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Original Study

Ability of an Appointment Complexity Categorization System Applied by Non-Medical Personnel to Discriminate Between Patient Categories

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Abstract

Background: The Midwestern University College of Veterinary Medicine hosts student-run free clinics through the campus-wide interprofessional program, Health Outreach through Medicine and Education. Veterinary students, attending veterinarians, and non-medical volunteers conduct clinics on a first-come-first-served basis. Patients are declined once estimated capacity is reached. Historically, capacity was based on the number of patients, but clinic end-time was found to be highly variable. An appointment complexity categorization system based on presenting complaint (used as a proxy for appointment duration) was implemented in an attempt to maximize patients seen while allowing for an on-time clinic conclusion.
Methods: A rubric was constructed based on prior clinical experience and provided to non-medical personnel assisting with check-in to determine a point value (1-3) for each patient, with lower point value appointments being simpler, and higher point appointments being more complex. Clinic capacity was set at 24 points. Appointment duration for each point category was analyzed via Kruskal-Wallis equality of populations rank test and Dunn's test of multiple comparisons.
Results: Median duration was the same for 1- and 2-point appointments (24 minutes), but longer for 3-point appointments (62 minutes). Duration of 3-point appointments was significantly different than 1-point (p=0.0071) and 2-point (p=0.0201) appointments, while duration between 1- and 2-point appointments was not different.
Conclusions: Non-medical personnel using a rubric were able to discriminate between simple (1-point) and complex (3-point) appointments but were unable to discriminate between simple and complicated (2-point) appointments. However, this utility of this in clinical practice was minimal.

Introduction

The Midwestern University (MWU) College of Veterinary Medicine (CVM) participates in MWU's Health Outreach Through Medicine and Education (HOME) program, which provides free medical care to underserved populations in Phoenix, Arizona.[1] These student-run free medical clinics offer wellness care, vaccines, and evaluation of health concerns, overseen by attending veterinarians. Teams of veterinary students are responsible for taking patient histories from owners, completing physical examinations (PE), determining diagnostic and treatment plans, presenting cases to attending veterinarians, performing diagnostics and treatments, and discharging patients to owners. Due to space constraints in a mobile veterinary clinic, only three student teams (typically one first-year student partnered with an upperclassman), can work at one time.

Without the administrative capacity to schedule appointments in advance, clinics are on a first-come-first-served (FCFS) basis. Recheck appointments (usually 1-4 appointments and most commonly vaccine boosters for young animals),

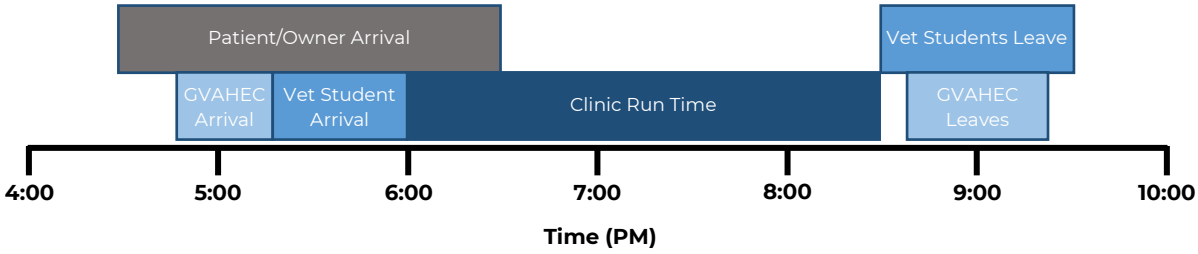
as well as occasional urgent walk-in cases, are also seen. Due to time constraints, patients are declined once estimated capacity is reached. Owners must arrive several hours before official clinic start (6pm) to secure an appointment; however, veterinary personnel are unable to arrive at the clinic location before 5:30pm. Non-medical social work students and interns from the Greater Valley Area Health Education Center (GVAHEC) arrive approximately one hour before clinic start to facilitate patient check-in (Figure 1). They oversee patient intake to minimize wait time for owners who will be denied due to capacity limitations as well as to maximize the time available for medical aspects of the clinic. Prior to this study, clinic capacity was defined by the number of patients (20), but despite limiting appointments, clinic duration was highly variable and historically ran 30 to 90 minutes over scheduled end time (8:30pm).

