Diagnoses and other predictors of patient absenteeism in an outpatient neurology clinic

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Abstract

Background

We sought to determine the neurologic diagnosis or diagnostic categories that are associated with a higher probability of honoring a scheduled follow-up visit in the outpatient clinic.

Methods

We conducted a retrospective analysis of patients evaluated over a 3-year period (July 2014–June 2017) at a single neurology clinic in an urban location. Adult patients who honored an initial scheduled outpatient appointment were included. Only diagnoses with a $\geq 0.5\%$ prevalence at our center were analyzed. Mixed-effects logistic regression was used to determine association of independent variables and honored follow-up visits.

Results

Of 61,232 scheduled outpatient subsequent encounters for 20,729 unique patients, the overall absenteeism rate was 12.5% (95% confidence interval [CI] 12.2%–12.8%). Independent risk factors associated with absenteeism included younger age, black or Latino race/ethnicity, Medicaid/Medicare payor status, and longer delay from appointment scheduling to appointment date. In mixed-effects logistic regression, diagnoses associated with the lowest odds of showing were medication overuse headache (show rate 79.2%, odds ratio [OR] for honoring appointment 0.67, 95% CI 0.48–0.93) and depression (rate 85.9%, OR 0.82, 95% CI 0.70–0.97), whereas the diagnoses associated with the greatest odds of showing included Charcot-Marie-Tooth disease (rate 96.3%, OR 2.54, 95% CI 1.44–4.49) and aphasia (rate 95.9%, OR 2.34, 95% CI 1.28–4.30).

Conclusions

Certain chronic neurologic diseases, such as medication overuse headache and depression, were associated with a significantly lower odds of honoring scheduled follow-up conditions. As these conditions influence quality of life and productivity, patients with these illnesses may benefit from selective targeting to encourage adherence with scheduled follow-up appointments.

Failure to honor a scheduled outpatient appointment (no-show) has been associated with delayed medical diagnosis, delayed treatment, clinical worsening, and financial losses to ambulatory clinics.¹⁻³ One academic pediatric neurology clinic with a 26% rate of no-shows could lose \$250,000 per year.⁴ Poor follow-up also has implications on medication management,

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especially for medications that require laboratory monitoring like anticonvulsants and immunotherapies.

Many investigators have analyzed the risk factors of absenteeism and found correlations with younger age, nonwhite race, non-English languages, mental health disorders, and other factors,⁵⁻⁷ with few evaluating factors intrinsic to neurology clinics.⁸ The abundance of described no-show predictors has led many groups to use predictive modeling to assign probabilities of absenteeism to each individual patient. Some of these prediction models are sophisticated⁹; however, due to imperfect discrimination, the relevance of such probabilistic prediction can be unclear.

More thorough characterization of the populations of patients evaluated, including a disease-centric view, may make it possible to understand the common issues and allocate specific resources to help patients honor their appointments, whether with work notes, transportation, translators, or guides. No one has yet published an analysis of neurologic diseases as predictors for absenteeism. This may be especially relevant in neurology due to the effect of neurologic diseases on memory recall, attention, and ambulation. Such an analysis might help us better understand underlying issues and optimize disease-based support systems to better serve those patients. We hypothesize that diseases with cognitive impairment (e.g., congenital epilepsy, dementia) or immobility (e.g., multiple sclerosis, stroke, spinal stenosis) are associated with higher rates of no-show.

Methods

Setting and patient population

This was a retrospective cohort study of consecutively scheduled follow-up appointments for patients ages 18 or older who were evaluated between July 2014 and June 2017. In order to reduce ascertainment bias of neurologic diagnoses, only follow-up encounters were evaluated for absenteeism, so patients had to have honored at least one prior visit. All patients were evaluated at a single clinic associated with a university health system in urban Philadelphia.

