Wait Times in Clinic Practice: An Operational Model of Outpatient Care

A new model allows a clinic to assess and modify its approach to follow-up appointments, an important element in the reduction of wait times.

By Anne James Goldsberry, MD, MBA, Patricia M. Sullivan, and Alexa Boer Kimball, MD, MPH

Over the last decade, concerns regarding long wait times for appointments in undersupplied medical fields have elicited increasing attention and negative press. In a 2004 study by Merritt, Hawkins & Associates, average wait times for new patient appointments exceeded 14 days in 87 percent, 80 percent, 73 percent, and 60 percent in metropolitan areas surveyed for gynecology, dermatology, cardiology, and orthopedics, respectively. In 2007, the Association of American Medical Colleges published a summary report of concerns over physicians shortages citing recent studies of shortages in specialties including allergy and immunology, anesthesia, cardiology, dermatology, endocrinology, neurosurgery, primary care, and psychiatry.

Dermatology has evaluated its access to care for nearly a decade. The American Academy of Dermatology reported an average national wait time of 33.2 days for new patient appointments and 19.5 days for established patient appointments in the 2007 Practice Profile Survey. This is a significant increase from 1996, when less than 20 percent of physicians had wait times over 30 days. Validating this data, Tsang and Resneck performed a telephone survey to estimate the approximate wait time for patients reporting changing moles. Despite this time sensitive complaint, the estimated wait time was approximately 38 days for patients paying out of pocket or covered by Medicare. In addition to the inconvenience and increased psychological distress to patients, these long wait times have generated concerns over their effects on patient outcomes.

Wait times have long been used as an indicator in fields where the current demand exceeds supply of services. Much of the literature to date has targeted methods to increase the supply of services by expanding the number of providers. It has become increasingly evident however, that in addition to augmenting supply, optimizing the utilization of resources is paramount to improve access. In outpatient practices, the availability of services is a function of supply, demand, and utilization of resources. Long wait times for new patients result from the demand exceeding the supply given the current utilization of resources. The queue of new patients continues to grow at a rate higher than the flow of new patients through the clinic, likely resulting in increased wait times for patients.

Take-Home Tips. Concerns regarding long wait times for appointments in undersupplied medical fields have elicited increasing attention and negative press. The American Academy of Dermatology reported an average national wait time of 33.2 days for new patient appointments and 19.5 days for established patient appointments in the 2007 Practice Profile Survey—a significant increase from 1996. It has become increasingly evident however, that in addition to augmenting supply, optimizing the utilization of resources is paramount to improve access. By applying a practical operational model, clinic directors in specialties of shortage can apply their own clinic parameters and identify tradeoffs of clinic practice that could otherwise result in long wait times for patients.
resulting from clinics having been saturated with follow up appointments from their established patient population. The resulting challenge for clinic managers becomes how to allocate more resources toward new patients while maintaining the quality of care for established patients. In a Canadian study, Appleby and Lawrence suggest instituting referral exclusion criteria and penalizing patients who miss appointments in order to decrease the overall patient load and hence decrease demand. However, restricting access to care does not resolve the long-term problem, which requires appropriately determining allocation of care to people who need it.

To date researchers have neglected the aspect of resource utilization over which physicians have most control: the frequency of office visits needed for different diseases, or more specifically, the scheduling of follow up appointments. Both the need for follow up and follow up times continue to be doctor-dependent as opposed to being dictated by evidence based practices. Facing increasing wait times in our clinic, we developed a model to better understand the clinic operation and guide potentially appropriate interventions. This study looks at the current follow up patterns in dermatology and analyzes them in a sensitivity analysis to identify tradeoffs between follow up practices and new patient appointment volume. By applying a practical operational model, clinic directors in specialties of shortage can apply their own clinic

Figure 1. Operational Model. Ratio of established patients entering the clinic to the number of patients requiring follow up determines the steady state average number of appointments per patient per year. The operational flow of the clinic forms two equations. The capacity equation defines the number of appointments during any given time period. The steady state equation holds the number of established patients constant at the beginning and end of the time period.