Scheduling is problematic for many clinics that take in patients on an urgent basis (measured in degree of painfulness or threat to life/wellbeing),[2] and the ability to predict appointment duration may help to maximize capacity while minimizing clinic time overruns. A review in 2003 suggested that grouping patients according to similar characteristics was an effective way of improving appointment schedules.[3] Multiple studies have attempted to redesign appointment scheduling templates by assigning patients to scheduled groups to maximize time management during appointments (i.e., appointment times are no longer or shorter than necessary).[2-6] One study grouped patients according to visit type (emergency/urgent care, follow-up, new patient, etc.) and found that a certain degree of categorization minimized patient wait time, physician idle time, and average overtime when compared to systems without categorization.[4] Another study utilized a novel approach to patient categorization with more individualized groupings (perception of health, chronic medical conditions, expressed symptoms, etc.).[5] The second study found that a simple classification (new versus returning patient) was less cost-efficient than a classification system with a more individualized approach, suggesting that more patients were able to be seen in a given time with the individualized approach because the actual appointment duration time was similar to scheduled time.[5]

In contrast to scheduled appointments, capacity-based FCFS medical appointment scheduling strategies are rarely mentioned in literature. Prior work regarding clinic operations tends to focus on minimizing wait times,[7] preventing no-shows,[8] coordinating multiple specialties,[2] or balancing new patient appointments with old.[5] One study stated that "overbooked clinic days require[d] students to skillfully triage and negotiate resources," acknowledging that schedules with finite appointment numbers are likely in place, but discussing no further how such days were managed.[9] Studies focused on capacity have leaned towards more complex clinical situations, with focus either on coordinating specialty care[2] or minimizing provider idle time[4-6] but do not use a FCFS system. To the authors' knowledge, there is no previously published work regarding capacity-based scheduling of FCFS clinics via organization of patients into scheduling categories; however, the scheduling challenges this clinic faces, including limited time, volunteers, and resources compared to the demand for veterinary care, are common and similar to those of other veterinary student-run free clinics, including the University of Minnesota College of Veterinary Medicine Veterinary Treatment Outreach for Urban Community Health (VeTouch) program[10] and the University of California Mercer Veterinary Clinic for the Homeless.[11] Additional studies conducted on human medical student-run free clinics demonstrate that patient scheduling and wait-time management is a common challenge amongst clinics of this nature in any profession, and that a more streamlined method of capacity determination and scheduling has the potential to improve patient satisfaction and overall efficiency.[12,13]

The practice of having non-medical personnel (NMP) make medically relevant decisions has been used in situations such as triaging, where patients are assigned a rating of medical severity to determine the order they receive medical attention.[7,14] Many studies have been published on the effectiveness of NMP, with mixed results.[7,14-16] A 2004 retrospective chart review revealed that using NMP (unlicensed assistive individuals) to triage emergency patients increased both patient wait time and incidence of patients who left without being assessed, as compared to triaging

Figure 1. An estimation of the approximate arrival and leave times of personnel with respect to official clinic run-time



GVAHEC: Greater Valley Area Health Education Center students

Table 1. The points-based rubric and criteria for point assignments by category of complexity

Point Value	Categorization	Criteria	Estimated Duration (minutes)
1	Simple	Vaccinations only	20
2	Complicated	Addresses 1 medical concern (with or without vaccinations)	40
3	Complex	Addresses 2+ medical concerns (with or without vaccinations)	60

done by more qualified nurses.[7] Additionally, a review of the Finnish emergency medical service missions showed that NMP who assigned a simplified triage category (A, B, C, or D) to injured patients were reported to have incorrectly triaged 32.5% of cases, with 10.7% of the lowest, least severe classifications actually having been high-risk cases.[14] In contrast, a 2010 Cambridge University study showed that first-year medical students who had yet to receive significant medical instruction were able to correctly triage in 64.3% of cases, after having received only a brief training.[15] Similarly, a 1999 Cambridge University study showed that emergency medical service providers (a population with some medical training) were able to predict a patient's final disposition with relative accuracy based on initial triage.[16] These studies indicate potential challenges with the use of NMP in determining the risk and severity of medical cases, even when these personnel are educated and the classification system is simplified.

