Open-Access Appointment Scheduling in Family Practice: Comparison of a Demand Prediction Grid With Actual Appointments

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Background: Inadequate access to their primary care physician remains a major reason for patient dissatisfaction in ambulatory care. The concept of open-access appointment scheduling has been found to accommodate patients’ urgent health care needs while providing continuous, routine care. We describe the development of a demand prediction grid for future appointments, compare it with one developed by Kaiser Permanente, and compare the predictions with actual appointments made and held in our clinic.

Methods: Using adjusted 1999 appointments based on historical data for the Scott & White Killeen Clinic (>75,000 annual appointments; 13 family physicians), we computed appointment predictions for calendar year 2000 by day of the week and by month of the year. We then compared our predictions with those of Kaiser and actual appointments for the first half of 2000.

Results: Our data and the Kaiser data agreed on the day of week, but they were different for the summer and winter months. Overall, actual appointments made and held at our clinic for January through June 2000 were within 6% of the predictions. Appointments for January and February were 18% and 4% more than the predictions, respectively, while appointments for March were 3% less than the predictions. Appointments for April through June were 3% to 7% more than the predictions. Few daily variations were observed between actual appointments and predictions.

Conclusions: We conclude that the Kaiser data might be tempered by a different climate, underscoring the need for each practice to develop its own demand prediction grid. That our actual appointments were 6% more than predicted overall but fluctuated month by month reemphasizes the need for continuous monitoring of the adjustment factor for prediction. (J Am Board Fam Pract 2001;14:259–65.)

Physicians who practice in ambulatory primary care are currently facing tremendous challenges in meeting the high demand for instant access to health care. This demand is clearly reflected in both ambulatory care standards and managed care standards. Inadequate access to their primary care physician remains a major reason for patients’ dissatisfaction in ambulatory primary care. In the United States, the average waiting period for a routine medical appointment is at least 3 weeks. The concept of open-access appointment scheduling has been recognized as one way to accommodate patients’ urgent health care needs while providing continuous, routine care as demanded in primary care, enriching service, using better available physician time, and improving the use of other provider resources.

Open access is the practice of scheduling patient appointments so that appointment slots are deliberately left vacant for daily access on demand. These appointment slots can then be used by patients in the physicians’ panels at the clinic. The aim of this concept is to provide patients, if they wish, an appointment with the provider of their choice on the day that they call. The basis of the open-access concept is the assumption that demand for same-day appointments can be predicted in any practice, and this demand prediction can be used to determine actual patient appointments by day of the week and by month of the year. In general, an open-access appointment-scheduling system should result in improved patient access to health care in a timely fashion.
Using the open-access appointment-scheduling concept requires aggressive management to predict accurately patient volume and the required staffing patterns. A prediction grid for forecasting same-day appointment demand is critical for implementation. Unfortunately, however, many providers who want to start open access do not have the demand prediction grid, particularly in the absence of a sophisticated electronic medical records system. Developing a prediction grid can be challenging. Although it is possible to depend on a prediction grid developed in a practice other than one’s own, it is important to consider certain differences that can exist between practices. For example, many practices might be tempted to use a prediction grid developed by Kaiser Permanente (personal communication, Sue Herriott, RN, MA, Carle Clinic, Champaign, Ill, 1 and 2 October 1997), which, to our knowledge, is the only one available.

In this article, we describe the development of a patient appointment demand prediction grid for one of the 18 regional family practice clinics of the Scott & White Health Care System. We then compare this grid with one developed by Kaiser by day of the week and month of the year, as well as with actual patient appointments made and held at our clinic during a 6-month period.

Methods

The Scott & White Killeen Clinic is one of 18 regional clinics of the Scott & White Health Care System. Scott & White is a large integrated health care delivery system that includes a 600-physician multispecialty clinic with more than 1.2 million outpatient visits per year, a 166,000-member managed care program, and 18 regional clinics. Killeen Clinic is located in a dynamic, thriving area of west Bell County in Central Texas and serves residents of Coryell, Lampasas, and Bell counties. It also draws patients from the nearby Fort Hood military base. Opened in September 1980, the clinic has recently been expanded to better meet the needs of patients. Primary care for all patients – from newborn to senior citizens – is available under one roof, with 13 family physicians, 9 family practice residents, 2 pediatricians, 1 pediatric nurse practitioner, and 1 occupational medicine physician. This clinic recorded 76,584 patient visits in 1999.