Detailed setting

The median age of patients in Philadelphia is 34.2 years and the median income is approximately \$34,000 (2010 census). The median income in the clinic's zip code (19104) is approximately \$24,000. Wait time for appointment scheduling was defined as the third next available appointment for a given provider. Median wait times for a neurology appointment by subspecialty were 2 weeks for general neurology, 5 weeks for neuromuscular, 7 weeks for multiple sclerosis, 9 weeks for cognitive, epilepsy, and movement disorders, and 13 weeks for stroke.

Patients are able to schedule appointments about 6 months in advance, and receive automated telephone calls to remind

them 48 hours prior to their appointments. Appointments are made or cancelled by telephone. In our clinic, there is no deadline for cancellation, and therefore no-show is defined as any encounter in which the patient does not cancel and does not present.

Statistical analysis

Patient-level data were abstracted from the electronic medical record (EMR) with support from our Data Analytics Center. The primary outcome of interest was an honored scheduled follow-up outpatient visit during the study period. Each scheduled patient encounter was evaluated as a separate observation with an outcome of show or no-show. For example, if a single patient had 4 scheduled appointments, this generated 4 unique observations. Appointment cancellations >24 hours prior to the scheduled encounter were excluded from the analysis.

Predictor variables included disease factors (diagnosis codes, as assigned by a neurologist in the patient encounters, each treated as a binary predictor), patient factors (age, sex, race, payor, and number of diagnoses), appointment factors (appointment age, appointment hour, appointment day of week), and historic behaviors (prior number of shows, no-shows, and cancellations within neurology). The independent variables and their association with the outcome were evaluated using descriptive statistics. Patients with missing demographic data were included in the analysis with the categorical variable of not specified. Because the EMR requires appointments to have dates and times, the appointment factors did not have missing data. In addition, the EMR requires assignment of at least one diagnosis to every completed visit, so the analysis of subsequent visits all had at least one diagnosis assigned by a neurologist.

The initial neurology clinic visit was queried for all diagnosis codes assigned during neurology visits, encoded using the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM). Only diagnosis codes with a prevalence of $\geq 0.5\%$ of patient encounters were included in the analysis. ICD-10-CM diagnosis codes that share similar pathophysiology were grouped into a single diagnosis category (e.g., ischemic stroke and TIA; table e-1, [links.wwn.com/CPE/A35](https://www.aan.com/CPE/A35), for diagnosis groupings). The diagnosis list contained several non-neurologic codes (drug monitoring, essential hypertension, osteoporosis, and vitamin D deficiency), which were included in the analysis but excluded from the table. Diagnoses with ambiguous neurologic origin (e.g., depression) were included for the purposes of maintaining a comprehensive, pragmatic design. Diagnosis codes were assessed for collinearity, and those determined to be collinear with at least one other code ($r > 0.6$) were dropped from the final regression model. The variance inflation factor was used to confirm collinearity of independent variables.

Race or ethnicity, which were not differentiated in our EMR, was used as a predictor without modification. Patient home

zip codes were used to approximate their home distance from the outpatient clinic zip code. This was calculated using the GPS coordinates of the centers of the zip code regions, obtained from US Census Bureau's cartographic boundary shapefiles (census.gov/geo/maps-data/data/tiger.html). Date and time of appointment, as well as date of scheduling confirmation, were abstracted from the EMR.

Mixed-effects logistic regression was used to determine association of independent variables with clinic shows. Patient factors, appointment, and historic behaviors were included in a single model. All disease factors were included in a separate pair of regression models, one unadjusted and another adjusted for age, race, insurance payor, resident home distance from clinic, and delay from scheduling of the appointment to appointment date. The predictors were each included as fixed effects and a random-effects term for intercept grouped by patient identifier was also included. For nominal predictors, the variable groups reflecting the largest sample size were used as referent categories for comparisons unless otherwise indicated.

MATLAB's fitglm function (version R2017b, Statistics and Machine Learning Toolbox) and STATA (College Station, TX) v13.0 were used in the statistical analyses. All tests were 2-sided and performed at the $\alpha = 0.05$ level.

