955	50/55	3	1960	Psychosis <i>ex constitutione</i>	F23.9
03	C2/1963	71/73	2	1965	Neurosis depressiva*	F33.3
04	C3/1963	70/70	1	1963	Melancholia involutiva	F32.3
Incidence per 1000 for the period 1886–1905: $[4/(577 \times 58.27)] \times 1000 = 0.12$						
01	C1/1948	33/59	6	1974	Psychosis <i>ex constitutione</i>	F23.9
02	C2/1954	46/46	1	1954	Psychosis <i>ex constitutione</i>	F23.9
03	C3/1960	44/72	5	1988	Psychosis reactiva depressive	F33.3
04	C1/1968	61/61	1	1968	Psychosis reactiva depressive	F32.3
05	C1/1990	83/83	1	1990	Psychosis reactiva depressive	F32.3
Incidence per 1000 for the period 1906–1925: $[5/(608 \times 67.26)] \times 1000 = 0.12$						
01	C1/1958	38/38	1	1958	Psychosis <i>ex constitutione</i>	F23.9
02	C2/1959	18/18	1	1959	Psychosis <i>ex constitutione</i>	F23.9
03	C3/1964	30/30	2	1964	Psychosis paranoids	F23.9
04	C2/1990	51/53	3	1992	Bipolar affective disorder	F31.7
05	C1/1993	49/49	1	1993	Bipolar affective disorder	F31.5
Incidence per 1000 for the period 1926–1945: $[5/(377 \times 72.34)] \times 1000 = 0.18$						
01	C4/1964	18/23	3	1969	Psychosis <i>ex constitutione</i>	F23.9
02	C1/1988	29/39	3	1998	Bipolar affective disorder	F31.5
03	C1/1992	36/43	4	1999	Bipolar affective disorder	F31.7
04	C1/1997	40/40	1	1997	Acute paranoid psychosis	F23.9
05	C1/2004	51/51	1	2004	Depressive episode with psychosis	F32.3
Incidence per 1000 for the period 1946–1965: $[5/(363 \times 75.29)] \times 1000 = 0.18$ .						
Incidence per 1000 for the entire period: $[25/(2838 \times 62.56)] \times 1000 = 0.140807$ .						

Ten men and 14 women were diagnosed with other non-organic psychotic disorders at their final discharge. One case was revised. They were admitted for the first time between 1886 and 2004. They were recruited from a population of 2838 born in the community studied between 1846 and 1959. The mean age at first admission in this category was 51.4 years for men and 44.3 years for women.

The estimated incidence is 0.14 per 1000.

\*Revised by the authors.

## Discussion

Constructed case registers of hospital-treated psychosis and suicide have been linked to the population development of a well-defined historical cohort of this particular rural community. The cumulative nature of historical case registers, the coverage of a well-defined population and the possibility for record linkage to other registers make them an effective tool for epidemiological research (23). The parochial nature of the population with few cases in each diagnostic category could be said to be a serious limitation of the study, especially as there already exist huge epidemiological studies in this field (24). However, these studies are generally cross-sectional, i.e. they lack personal continuity and a historical perspective. We have chosen a longitudinal and multigenerational approach to a limited population which is

effective for the study of developmental processes as it tracks changes over time. The longitudinal approach allows us to define the populations precisely and to construct continuous case registers. The design of the study in combination with the accessible sources has brought this study to what we have reasons to believe is a (nearly) complete coverage of cases of hospital-treated psychosis, since the dawn of hospital treatment era in Norway (Tables 1, 3 and 5). The suicide registrations in this study meet general problems in all suicide research, namely in finding the distinction between suicide and accidental death.

Concerning the question of completeness and clinical information of cases, we have considered several relevant factors. Due to travelling distances and admission policy (16), it was unlikely that the mentally ill persons in the population studied would have used any other hospitals (than Gaus-

Table 6. A national overview of manic depressions and psychosis *ex constitutione*