Model of Clinic Operations in Steady State

New Patient (NP)

Established Patient (EP)

Clinic Capacity (C)

Capacity Equation

C = EP*EPAR + NP

No Follow Up Required

(EP*EPER + NP*NPER)

No Follow Up Required (EP)

Steady State Equation

EP = EP*(1 - EPER) + NP*(1 - NPER)

EPAR = Established Patient Appointment Rate or the frequency of visits per time period for each established patient. • EPER = Established Patient Exit Rate or the percent of established patients who do not return to the clinic for further care. • NPER = New Patient Exit Rate or the percent of new patients who do not return to the clinic for future care.

parameters and identify tradeoffs of clinic practice that could otherwise result in long wait times for patients.

Methods

Data Collection. Follow up times were determined for patients attending the Massachusetts General Hospital (MGH) Medical Dermatology Clinic in 2005, 2007 and 2008. The protocol for the study was approved through the Partners IRB. Billing records for July 9 to July 13, 2005, July 11 to July 15, 2007 and July 7 to July 17, 2008 were collected. The billing records included the following information for each encounter: provider name, medical record number (MRN), date of birth (DOB), gender, date of service (DOS) and ICD 9 Coding. Additionally, an electronic chart review was performed to add follow up appointments dates to the data set. For encounters in 2005, completed appointments within three years of the patient’s initial appointment were recorded. The three-year interval complies with insurance billing cycles, which categorize patients as established as long as they are seen within three years. For encounters in 2007 and 2008, follow up appointments included both completed appointments and prospective pending patient appointments.

Eligible patients included those patients seen in the MGH Medical Dermatology Clinic during the aforementioned dates. Appointments at satellite outpatient sites were included when the practitioner was providing follow ups to the same patients in their other clinic locations. Patients concomitantly being seen in MGH Pigmented Lesion Clinic were excluded; these patients require a previous diagnosis of melanoma to gain access to the clinic. Wait times and operations in this clinic were not consistent with the General Medical Dermatology Clinic. Patients seen in the
Results

Data were collected on a total of 2,428 patient encounters from 2005, 2007 and 2008. The final year (2008) accounts for the majority of the data, due to the longer eligibility period for that year and growth of clinic volume. A summary of patient demographics is shown in Table I and reveals that the typical patient is middle aged and the patient population includes a higher percentage of women than men. The average follow up interval for the samples ranged from 22 to 34 weeks (Table 1).

For each year of data collected, the patients not returning were counted to determine the exit rate. These rates, shown in Table 2, represent the patients who do not pursue further care in the MGH Dermatology Clinic. The new patient exit rate, or NPER, represents the fraction of new patients who do not return following their initial office visit. To adjust for the longer follow up intervals available for 2005 and 2007, a one year exit rate was calculated. The one year exit rate assumes that patients who did not return to the clinic within 56 weeks were likely a PRN population who choose to seek care at later date. The observed one year NPER decreases between each of the population samples from 60.7 percent in 2005 to 44.0 percent in 2008. The established patient exit rate, or EPER, observed for the MGH Dermatology Clinic population was significantly lower than the NPER. Once a patient returns for follow up, their discharge rate falls to nearly half of that observed for new patients. The clinic experienced declining EPER over the three samples from 26.2 percent in 2005 to 19.9 percent in 2008. Reason for ending care was not specified in this study but could be a result of condition improvement or resolution, referral back to general practitioner, change in health insurance, patient relocation, patient preference, or in the case of 2007 and 2008 data, insufficient time lapse for appointment.

A number of variables were identified as possible follow up interval predictors, including patient demographics, physician experience, new versus established patient status, and diagnosis code. These variables were included in a multivariable regression analysis.
The analysis identified patient age, physician experience, certain diagnoses (dermatitis, warts, neoplasm, melanoma, nonmelanoma skin cancer, dermatoheliosis, nevus, and seborrheic keratosis) as statistically significant (p value < 0.05) predictors of follow up intervals for the 2008 data set (Table 3). Interestingly, physician experience, defined by the number of years since completion of residency, was also found to be a significant predictor of follow up interval. Physicians less than five years out of residency on average provided patients with shorter follow up times than more experienced physicians. The average follow up interval increased for physicians five to 10 years after training and plateaued after 10 years of practice.

Diagnoses were studied further in order to assign a clinical context to the follow up intervals. The various ICD9 codes were grouped into the common dermatological complaints as shown in Table 4. The data were used to calculate diagnosis-specific exit rates, mean follow up intervals, and median follow up intervals.

Diagramed in Figure 1, an operational model of the clinic was built to identify a steady state. As defined in Table 5, the model includes eight parameters: capacity (C), established patient (EP), established patient appointment percentage (EP%), established patient appointment rate (EPAR), established patient exit rate (EPER), new patients (NP), new patient appointment percentage (NP%), and new patient exit rate (NPER). The model consists of two guiding relationships: capacity equation and steady state equation.