Power calculation

All analyses were exploratory. However, to ensure a sufficient time window such that rare diseases would be captured and that there would be opportunity for more than one annual follow-up for chronic diseases, at least 2 years of patient encounters would be necessary for evaluation. Assuming a rate ratio of 15% absenteeism, a sample size of 239 encounters per diagnosis code would provide 80% power to detect an 8% difference in the proportion of missed encounters per diagnosis at the 2-sided 0.05 level. To include rare diagnoses comprising $\geq 0.5\%$ of all encounters, a minimum of 47,800 patient encounters would be required for screening.

Standard protocol approvals, registrations, and patient consents

This study was reviewed and approved by the University of Pennsylvania institutional review board with waiver of informed consent.

Data availability

Any request for anonymized data from a qualified investigator would be at the discretion of the University of Pennsylvania institutional review board.

Results

We analyzed 61,232 scheduled outpatient subsequent encounters for 20,729 unique patients, with an overall show rate of 87.5% (95% confidence interval [CI] 87.2–87.8%). During the 3-year study period, there were 142 clinicians,

Notably, patients with medication overuse headache, chronic daily headaches, and seizures were among those with the poorest show rates in our cohort.

including attending physicians, residents, fellows, and nurse practitioners. The mean patient age per encounter was 54.2 years and 62% were female (see the table for demographic data). Patients had a mean of 2.95 scheduled visits (median 2, interquartile range [IQR] 1–4) and 3.97 diagnoses (median 3, IQR 1–5). There was a mean of 1.54 diagnoses coded per completed visit (median 1, IQR 1–2). Patients between 60 and 69 years of age had the highest odds of honoring their appointments, whereas younger patients had a lower odds of showing. Of the 96% of patients with reported race/ethnic groups, patients who identified as black or Latino had lower odds of honoring appointments when compared to other races/ethnic groups. When assessing proximity to the clinic, the odds of honoring appointments were greater if the patient resided further from the clinic. Compared to other insurance payors, registered non-Medicare/Medicaid patients were at higher odds of honoring appointments (figure 1).

While 63.6% of all patient encounters were scheduled a month or greater in advance, more recently scheduled appointments were more likely to be honored (figure 1). The relationship between appointment time during a scheduled workday and the odds of honored appointment was bimodal, with early morning and late afternoon appointments having higher rates of absenteeism. Monday appointments were also less likely to be honored when compared to other days of the week (figure 2). History of absenteeism and number of prior missed appointments was associated with recurrent absenteeism, whereas a higher number of honored appointments were associated with future honored appointments (figure 3).

The 3 most common disease categories observed per encounter were multiple sclerosis or demyelinating changes (29.7% of patient encounters, show rate 93.5%), seizures or seizure disorder (21.6% of encounters, show rate 86.0%), and localization-related epilepsy (20.4% of encounters, show rate 88.2%). The diagnoses with the highest probability of showing in the adjusted model were Charcot-Marie-Tooth (rate 96.3%), transverse myelitis (96.2%), and aphasia (95.9%), whereas diagnoses with lowest probability of showing were medication overuse headache (79.2%), pseudotumor cerebri (82.7%), chronic daily headache (83.8%), and transient alteration of awareness (83.8%; figure 4).