Manic depression						Psychosis <i>ex constitutione</i>					
Male			Female			Male			Female		
No. of cells	Age at onset	Incidence per 100 000	No. of cells	Age at onset	Incidence per 100 000	No. of cells	Age at onset	Incidence per 100 000	No. of cells	Age at onset	Incidence per 100 000
01	10–11	0.2	17	10–11	0.4	01	10–11	0.5	16	10–11	0.8
02	12–14	0.9	18	12–14	1.9	02	12–14	1.0	17	12–14	1.1
03	15–17	3.4	19	15–17	5.4	03	15–17	1.8	18	15–17	4.0
04	18–20	6.3	20	18–20	8.6	04	18–20	2.8	19	18–20	6.1
05	21–25	7.8	21	21–25	10.6	05	21–25	4.9	20	21–25	8.4
06	26–30	8.4	22	26–30	13.0	06	26–30	5.9	21	26–30	7.9
07	31–35	8.1	23	31–35	13.1	07	31–35	6.0	22	31–35	7.8
08	36–40	9.5	24	36–40	14.5	08	36–40	6.8	23	36–40	10.4
09	41–45	9.2	25	41–45	15.3	09	41–45	7.1	24	41–45	10.9
10	46–50	13.5	26	46–50	18.4	10	46–50	6.4	25	46–50	10.5
11	51–55	12.6	27	51–55	21.2	11	51–55	5.4	26	51–55	8.1
12	56–60	11.8	28	56–60	14.4	12	56–60	5.4	27	56–60	4.5
13	61–65	9.9	29	61–65	9.5	13	61–65	3.5	28	61–65	1.8
14	66–70	4.6	30	66–70	4.6	14	66–70	1.8	29	66–70	0.3
15	71–75	1.1	31	71–75	3.1	15	71–75	0.1	30	71–75	0.5
16	76–80	0.2		76–80			76–80			76–80	
Sum		107.5	Sum		154.0	Sum		62.2	Sum		83.1

Sum of incidences in males and females:  
 107.5 + 154 = 261.5  
 Total no. of cells: 31  
 261.5/31⇒8.435/100 = 0.08435

Sum of incidences in males and females:  
 62.2 + 83.1 = 145.3  
 Total no. of cells: 30  
 145.3/30⇒4.843/100 = 0.04843

Rates of manic depression and psychosis *ex constitutione* per 100 000 are arranged according to age and gender. The patients were admitted for the first time between 1926 and 1935 and recruited from a population of 2.8 million. We have converted the original incidence figures of the national case register and found an overall incidence of 0.13 per 1000. Adapted from Ødegaard (16). Average incidence per 1000 of manic depression and psychosis *ex constitutione*: 0.08435 + 0.04843 = 0.13278 = 0.13.

tad, Rotvold and Sanderud; Fig. 1). The patients have consistently been registered with the date of first admission, their age and place of birth, historical and current diagnoses (Fig. 2).

Most of the diagnostic terms of psychosis are straightforward and easily understood, but a few of the older terms are not. The term dementia (Table 3; Fig. 2) includes cognitive failure, chronic behavioural disturbance and psychosocial incompetence occurring at any age. The term amentia (Table 5) designates acute psychotic states accompanied by confusion (25). Psychosis *ex constitutione* is supposed to consist of reactive psychosis of depressive, paranoid or hysterical form, and is also supposed to include the small group of paranoia. But, in practice, a number of cases are put in this group mainly because a choice between schizophrenia and manic depressive psychosis is considered too difficult. So this group may, somehow, be said to help make the other groups more clear-cut (16).

Twenty-two cases of organic mental disorders were recruited from the 2180 persons born in the community between 1846 and 1925 (Table 1). Thirty-nine cases of schizophrenia were recruited from the 2580 persons born between 1846 and 1946 (Table 3). Twenty-five cases of other non-organic psychosis were recruited from the 2838 named

persons born between 1846 and 1959 (Table 5). We have also constructed a local register of intentional self-harm with fatal or near-fatal outcome of the identified persons in the cohort (Table 7). This case register is based on historical commentaries attached to written genealogy (7), a historical study on the community (26), and clinical information in patient records at the local psychiatric out-patient clinic at Tynset General Hospital between 1986 and 2005. The various sources have given consistent information.

The 19 cases of intentional self-harm with fatal or near-fatal outcome were found amongst the 2920 identified individuals born in the community between 1846 and 1965. These acts of self-harm took place between 1880 and 2004 (Table 7).

