Health Inequalities in Outpatient Neurology across Greater Manchester, UK: a Retrospective Observational Study using Automated Coding.

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Introduction

- In the UK, structured recording of outpatient data is not mandatory. Rich data is therefore missed.
- Outpatient (OP) clinic letters are typically written in unstructured (free text) or semi-structured formats (headers with free text).
- The Manchester Centre for Clinical Neurosciences (MCCN) provides neurological services for the Greater Manchester (GM) population (3.3 million people), with 13 district general hospitals.
- We aimed to:
  1. Develop an automated pipeline to extract neurological diagnoses from semi-structured electronic OP neurology letters;
  2. Map these to broader diagnostic categories;
  3. Link diagnoses with sociodemographic data.;
  4. Analyse data for inequalities in healthcare access by age, sex, ethnicity, deprivation, and geography.

Methods

- All patients who attended neurology OP clinics between 01/01/2018 to 01/11/2024 were identified using specific clinic codes.
- Data was extracted as in Figure 1 and results were mapped to broader diagnostic categories.[2]
- Validation was performed on 7 clinics over June 2024. Adult population data was from 2019 UK census data.

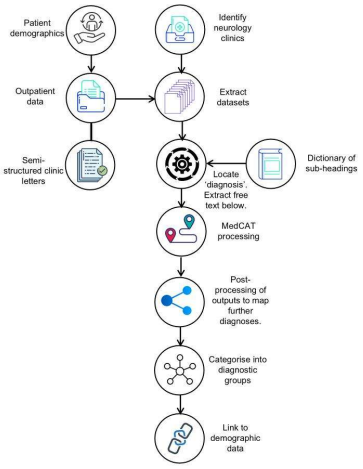

Figure 1. Automated Pipeline developed by the Northern Care Alliance (NCA). MedCAT,[1] an extraction and linkage system of free-text diagnoses to Systematic Nomenclature of Medicine Clinical Terms (SNOMED-CT), was used.

- Rate ratios (RRs) were calculated using a negative binomial regression model adjusted for age, sex and area. Odds ratios were used for binary outcomes. Age standardised rate ratios adjusted for age and sex.
- The index of multiple deprivation (IMD) quintiles is a composite score showing how deprived an area is.

Results

- A total of 105,936 patients were included in the final dataset. No diagnosis was mapped in 7,357 (6·95%) patients. From the remaining 98,579 patients, a total of 137,173 neurological diagnoses were coded (Table 1).
- Validation of the automated pipeline gave precision of 90·6% and recall of 90·0%.
- Headaches (17.0%) were the top diagnosis in clinic, followed by epilepsy/seizures (15.1%) and movement disorders (10.5%) (Table 1).

Diagnosis Category	N	%
Headache	23,263	17.0%
Epilepsy/seizure	20,724	15·1%
Movement disorder	14,347	10·5%
Neuromuscular disorder	13,679	10.0%
Functional/psychological disorder	13,648	10.0%
Suspected neurological diagnosis*	9,514	6·9%
Demyelination/inflammation	6,454	4·7%
Spinal degenerative disease	5,462	4.0%
Non-neurological disorder	3,313	2·4%
No definite neurological diagnosis made	489	0·4%
Other	26,280	19·2%
Total	137,173	

Table 1. Clinic Diagnoses by Category.

- Conditions such as headache, epilepsy and functional neurological disorders (FND) were seen more frequently in younger adults (median age 45) (Table 2).
- The neurology clinic was over-represented by White ethnicity patients, compared to the population proportions (n=78,400, 88.7% vs 81.3%, p<0.0001).
- Black, Mixed and Asian were seen less frequently in clinic compared to the local population (Figure 2).
- There was a significant amount of missing data for ethnicity (n=17, 523, 16.5%), affecting reliable analysis.