Table Demographic information

Characteristics	All scheduled follow-up visits
Age, y, mean ± SD	49.9 ± 16.5
Female, n (%)	37,607 (63)
Diagnoses per patient across all neurology visits during 3-year study period, n (%)	
1	5,885 (30)
2	4,664 (24)
3	3,391 (17)
4	2,258 (11)
≥5	3,546 (18)
Scheduled appointments per patient during 3-year study period, n (%)	
1	7,008 (35)
2	3,936 (20)
3	2,751 (14)
4	1,677 (8)
≥5	4,372 (22)
Payor, n (%)	
Non-Medicare non-Medicaid insurance	34,360 (57)
Medicare	15,856 (26)
Medicaid	8,695 (14)
Not specified	1,174 (2)
Race or ethnicity, n (%)	
American Indian	49 (<1)
Asian or Pacific Islander	1,092 (2)
Black	14,964 (25)
East Indian	242 (<1)
Hispanic Latino/Black	348 (1)
Hispanic Latino/White	921 (2)
Other	2,479 (4)
Unknown	2,617 (4)
White	37,373 (62)

Discussion

In our single-center experience, we observed a higher rate of outpatient absenteeism for certain common neurologic diseases that would otherwise benefit from honored follow-up appointments. Notably, patients with medication overuse headache, chronic daily headaches, and seizures were among those with the poorest show rates in our cohort. This population comprises a majority of outpatient neurology clinic

Also notable were the relatively high rates of show among patients with neurodegenerative conditions like Parkinson disease, Alzheimer disease, and frontotemporal dementia.

visits in several centers,^{10,11} and are often treated with daily medications that require more frequent evaluations and laboratory monitoring for pharmacologic toxicity, especially when compared to more chronic conditions, such as Charcot-Marie-Tooth syndrome. There is also overlap between these neurologic illness and comorbid mental health disorders, particularly depression and drug-seeking.^{12,13} Patients with headache or seizures and comorbid depression may lack sufficient motivation to honor their appointments or participate in other daily activities.^{14,15} Other factors such as personal constraints, financial limitations, or occupational commitments may also prevent these patients from honoring a higher frequency of follow-up visits.

Also notable were the relatively high rates of show among patients with neurodegenerative conditions like Parkinson disease, Alzheimer disease, and frontotemporal dementia. These effects are strong and independent of known age factors. This phenomenon may be in part due to the effect of caretakers. Further reinforcing this is the fact that Lennox-Gastaut syndrome—which is associated with physical and psychosocial dependence—has a higher rate of showing than localization-related epilepsy, generalized epilepsy, or seizures.

Physical outpatient encounters are not the only option available for effective patient evaluations. Over the last 2 decades, it has become increasingly common to bill for complex or lengthy telephone encounters,¹⁶ and some centers have successfully implemented fully electronic visits (e-visits).^{17,18} While these e-visits are not without their own limitations,¹⁹ scheduling these electronic encounters may improve the ability for clinicians to manage patients and medications without any anticipated loss of revenue to an outpatient practice.

Among the population who lives within 8 km of the medical center, we observed a lower odds of showing, despite adjustment for Medicare and Medicaid status. We suspect this is due to socioeconomic factors in the zip code regions surrounding the medical center that we did not capture. In addition, this local population likely has more patients referred on the basis of common problems and a lower proportion of conditions that require subspecialty care.

In planning this study, we had originally hypothesized that more physically restricting physical illnesses (e.g., weakness,

Figure 1 Patient factors associated with honoring a subsequent appointment

myelopathy, or transverse myelitis) and multiple diagnoses²⁰ would have correlated with outpatient absenteeism. While we observed a higher rate of absenteeism among patients with more than one neurologic diagnosis, patients with (presumably) more physically disabling diagnoses were at a higher odds of honoring scheduled follow-up visits. This may be related to the overall mildness of symptoms for most patients with these conditions or the resources available for patients seen at our center for more debilitating symptoms. Conversely, several neurologic conditions that may not be physically disabling but could be functionally restrictive (e.g., medication overuse headache and depression) appear to strongly correlate with absenteeism. Mental health disorders have been previously associated with absenteeism in several studies.²¹ While few patients in our cohort were given these

diagnoses, and these patients may lack a physical handicap that could prevent them from honoring a scheduled follow-up visit, their functional impairment should not be discounted.