The incidence rates have been calculated by dividing the number of individual disease onsets in each diagnostic category by their respective person-times at risk, i.e. the product of the populations and the periods at risk (21). To estimate periods at risk, we made use of the national mortality-life tables (20). The estimated incidence rates per 1000 of organic mental disorders, schizophrenia and other non-organic psychotic disorders (Tables 1, 3 and 5) have been compared with the rates of senile psychosis,



Table 7. Intentional self-harm with fatal or near-fatal outcome – the 1846–1965 historical cohort

No.	Case id./year of self-harm	Age at self-harm	ICD-10 codes	Outcome	Sources
01	C1/1880	33	X70	Fatal	Nygaard (26)
02	C2/1890	39	X70	Fatal	Nygaard (26)
X60–X84: $[2/(507 \times 50.64)] \times 100\,000 = 7.8$ X60–X84: The average national suicide rate per 100 000 was 6.7					
03	C2/1915	39	X84	Fatal	Bull (7)
X60–X84: $[1/(488 \times 52.31)] \times 100\,000 = 3.9$ X60–X84: The national suicide rate per 100 000 of 1915 was 5.9					
04	C2/1940	44	X70	Fatal	Patient record of relatives
X60–X84: $[1/(577 \times 58.27)] \times 100\,000 = 3.0$ X60–X84: The national suicide rate per 100 000 of 1940 was 7.1					
05	C1/1936	29	X69	Fatal	Patient record of relatives
06	C1/1939	30	X70	Fatal	Patient record of relatives
07	C2/1948	41	X70	Fatal	Patient record of relatives
08	C3/1969	63	X71	Fatal	Patient record of relative
09	C2/1988	78	X73	Fatal	Our patient record
10	C1/1989	73	X61	Fatal	Our patient record
X60–X84: $[6/(608 \times 67.26)] \times 100.00 = 14.7$ X60–X84: The average national suicide rate per 100 000 was 8.8					
11	C6/1964	20	X61	Fatal	Patient record of relatives
12	C1/1978	48	X84	Fatal	Patient record of relatives
13	C2/1978	46	X72	Fatal	Patient record of relatives
14	C2/1993	48	X71	Fatal	Patient record of relatives
X60–X84: $[4/(377 \times 72.34)] \times 100\,000 = 14.7$ X60–X84: The average national suicide rate per 100 000 was 13.1					
15	C4/1970	17	X61	Fatal	Patient record of relatives
16	C1/2001	47	X82	Fatal	Our patient record
17	C1/2003	39	X70	Fatal	Patient record of relatives
18	C2/1996	31	X74	Near-fatal	Our patient record
19	C2/2004	47	X70	Near-fatal	Our patient record
X60–X84: $[5/(363 \times 75.29)] \times 100\,000 = 18.3$ X60–X84: The average national suicide rate per 100 000 was 12.6 X60–X84: $[19/(2920 \times 62.66)] \times 100\,000 = 10.4$					

There were 11 men and six women of intentional self-harm (X60–X84) in six 20-year subintervals of the cohort. Local incidence of intentional self-harm was per 9.3 per 100 000. The national average of suicide was 8.3 per 100 000.

schizophrenia, psychosis *ex constitutione* and manic depression in the national case register (Tables 2, 4 and 6). Likewise, national suicide rates have been compared with local rates of severe self-harm with fatal or near-fatal outcome (Table 7). Finally, national and local rates of severe mental disorders have been compared with each other (Table 8).

The psychiatrist and epidemiologist Ørnulf Ødegaard (1901–1986) has performed a pioneering comprehensive case register study of the hospital-treated psychosis of the entire population of Norway (16). Ødegaard avoided the use of mortality–life tables when calculating the incidence of psychosis. Totally, 14 231 disease onsets were reported to the national case register of psychosis between 1926 and 1935 (16, 17). These cases were divided by the population of Norway, which was 2.8 million in 1930 (16). Ødegaard presented his findings in several diagnostic categories per 100 000 for age-stratified groups of both genders. We have converted his findings by summing up all incidence estimates in each diagnostic category.

This sum was first divided by the number of cells in each table and then by 100 (Tables 2, 4 and 6).