Given these challenges, we attempted to create a system for determining medical clinic capacity using estimated appointment complexity based on patient presenting complaint as a predictor of duration, with the goal of creating a consistent clinic duration despite a diverse case mix. The rubric was designed to discriminate between appointments of different levels of complexity and their presumably different durations while being simple enough to be implemented by NMP. The purpose of this study was to determine the ability of a simplified appointment categorization system applied by NMP to discriminate between categories of patient appointment (simple, complicated, and complex) as measured by the duration of patient encounters.

Methods

An appointment categorization system based on the relative complexity of the presenting complaint was created by the clinic's faculty advisor, Dr. Rachael Kreisler, with input from HOME veterinary student officers and GVAHEC advisors. The system assigned a point value (1-3) to each patient, which corresponded to estimated appointment complexity using the criteria outlined in Table 1 and was designed to balance anticipated utility with ease of use for NMP.

Historically, appointment duration was not captured, but based on prior experience with clinic operations it was estimated that 1-, 2-, and

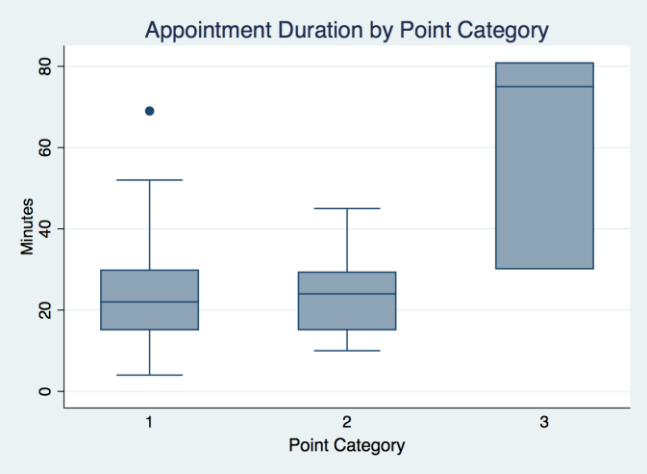
3-point appointments would take approximately 20 minutes per point, for durations of 20, 40, and 60 minutes, respectively. To accommodate scheduled re-checks, allow for occasional urgent walk-ins, and to account for turn-over time between patients, clinic capacity was set at 24 points. Over the course of 7 months (March to September 2017), GVAHEC members assigned points to each patient according to their presenting complaint, while veterinary students recorded appointment start time (post-history taking) and appointment end time (post-client discharge). Appointment duration for each point category was visualized via box plot and analyzed via the non-parametric Kruskal-Wallis equality of populations rank test, followed by Dunn's test for multiple comparisons using rank sums. Significance for all tests was $p<0.05$.

Results

A total of 128 appointments occurred during the 7-month study. Of these, 108 were assigned a point value, with 87 (70%) assigned 1 point, 15 (12%) 2 points, and 6 (5%) 3 points. Of the 108 appointments with a point value, 107 had a start time recorded. Of those 107 appointments, 80 had an end time recorded, resulting in 63% of appointments being complete and usable for analysis. Of the 80 complete records, 69 (86%) were assigned 1 point (simple), 8 (10%) 2 points (complicated), and 3 (4%) 3 points (complex).

The median duration for simple 1-point appointments was 24 minutes (range: 4-69 minutes). The median duration for 2-point appointments was 24 minutes (range: 10-45 minutes). The median duration for 3-point appointments was 62 minutes (range: 30-81 minutes). Results were visualized via a box plot (Figure 2). A Kruskal-Wallis equality of populations test showed a statistically significant difference between the three groups ($p=0.0495$). Dunn's pairwise comparison of duration showed that the 3-point category was different from both the 1-point ($p=0.0071$) and 2-point ($p=0.0201$) categories. There was no significant difference in the duration between 1-point and 2-point categories.