Living with these chronic conditions and failing to make a scheduled follow-up visit is associated with losses to quality of life and occupational productivity.²²⁻²⁴ Arranging for supplementary outpatient services that may otherwise be reserved for patients with physical disabilities may benefit these patients and improve show rates in a high-risk population.

Future research

This study does not include predictive modeling, although that is a logical next step. Other groups have created predictive models for their populations,⁹ but we argue that the

Figure 2 Appointment factors associated with honoring a subsequent appointment

translation to operational improvements to reduce financial burden and improve continuity of care is the major hurdle. While others have devised schemes for oversaturating clinic schedules,⁵ we argue that this strategy has major drawbacks. For a patient with a 50% chance of showing, it may seem wise to double-book the appointment slot. However, if the overbooked patient also has a 50% chance of showing, there remains a 25% chance that both show, and a 25% chance that neither shows, an unsatisfactory level of variability. In clinics with higher show rates, providers may face a different dilemma. How can we optimize a schedule in which the vast majority of patients have an 80% or greater probability of honoring the appointment? Overbooking in this case may seem unattractive to clinicians due to the higher risk that multiple patients show up simultaneously, but the alternative consequence of 10%–20% loss in revenue is major nonetheless. Further, overbooking algorithms^{5,25} all suffer from the cost of increased waiting room time, overtime cost, and the potential negative experience for patients.

Other operational strategies include addressing forgetfulness, converting intentional no-shows to cancellations, and optimizing scheduling.

Clinics could dedicate extra resources to patient reminders.²⁶⁻²⁹ One single-center randomized trial at

Massachusetts General Hospital of selective phone call reminders to patients at high risk of absenteeism demonstrated a significant improvement in show rates and a reduction in health care losses.²⁹ Despite employing automated calls in our clinic, no-shows remain a significant and costly problem. Some research shows that personal calls are more effective than automated,²⁶ although there are limitations due to scalability. A disease-specific approach to phone call reminders may help alleviate this burden. In addition, in our experience, a substantial portion of reminder calls from our clinic are unanswered and voice messages not returned. Further research may help determine if reminders can be tailored around patients' preferred method of communication, in particular considering new technologies.

A second operational strategy could involve the conversion of no-shows to cancellations so that there is ample time to rebook appointment slots with other patients. Currently, our clinic requires patients to call in order to cancel, which may be enough of a barrier to deter some patients.

It is known that timing of appointment scheduling has an effect on the rates of no-show, and clinics must balance the tradeoffs of allowing patients to plan ahead vs maximizing show rates. Such disease-specific insights could allow clinics to use different strategies, perhaps reserving appointment

Figure 3 Historic factors associated with honoring a subsequent appointment

slots for headache or other disease follow-ups that can be reserved closer to the date of appointment.

Regardless of the strategy, clinics must exercise caution to avoid discrimination by race, payor status, and disease.

The additional value of a disease-centric analysis is to identify which disease groups are at risk for absenteeism and help design the clinic experience around these groups. Multiple sclerosis is a disease often involving immunosuppressing medications, which carry the risk of serious complications, especially if patients miss critical laboratory monitoring. In our cohort, the patients with this diagnosis had much higher than average odds of showing. This may be due, in part, to a disease-specific multidisciplinary treatment team that helps care for these patients at our center.

Further research is necessary to determine which patients are most likely to benefit from these interventions, and specifically which interventions (and when) would be the most effective. Because of the heterogeneity in rates of absenteeism across neurologic diagnoses, regardless of physical disability, we recommend investigators consider individual conditions when implementing quality improvement interventions to improve show rates. For instance, in patients who require frequent clinic visits for monitoring of symptoms or adjustment of medications (e.g., seizure disorders) but who are unable to physically arrive at their scheduled appointment, it

might be reasonable to conduct these visits over the phone or via other electronic means.