Concerning the diagnostics, generations of Norwegian mental hospital psychiatrists have had a homogenous educational background and seem to have perceived psychotic disorders in much the same way. Differentiation of cases into the three large categories of hospital-treated psychosis, as defined in this study, appears to have been the same in both our local multigenerational and the national case register. We think there are good reasons to believe that our collection of cases of hospital-treated psychosis is nearly complete, i.e. the national case register (16) of psychosis was close to complete in the years between 1926 and 1935. Clinical and epidemiological hospital psychiatry in Norway during these years had an academic medical approach. The register of psychosis was regarded as an important innovation, and there was a culture of conscientiously sending reports to that register before World War II. Later on, the register fell into decay and was closed, due to the political climate of the 1980s.

Løbe.No.	NAVN.	Alder.	Silling og Leveet.	Gift, ugift, Enke eller Enkemand.	Fødested.	Hopæl.	Forsørgelses-hjem.	Har den Syge været optaget i Asylet og hvorlænge.
650.	Ole	21 år	Gårdmand.	Ugift	Rendalen.			

*Prædium, 9<sup>de</sup> marts 1877.*

Plan er søn af gårdmandspæle i g. 12 hær. Ingen sindslidelse i slægten. Som barn led han af en flux af langvarige brænder, men var for øvrigt frisk og udviklede sig normalt og ville sig fin på skole, da han havde led for sig indtil årsarsagen, da han begyndte at miste, at han havde været for et lusee om tidligere. Han har altid været adroget og ordentlig. Som en 4-5 år siden ledte om viden-blev han pludseligt syg på en søndag, meget uret at gå og fælde i sammenhengende, men klagede ikke over noget særligt ondt og kom sig til efter en aarsbehandling i løbet af et par dage. Da var han frisk indtil for 3 uger siden, da han led af en oplyst og samlet under fri vilkårlig, hovedpine og søvnløshed, hvilket var kom- efter at han var bleven forstøret i en efter en i mængde af en optant i d- hallukinationer, hvorved han så gode og onde indre vinder om sig og vilde sig lommelig, uret og forværet, hvilket indte nogen uretten var de hele vinteren. Han var derpå bra til julstiden i fjor vinter, da han fik et u- uret sygdomsanfald, der under remission og ubestemte tider varde til april. Næstfølgende angreb begyndte i lidende skibleden og var essentiel, givet sig på samme måde som de tidligere med søvnløshed, trist og mørk, lidet over stemning, indestillet og hallukinationer, her for- led i løften og gjort friske gæster som om han havde nogen for sig. Han havde ingen behandling andet end beroliget, men blev i forbered efter brugen af kloral.

19. Status præens. Plan er stor og velbygget af osset for sin alder, med god holdning og i midte hær. Størstedt veltrænet med rogt, blondt hær. Ansigtet er med lette pudske og et gjendimuligt forveget der sigende blid. Ansigtet i sig selv meget ledt og ritt- ofte i høj grad, færdene og lidet karaktere sigende. Sænkene gode. Ellipse sig. Mel- ligen god. Rødtmættede i ører. Hjertet langsmalt meget forveget, ligesom timet stene og dunge, lidet anslønde sig. Lungene og indre organer med sigende at påvise. Venstre ledet færdigt strøfærdt efter en- anslønt trænisk- orkit; fjernes af hjertet og kendes som en essentiale sigende. Plan bruger sig på det bestemte negansinte at have længere sig til selvbestemt.

Han begyndte allerede gå lidet om at føle sig lidet, lide over og store berde. Siden ind- braden har han opværet sig i Udførelse, her har han opværet sig ordentlig, med frigid og arbejdsom. Han klager sig frem over nogen færd og lidet

Fig. 2. A facsimile of the oldest patient record included, dated 9 March 1877.

Table 8. Rates of organic mental disorders, schizophrenia and other non-organic psychosis per 1000 in Norway (1926–1935) and in the various historical cohorts of the community studied

Location	Population	1846–1865	1866–1885	1886–1905	1906–1925	1926–1945	1946–1965	1846–1965	1926–1935
Norway (16)	2 800 000								
F00–F09									0.18
F20									0.24
F23, F30–F33									0.13
X60–X84/1880–2004									8.3
The local community									
F00–F09	2.183	0.12	0.16	0.30	0.12	0.00	0.00	0.17	
F20	2.580	0.16	0.43	0.24	0.22	0.22	0.04	0.24	
F23, F30–F33	2.838	0.04	0.20	0.12	0.12	0.18	0.18	0.14	
X60–X84/1880–2004	2.920	7.8	3.9	3.0	14.7	14.7	18.3	9.3	

Rate of suicide or intentional self-harm per 100 000 in Norway and in the community studied between 1880 and 2004. The diagnoses are categorized according to the ICD-10 (19).