**Capacity Equation:** \( C = EP \times EPAR + NP \)

**Steady State Equation:** \( EP = EP \times (1 - EPER) + NP \times (1 - NPER) \)

The capacity equation assumes that the number of appointments equals the established patient pool multiplied by the rate of appointment per patient plus the volume of new patients. Note that the time period remains unspecified; the model can apply to any time period. Steady state is defined as a state where parameters remain fixed over time. In order to achieve steady state, the established patient pool must remain consistent over time. Hence, the established patient pool must equal the established patient pool times the percent of patients pursuing follow up plus the number of new patients times the percent of patients pursuing follow up. The model assumes fixed capacity. It also assumes that the EPAR, EPER, and NPER are given based on the observed clinic parameters. From these four variables, it is possible to calculate the allocation of appointments to new patients and established patients in the clinic. Varying EPAR, EPER, and NPER within the model results in the sensitivity analysis shown in Tables 6-8. Using the tables, one can see that in order to adjust the steady state from the current 15 percent allocation of appointments to new patients to 20 percent—a 33 percent increase in new patient volume—a clinic manager could adjust EPAR from 2 to 1.5, EPER from 20 to 25 percent or NPER from 45 to 60 percent.

**Discussion**

Like many other fields of medicine, dermatology is plagued by increasingly lengthy wait times for new patient appointments. We are at the beginning of determining how these delays in patient care affect patient outcomes, but we know they certainly affect patient and physician satisfaction. This study approaches the issue from a business operations perspective. Assuming a fixed supply of an individual clinic, how can physicians adjust their clinical practice in order to reach a steady state of clinic operations that

<table>
<thead>
<tr>
<th>Table 3. Variables Influencing Follow Up Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
</tr>
<tr>
<td>&lt; 30 years (11.8%)</td>
</tr>
<tr>
<td>30-50 years (26.1%)</td>
</tr>
<tr>
<td>&gt; 50 years (59.9%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Weeks</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (44.3%)</td>
<td>23</td>
<td>0.226</td>
</tr>
<tr>
<td>Female (55.7%)</td>
<td>22</td>
<td>0.226</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New/Established Patients</th>
<th>Weeks</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Established</td>
<td>23</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years of Physician Experience</th>
<th>Weeks</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 years</td>
<td>15</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>5 to 10 years</td>
<td>22</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt; 10 years</td>
<td>26</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* p value <0.05 in multivariable regression.

† T Test and ANOVA were used to compare the means follow up times between categories.

The analysis identified patient age, physician experience, certain diagnoses (dermatitis, warts, neoplasm, melanoma, nonmelanoma skin cancer, dermatoheliosis, nevus, and seborrheic keratosis) as statistically significant (p value < 0.05) predictors of follow up intervals for the 2008 data set. Interestingly, physician experience, defined by the number of years since completion of residency, was also found to be a significant predictor of follow up interval. Physicians less than five years out of residency on average provided patients with shorter follow up times than more experienced physicians. The average follow up interval increased for physicians five to 10 years after training and plateaued after 10 years of practice.

Diagnoses were studied further in order to assign a clinical context to the follow up intervals. The various ICD9 codes were grouped into the common dermatological complaints as shown in Table 4. The data were used to calculate diagnosis-specific exit rates, mean follow up intervals, and median follow up intervals.

Diagramed in Figure 1, an operational model of the clinic was built to identify a steady state. As defined in Table 5, the model includes eight parameters: capacity (C), established patient (EP), established patient appointment percentage (EP%), established patient appointment rate (EPAR), established patient exit rate (EPER), new patients (NP), new patient appointment percentage (NP%), and new patient exit rate (NPER). The model consists of two guiding relationships: capacity equation and steady state equation.