Limitations

The present study of a single-center experience with a low rate of absenteeism may differ in case mix compared to other neurology practices; therefore these results may not be generalizable to other centers. Although our odds ratios for disease factors are adjusted for demographic and appointment factors, and should largely generalize to other settings, some components, like clinical reputation, are not incorporated into the model. For instance, our center has a dedicated Charcot-Marie-Tooth clinic staffed by a single provider with a high referral rate. In this case, clinic reputation and relative scarcity of appointment slots may account for the high probability of these patients honoring a scheduled follow-up appointment. Further, certain subdivisions with a high research commitment and more resources may more aggressively confirm appointment times or rescheduling needs. Conversely, some patient populations are underrepresented by our single-center experience due to a scarcity of providers with that expertise (e.g., neuro-oncology). These factors may only be applicable to a single center; therefore, other institutions ought to determine which diagnosis codes are associated with local absenteeism.

We selected a large date range to avoid bias in the acquisition of data due to variability in the frequency of visits for each

Figure 4 Disease factors associated with honoring a subsequent appointment

Odds ratios shown are paired with 95% confidence intervals in parentheses.

disease, but this may still confound the results. A higher frequency of visits for some diagnoses may increase the likelihood of absenteeism (e.g., seizure patients), whereas a low frequency of subsequent encounters (e.g., frontotemporal dementia patients) may ensure that a follow-up appointment is honored. There is also the possibility of immortal time bias, which would account for a lower rate of honored follow-up visits among patients less likely to survive to subsequent appointment (e.g., oncologic diagnoses). Patients with more severe disease may be less likely to show due to unanticipated hospitalization or deterioration.

As in other studies that rely on the retrospective review of diagnosis codes,^{2,21} this study was limited by the potential inaccuracies of provider documentation. This is best appreciated by differences in show rates between patient groups representing similar conditions. For example, “seizure

disorder” is associated with a lower odds of honored follow-up visits in the unadjusted model, and “localization-related epilepsy” is associated with a higher odds of honored follow-up visits. This might be explained by a higher likelihood of a more precise neurologic diagnosis in patients who more frequently honor their follow-up appointments such that the more accurate diagnosis can be ascertained. However, this effect was not universally observed across other diagnostic categories. For example, the specific diagnosis “carpal tunnel syndrome” was associated with a lower odds of honored follow-up appointment in unadjusted logistic regression, whereas the more generic diagnosis of “neuropathy” was associated with a higher odds of honored follow-up appointment.

Furthermore, our investigation only evaluated absenteeism in subsequent neurology appointments, and not in initial

outpatient encounters. This may overestimate expected show rates for all-comers. A meta-analysis of no-show studies reported median no-show rates of 24% (IQR 21%–28%) in neurology clinics, which is higher than primary care, at 18% (IQR 12%–31%).³⁰ Rates may be lower, about 14%, in private practices,³¹ and higher in urban academic centers, especially in resident clinics.⁸ It is worth noting that the prediction of no-shows in initial visits may be more financially important than return visits given they are typically given longer appointment slots and are anticipated to have a higher probability of absenteeism; however, diagnostic codes would be less reliable for an investigation such as this.

This study demonstrates neurologic diseases as specific risk factors associated with outpatient absenteeism. Prior models and quality improvement initiatives that have investigated clinic show rates have not commented on specific disabilities as predictors of failing to honor a subsequent visit. Certain physical and intellectual disabilities, as well as the number of comorbidities, may increase a patient's probability of absenteeism. However, individual medical diagnoses also appear to contribute to the overall likelihood of honoring a follow-up appointment. Selective targeting of patients with particular diagnoses with social work, human reminders, technology-based reminders, or alternative scheduling procedures may improve show rates, even in clinical settings where show rates are already high.

Author contributions

David H. Do: conception of the idea of the manuscript, data acquisition, statistical analysis, drafting of the manuscript, review of the manuscript for important intellectual content. James E. Siegler: statistical analysis, critical revisions to the manuscript for important intellectual content.

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