The rates of psychosis and suicide in the total historical cohort have been compared with those of the entire country (Tables 1–7). Studies of psychiatric epidemiology of rural Scandinavia (1–5) are considered sensitive and reliable, but their representativeness has been questioned (23). This is particularly true of studies carried out in small communities with highly frequent endogamy (5, 7). We have compared the incidence rates of our cumulative registrations of hospital-treated psychosis for the total local historical cohort (Tables 1, 3 and 5) with the incidence rates of the corresponding diagnoses of the nationwide case register (Tables 2, 4 and 6) kept between 1926 and 1935. The nationwide case register study (16) and the small, local, extensive historical cohort study represent two different methods of estimating the incidence rates of psychotic disorders and suicides. Their periods and populations at risk differ rather immensely. Yet, the outcomes of the two studies are quite similar (Tables 1–8), which should be of interest also from a genetic point of view, considering the frequency of consanguinity in the local community. The incidence rates of hospital-treated psychosis and suicide in the small population studied seem to be representative for Norway at large in the long term. Known and substantial endogamy does not seem to have had impact on the overall incidence rates of psychotic disorders and intentional self-harm.

We have arranged the patients according to their year of birth and first admissions in six 20-year birth cohorts (Tables 1, 3, 5, 7 and 8). The gender of the patients is shown in the tables. The rate of schizophrenia dropped to 0.04 per 1000 in the last 20-year birth cohort (Table 3). A similar drop in the last subinterval is not observed in the other diagnostic categories (Tables 1, 5 and 7) of the historical cohort. The drop in incidence rates of schizophrenia is in accordance with international hypotheses, indications and findings (27–35). The last onset of schizophrenia occurred in 1976 (Table 3), while the last onset of other non-organic psychosis occurred in 2004 (Table 5), the last onset of organic mental disorders occurred in 2005 (Table 1) and the last suicide occurred in 2003 (Table 7). We cannot explain this drop by migration and social class. As recent migration to the community was negligible, and migrants were excluded, we may say that the persons in the cohorts descend from the named persons in the local census of 1665. The rural population of the small, well-defined historical cohort has been fairly uniform throughout the study. There have not been substantial changes in legislation, admission policy and treatment philosophy for

most of the duration of this study. Under such relatively stable circumstances, it is believed that people with psychosis in different periods have approximately equal chances of being admitted to mental hospitals (23). The drop in the incidence of schizophrenia in the 1946–1965 subinterval can not be explained by faulty classification at first discharge (36). The patients were diagnosed at final discharge or from long-term stays in hospitals. The drop is in contrast to the fairly stable incidence rates of other hospital-treated psychosis in most of the subintervals (Tables 1, 3 and 5), with the exception of one patient receiving the diagnosis of other non-organic psychosis in the first subinterval. Patient C2/1911 was the only one to be admitted in this category (Table 5). This indicates that patients with brief, acute, transient or affective psychosis in the first 20-year subinterval were less likely to be admitted to mental hospitals than the more severe cases of organic mental disorders in elderly, and schizophrenia, which both involve cognitive disturbances and chronic courses (Tables 1 and 3).

The drop in the incidence of schizophrenia in the last subinterval cannot be explained by a population decrease in the historical cohort (Tables 5, 7 and 8). The population declined starting in the 1920s, probably due to decreased fecundity and increased emigration, or a combination of both. There were minute differences in the populations and the periods at risk in the fifth and sixth birth cohorts. Yet, the incidence of schizophrenia dropped from 0.22 to 0.04 per 1000 from the fifth to the sixth birth cohort (Table 3). A similar drop was not seen in cases of other non-organic psychosis and suicide (Tables 5 and 7). Decreased fecundity and increased emigration can therefore hardly explain the drop in the incidence of schizophrenia in the last subinterval.

As this is an incidence study of patient admissions to mental health hospitals, we have also considered whether a drop in the incidence of schizophrenia is due to changes in primary care and mental health services that keep patients in the community and reduces the number of admissions. All cases of hospital treated psychosis were canalized through the psychiatric out-patient clinic on their way to primary care and local mental health services. No additional cases of schizophrenia were detected.