	Headache	Epilepsy/ Seizure	Movement Disorder	Neuromuscular Disorder	Functional/ Psychological Disorder	Demyelination/ Inflammation
Age (years) Median (LQR-UQR)	44 (33-57)	46 (31-61)	69 (58-77)	61 (48-73)	45 (33-57)	53 (41-64)
Ethnicity (%(n))						
White	68·3 (15,894)	75·0 (15,549)	78·1 (11,209)	79·4 (10,854)	75·1 (10,255)	84·7 (5,464)
Unknown	19·9 (4,634)	15·8 (3,263)	14·6 (2,092)	11·8 (1,612)	16·3 (2,221)	5·6 (363)
Asian	6·7 (1,560)	5·1 (1,050)	4·6 (660)	4·9 (674)	4·4 (602)	4·9 (318)
Black	2·0 (462)	1·7 (351)	1·1 (154)	1·7 (235)	1·3 (178)	1·9 (120)
Mixed	1·3 (290)	1·2 (239)	0·6 (85)	0·9 (122)	1·4 (186)	1·3 (86)
Other	1·8 (423)	1·3 (272)	1·0 (147)	1·3 (182)	1·5 (206)	1·6 (103)
Sex (%(n))						
Female	71·5 (16,628)	47·9 (9,936)	48·5 (6,963)	49·2 (6,727)	68·1 (9,293)	67·5 (4,359)
Male	28·5 (6,635)	52·1 (10,788)	51·5 (7,384)	50·8 (6,952)	31·9 (4,355)	32·5 (2,095)
Total	23,263	20,724	14,347	13,679	13,648	6,454

Table 2. Demographic Data for Neurological Diagnostic Categories.

- Patients were seen more frequently from the most deprived areas compared to the regional population.
- Headache, epilepsy, and FND saw proportionally more from the most deprived areas, compared to the population (Figure 3).

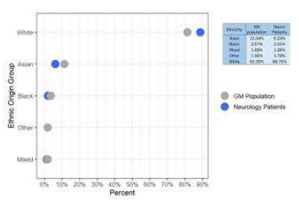

Figure 2. Percentage proportion of neurology patients compared to Greater Manchester population for Ethnicity.

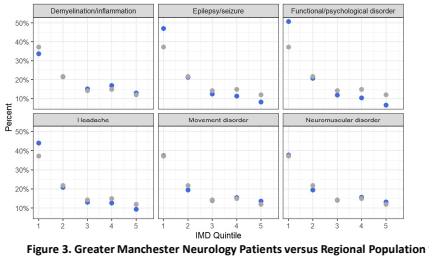

Figure 3. Greater Manchester Neurology Patients versus Regional Population % for deprivation for diagnostic categories. 1 = most deprived; 5 = least deprived.

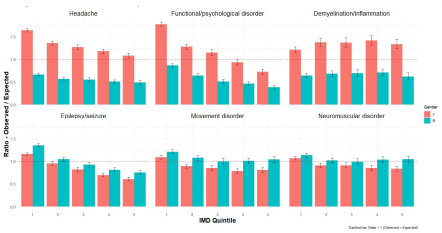

Figure 4. Age-adjusted rate ratios by deprivation and sex for diagnostic categories (IMD Q1 = most deprived; Q5 = least deprived).

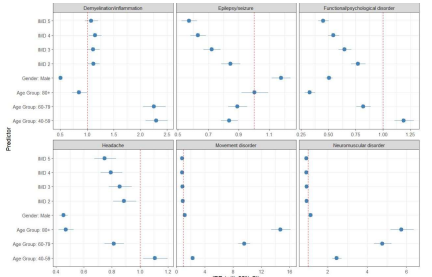

Figure 5. Rate ratios for age, sex and deprivation for diagnostic categories. (IMD Q1 = most deprived; Q5 = least deprived).

- For movement and neuromuscular disorders, there were proportionally more patients seen from the least deprived areas.
- When age-adjusted, females were more likely to be seen for headache (*IMD Q1:* 1.64 [1.61-1.68]) and FND (*IMD Q1:* 1.78 [1.73-1.83]) with increasing deprivation.
- Epilepsy in clinic had higher odds of an OP clinic if most deprived for males (*IMD Q1:* 1.36 [1.32-1.39] and females (*IMD Q1:* 1.16 [1.13-1.19])
- Adjusting for co-variables (Figure 5), headaches (*IMD Q5*: 0.74 [0.67-0.83]), epilepsy (*IMD Q5:* 0.57 [0.52-0.63]), and FND (*IMD Q5:* 0.45 [0.41-0.50], p<0.001) had lower rates of clinic if less deprived.
- Demyelination/inflammation had slightly higher clinic rates for less deprived (IMD Q2-4)

Conclusions

- To our knowledge, this is the largest UK OP neurology dataset analysed.
- For headache, epilepsy/seizures, and FND, patients are more likely to be seen with higher deprivation indicating possible barriers to effective community diagnosis and management.
- Limitations: no longitudinal trend data; non-definitive diagnoses; missing ethnicity data and extraction of diagnostic data only.
- Automated extraction and coding of OP clinic letters may provide structured data to support service planning and resource allocation.