**Capacity Equation:** \( C = EP \times EPAR + NP \)

**Steady State Equation:** \( EP = EP \times (1 - EPER) + NP \times (1 - NPER) \)

The capacity equation assumes that the number of appointments equals the established patient pool multiplied by the rate of appointment per patient plus the volume of new patients. Note that the time period remains unspecified; the model can apply to any time period. Steady state is defined as a state where parameters remain fixed over time. In order to achieve steady state, the established patient pool must remain consistent over time. Hence, the established patient pool must equal the established patient pool times the percent of patients pursuing follow up plus the number of new patients times the percent of patients pursuing follow up. The model assumes fixed capacity. It also assumes that the EPAR, EPER, and NPER are given based on the observed clinic parameters. From these four variables, it is possible to calculate the allocation of appointments to new patients and established patients in the clinic. Varying EPAR, EPER, and NPER within the model results in the sensitivity analysis shown in Tables 6-8. Using the tables, one can see that in order to adjust the steady state from the current 15 percent allocation of appointments to new patients to 20 percent—a 33 percent increase in new patient volume—a clinic manager could adjust EPAR from 2 to 1.5, EPER from 20 to 25 percent or NPER from 45 to 60 percent.
permits a higher flow of new patients into the clinic practice and therefore decreases patient wait times?

In order to consider the operations of the clinic from this perspective, a model of a traditional outpatient clinic was built. As shown in Figure 1, the operations of the clinic resemble a circuit. There is a flow of patients through the clinic that is limited by the clinic’s maximum capacity. The flow into the clinic is comprised of two patient groups: new patients and established patients. Once the patients receive care, they exit in one of two groups: no follow up required or follow up required. The percent of patients discharged represent the patient exit rate. The remaining patients filter into the established patient pool to return for follow up care in the clinic. To achieve steady state, the number of established patients within the system must remain constant each year. Therefore, the number of established patients leaving the system each time period \([EP \times EPER]\) must equal the number of new patients entering the established patient pool \([NP \times (1-NP)]\). From the parameters of the clinic, one can predict the percent of appointments allocated to new patients and the percent of appointments remaining for established patients. Note that exit rates and appointment frequency become the key predictors of resource allocation. Introducing new or eliminating current parameters of the model allows us to consider different factors that affect clinic steady state including growth of clinic capacity and efficiency of the clinic capacity. While this model assumes that new patient appointments and established patient appointments are interchangeable, additional parameters could be added to account for the lengthier new patient appointments. Because of the assumption of equity between new and established patient appointments, the model likely overestimates the flow of new patients through the clinic.

As expected, applying the model to the actual clinic operations reveals a large disparity between the actual clinic operations and steady state. In practice, the MGH clinic allocates approximately 20 percent of appointments to new patients. However, each week the clinic faces approximately 30 last-minute add-on appointments. Using the observed follow up intervals and exit rates, the steady state allows only 15 percent of appointments to be allocated to new patients in order to maintain sufficient follow up appointment slots. Recognizing the discordance, we can review the importance of key parameters in context of the model.

Exit rate determines the number of patients who share the clinic resources (i.e., appointment slots) and consequently could be a target of change. The MGH clinic has experienced decreasing exit rates over time therefore forcing a larger patient population to share those appointments allocated to follow up appointments. By discharging stable patients, the clinic could potentially increase access to other patients. The caveat to a higher exit rate is that patients must be sta-
ble enough to be managed by primary care or not require follow up. Establishing industry standards for discharge and follow up times would allow clinicians to analyze the efficiency of their own practice.

Physician determined follow up intervals represent patient appointment frequency and therefore affect the number of patients able to consume the clinic resources in a given time period. The data revealed that, in addition to diagnosis, a number of factors affect follow up intervals. While many of these relationships are intuitive, it does not mean that they are efficient. For example, there are multiple explanations for the variation in follow ups between physician experience groups: different patient populations, varying severity of illness, length of relationship with patient, and physician comfort. However, should less experienced physicians on average be providing patients with shorter follow up intervals? Evidence based guidelines for disease follow up have the potential to guide practitioners to more appropriate follow up times. Unfortunately, a thorough literature review of each of the diagnoses revealed a lack of evidence based recommendations on follow up times for all diagnosis except verruca. The literature suggests cutaneous verruca require cryotherapy treatment every three weeks for optimal efficacy. Yet, the mean follow up interval is 12 weeks for these patients, which suggesting that the follow up intervals should be shortened for more effective treatment.