The contemporary incidence of schizophrenia may be interpreted to be in decline in the industrialized world, although this is a controversial issue. A real decline would be pointing to the potential important role of the environment.

Recent explanations deriving from an improved economy and related improvements in health such as prenatal nutrition, maternal immunization and infection control, have been discussed as explanations (35). And one gene–environment model, which could contribute to the explanation of variability, may come from the currently growing field of epigenetics (37).

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## Appendix

### Nine clinical vignettes

1. C1/1973 of Table 1 was an 86-year-old patient, who became acutely psychotic after a cataract operation. This patient recovered after a short stay in a mental hospital. The diagnosis was changed from psychosis reactiva to organic hallucinosis (black-patch syndrome), i.e. F06.0 (19), which should be more in accordance with common diagnostic inferences of this phenomenon of a person at this age.
2. C1/1898 of Table 3 was a 42-year-old patient, who was admitted to a mental hospital with delusions of grandeur and persecution, and with periods of excitement and negativism. One of his siblings was treated for schizophrenia. The patient was described as cataleptic, hallucinated and was suspected of drinking before a final transference to a private nursing home after a couple of years in hospital. The patient stayed there for 30 years until the age of 72 years. We have changed the original (primary) diagnosis of alcoholismus chronicus to unspecified schizophrenia, i.e. F20.9 (19) due to the symptoms and lifelong observations.
3. C1/1899 of Table 3 was a 24-year-old unmarried patient, who was admitted to a mental hospital with confusion, auditory and visual hallucinations, excitement and pressure of speech with a lot of gestures alternating with rigid mutism. The patient had two siblings diagnosed with schizophrenia. The patient stayed in hospital for 2 years and was transferred to private custody, where we lost track of him. We have changed the original diagnosis of mania to catatonic schizophrenia, i.e. F20.2 (19). The diagnosis has been changed due to the severity of his symptoms and course of his illness: He stayed in hospital for 2 years without improvement before he was transferred to private custody.
4. C1/1917 of Table 3 was a 41-year-old local farmer, who was admitted to a mental hospital with delusions of grandeur and auditory hallucinations. The condition never improved. The patient stayed in hospital until death at age 57 years. The diagnosis has been changed from paranoia to paranoid schizophrenia, i.e. F20.0 (19).
5. C1/1963 of Table 3 was a pupil, who was admitted to a mental hospital with religious delusions, aggressive behaviour, excitement, hallucinations, inappropriate speech and bizarre postures. We have changed the original diagnosis of this patient from schizo-affective psychosis to catatonic schizophrenia, F20.2 (19). The patient committed suicide later on. The diagnosis has been changed due to the severity of the symptom descriptions.
6. C1/1964 of Table 3 was a middle-aged unmarried man, who was hospitalised after the onset of a paranoid psychosis. On a subsequent admission his condition was virtually unchanged. We have modified the diagnosis from paranoid psychosis to paranoid schizophrenia, i.e. F20.0 (19).
7. C2/1964 of Table 3 was around 70 years old, unmarried patient, who was admitted to a mental hospital for the sixth and last time when his diagnosis was changed from schizophrenia to psychosis manio-depressiva. The patient had been diagnosed with schizophrenia on all previous stays and had been unable to work for a number of years. The patient had delusions and hallucinations and remained disabled and psychotic until death occurred. Several relatives have had schizophrenia. The patient's diagnosis has been changed back to unspecified schizophrenia, i.e. F20.9 (19) due to the lifelong observation of a chronic course.
8. C2/1973 of Table 3 was a middle-aged unmarried patient, who was admitted to a mental hospital for the third time after clozapin medication was discontinued. The patient had been diagnosed with schizophrenia after the two previous stays. The mental condition improved when the clozapin was reinstated while in hospital. Clozapin is reserved, in



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practice, for the treatment of schizophrenia in Norway. The diagnosis of *exitativa reactiva* has been changed back to unspecified schizophrenia, i.e. F20.9 (19).

9. C2/1963 of Table 5 was an 80-year-old patient, who was admitted for the second

time. This patient was diagnosed with *neurosis depressiva* at his final discharge. At a previous stay, the patient was diagnosed with *confusio reactiva*. The diagnosis has been changed to recurrent depressions with psychosis, i.e. F33.3 (19), due to an earlier episode of psychosis.