Figure 2. Box plots of the appointment duration, in minutes, for each point category



Discussion

In constructing the rubric, it was estimated that each point would increase appointment duration by 20 minutes. While 1-point appointments (24-minute median duration) and 3-point appointments (62-minute median duration) were close to their estimated values of 20 and 60 minutes, respectively, 2-point appointments (24-minute median duration) were not close to the estimated 40 minutes. Moreover, 1- and 2-point appointments were similar in median duration and ranges, despite the fact that 2-point appointments typically required more medical services. The similarity between 1-point and 2-point appointment duration may indicate failure of NMP to apply the rubric, mismatch between initial presenting complaint and the findings of a complete history and PE, or failure of the assumptions underlying the rubric. Interpretation of these findings is limited in that only 3 appointments were assigned 3 points, only 8 appointments were assigned 2 points, and only 63% of the medical records had all data points completed (point score, start time, end time). There was no apparent trend in the difference between the duration of 1- and 2-point categories that might become significant with a greater sample size. The percentage of missing end times increased as point value increased, suggesting that increasingly complex appointments may have made it more likely that

veterinary students were distracted or fatigued after discharge and less likely to record the end time.

It is possible that NMP's lack of medical knowledge limited their ability to discern between what constitutes a medical complaint and a vaccine-only appointment. For example, it may have been unclear whether requests for nail trims would have been considered a medical complaint or not. It is also possible that language barriers were present since many owners are Spanish-speaking and translator availability was limited. Additionally, NMP were tasked with applying the rubric in a crowded environment, complicating thoughtful application. NMP anecdotally reported that it was more stressful to assign points to each appointment and track the cumulative points, as compared to counting patients. While NMP may help facilitate a FCFS check-in at clinics where student presence at check-in is hindered by academic schedule, the ability of NMP to categorize patients according to complexity of presenting complaints is likely limited. It is possible that utilizing this system without NMP in a clinic setting where students with medical training can facilitate check-in would yield a different result.

In addition to the possible rubric misapplication by NMP, there could be a mismatch between presenting complaint to the NMP and findings from the history and PE. Detailed histories and PEs are crucial components of companion animal diagnosis, and veterinarians are trained to elicit clinically relevant information from owners. Concerns outside of the presenting complaint are commonly revealed during targeted history-taking because owners are often unaware of medical conditions in their companion animals. For instance, two 2014 studies determined that owners had misconceptions about puberty onset[17] and intestinal parasites in their pets,[18] requiring additional discussion time.

It is also possible that assumptions underlying the rubric were faulty. The system may have been too simplified, incorrectly estimated relative appointment complexity, inaccurately estimated duration per point, or excluded important variables. A more robust description of individual categories outlining specific medical conditions may have made the correct allocation of point values easier for the NMP; however, with the NMP reporting stress assigning points and tracking cumulative points, a more complex rubric, even if more accurate, is unlikely to be a good fit for this clinic design. While it was assumed that the presence of at least one medical condition would increase appointment duration (presumably requiring further diagnostics, discussion, and treatment), it is possible that the impact of this difference was confounded by preceptors spending more time on student education for simpler appointments.

Finally, presenting complaint may not have been the best predictive variable of appointment duration. An exploratory study that analyzed factors which impacted duration of human periodontal maintenance appointments discovered specific variables that aided in predicting duration more accurately (presence of blood on probing, number of teeth versus number of implants, number of carious lesions and/or restorative defects, etc.).[19] These variables were determined only after a thorough PE, which may indicate that a pre-examination rubric may not successfully discriminate between patient categories. Further study is required to determine the cause of system failure and whether a system could be devised to predict appointment duration during the check-in process.

Conclusions

Non-medical personnel using a simplified complexity categorization rubric were able to discriminate between simple 1-point and complex 3-point appointment categories, but unable to discriminate between simple 1-point and complicated 2-point appointments. While the small sample size limited the conclusions that could be drawn from the data, it was clear that this rubric employed by NMP had limited clinical utility in this environment due to the low proportion of complex 3-point appointments and administrative overhead of assigning and calculating point totals in a dynamic FCFS clinic setting. This finding highlights the importance of ongoing quality improvement efforts to all student-run clinics to ensure that resources are efficiently utilized as well as the challenge with estimating the duration of medical appointments.

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Disclosures

The authors have no conflicts of interest to disclose.

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