While this type of analysis may seem fairly obvious, it does not appear to be frequently performed. In our case, it led to some important observations and subsequent changes in operations of the clinic that were able to drive down wait times. First we had been unaware that exit rates for established patients were so low. In an era where patients often switch insurance, relocate, and are encouraged to use primary care before specialty services, the retention rate was surprisingly high. This finding underscores the importance of managing follow up intervals aggressively, since they drive most of the demand in the clinic. Conversely, we were struck that the exit rate for new patients was relatively high, suggesting that seeing a substantial number of new patients was not likely to stress the follow up system as severely as we had feared. Similarly, it was not obvious before this analysis that the absolute queue for services was not that long compared to the volume of patients seen weekly. Indeed, our five month queue of new patients was made up of approximately 3,000 patients, and the clinic is able to accommodate approximately 850 patient appointments (new and established) per week. These findings led us to believe that seeing consolidated numbers of new patients and adding two new mechanisms—an urgent access clinic for new patient referrals or scheduling occasional weeks dedicated to seeing new patients—could substantially reduce our waits for new patient appointments. Indeed, by changing our new patient volume with these measures and adjusting our ratio of new to established patients from 20 percent to 29 percent, we have decreased our waits by 40 percent, down to approximately three months.

Lastly, it is clear that a huge amount of work remains to be done in terms of determining adequate and appropriate follow up intervals for common dermatologic diseases. The literature in this area is almost non-existent and critically needed.

These results are limited by the fact that the study only included the MGH Medical Dermatology Clinic. The follow up intervals are diagnosis specific. However, the clinic operations model should be applicable to fields of medicine delivering care via outpatient clinics and highlights the importance of evaluating operational patterns in a systematic way.

**Conclusion**

Simply having health insurance no longer guarantees an individual access to care. Our model shows that the current state of operations in the MGH clinic is far from its optimal steady state, and adjusting follow up

---

### Table 5. Simplified Steady State: No New Patients.

<table>
<thead>
<tr>
<th>Established Patients Exit Rate (EPER)</th>
<th>Avg. Appointment/ Patient, Y 1</th>
<th>Avg. Appointment/ Patient, Y 2</th>
<th>Avg. Appointment/ Patient, Y 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10%</td>
<td>1.11</td>
<td>1.23</td>
<td>1.37</td>
</tr>
<tr>
<td>20%</td>
<td>1.25</td>
<td>1.56</td>
<td>1.95</td>
</tr>
<tr>
<td>30%</td>
<td>1.43</td>
<td>2.04</td>
<td>2.92</td>
</tr>
</tbody>
</table>
patterns—both appointment intervals and exit rates—requires substantial changes in our attitudes towards delivery of care. Using this model may be instructive in other outpatient clinic settings. Applying the model to a clinic allows managers to analyze how changes in allocations of new and existing patient appointments and follow up intervals may affect the overall steady state, and therefore wait times, to their clinics. The model has potential to guide operation adjustments to achieve specific goals in delivery of care. At one extreme, for example, the University of Michigan’s Department of Dermatology modified its clinical practice by eliminating follow up appointments and referring all patients to follow up with their general practitioner and achieved substantial changes in their wait queue.13

Ultimately as we address imbalances in the system, physicians in similarly backlogged specialties will need to review follow up intervals and exit rates in order to identify potential areas of resource reallocation.

No funding was provided to support the study and the authors report no relevant disclosures. • N one of the authors had any conflicts of interests or financial relationships to influence the data. No financial or material support was used to fund the study.

Anne James Goldsberry, M.D., M.B.A., Department of Dermatology, Northwestern Memorial Hospital.

Patricia M. Sullivan, Department of Dermatology, Harvard Medical School.

Alexa Boer Kimball, M.D., M.P.H., Department of Dermatology, Harvard Medical School.


### Table 6. Steady State: New and Established Patients

<table>
<thead>
<tr>
<th>Established Patients Exit Rate (EPER)</th>
<th>New Patient Exit Rate (NPER)</th>
<th>Average Appointment Per Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0%</td>
<td>0.81</td>
</tr>
<tr>
<td>10%</td>
<td>0%</td>
<td>0.88</td>
</tr>
<tr>
<td>20%</td>
<td>0%</td>
<td>0.97</td>
</tr>
<tr>
<td>20%</td>
<td>15%</td>
<td>1.00</td>
</tr>
<tr>
<td>20%</td>
<td>30%</td>
<td>1.04</td>
</tr>
<tr>
<td>20%</td>
<td>45%</td>
<td>1.08</td>
</tr>
<tr>
<td>30%</td>
<td>45%</td>
<td>1.21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observed EPER</th>
<th>Observed NPER</th>
<th>Observed Average Aptomt. Per Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.9%</td>
<td>44.0%</td>
<td>1.736</td>
</tr>
</tbody>
</table>