Among the components of the highly sophisticated Scott & White computer-based information system is a data warehouse, which aggregates and makes available data from the billing system and the appointment system, as well as patient demographic data, including patient scheduling data from all 18 regional clinics. The data reside in an Oracle database and can be accessed by any of 40 managers and administrators who have been selected to represent all departments in the organization. These managers and administrators have been given special training in the use of the software system used to access the data warehouse.

The appointment demand prediction grid was generated by defining, within the data warehouse, the variables available for analysis, the types of appointments required, and the types of date and time data required. We defined a same-day appointment as one made and held within 24 hours. The actual numbers of same-day appointments made and held at the Killeen Clinic by day of the week and month of the year for the calendar year 1999 were downloaded from the Scott & White data warehouse onto a spreadsheet (Table 1). We then computed the average number of same-day appointments per day made and held for 1999. Using this statistic and the actual appointments extracted from the data warehouse, the percentage of same-day appointments needed by day of the week and month of the year was computed to complete the appointment demand prediction grid (Table 1).

Predicted appointments for calendar year 2000 by day of the week and month of the year were computed using the historical data generated from the grid and an adjustment factor based on subjective forecasting of whether the clinic will experience growth, decline, or be stagnant. For instance, to make predictions for January 2000, the appointments made for the last 6 months were studied, along with the historical data for the month of January (eg, January 1998 and January 1999). Additionally, growth in panel size from managed care payers was considered. The adjustment factor selected and applied to predict appointments for January through March 2000 was 5%. This factor, however, varied depending on the degree of deviation of actual appointments from that predicted. The initial data were copied to an Excel spreadsheet for analysis, and the demand was graphed over time.

We compared our grid with one developed by Kaiser by day of the week and month of the year.
We then compared our predictions with actual patient appointments made and held in our clinic for January through June 2000. Actual patient appointments made and held for calendar year 2000 were computed as the mean of the number of same-day appointments and those made within 24 hours of the appointment. The chi-square test for trend was used to check for statistical significance in trends.

**Results**

**Appointment Demand Prediction Grid**

From the historical data obtained from the data warehouse, the actual same-day appointments made and held by day of the week and by month of the year for calendar year 1999 are displayed in Table 1. The average number of same-day appointments per day made and held for 1999 was subsequently computed to be 113. Based on this statistic, the percentage of same-day appointments needed by day of the week and by month of the year for 1999, which would be needed for future predictions, was computed as shown in parentheses in Table 1.

**Predicted Appointments for Calendar Year 2000**

Based on the generated appointment demand prediction grid displayed in Table 1, the predicted appointments for calendar year 2000 were computed using an adjustment factor of 5% to 8%; 5% for January through March, 8% for April and May, and 5% for June (Table 2).

**Comparison of the Scott & White Killeen Clinic Grid with the Kaiser Grid**

For each week, the demand prediction for same-day appointments in our clinic generally decreased dramatically from Mondays to Wednesdays and tapered off through Fridays. The decrease from Mondays to Tuesdays was significantly higher than the decrease from Tuesdays to Wednesdays ($P < .01$). On the whole, however, our data agreed with the Kaiser data by the day of the week (Figure 1).

Regarding month of the year, our demand prediction was highest for the months of March and December, and lowest for the months of June and August. Comparing our data with the Kaiser data showed a difference for the summer and winter months. While our appointment demand prediction dropped for the months of June through August and rose between October and December, the Kaiser grid remained fairly constant during the 12 months (Figure 2).

**Comparison of Predictions with Actual Appointments**

Overall, actual patient appointments made and held for January through June 2000 in our clinic were 6% more than the predicted numbers. Actual appointments made and held for January and February were 18% and 4% more than the predicted numbers, respectively, while appointments for March were 3% less than the predicted numbers, although the adjustment factor for this period was

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Table 1. Same-Day Appointments by Day of Week and Month of Year, Scott & White Killeen Clinic, 1999.

<table>
<thead>
<tr>
<th>Month</th>
<th>Monday No. (%)</th>
<th>Tuesday No. (%)</th>
<th>Wednesday No. (%)</th>
<th>Thursday No. (%)</th>
<th>Friday No. (%)</th>
<th>Average No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>143 (127)</td>
<td>128 (114)</td>
<td>117 (104)</td>
<td>114 (101)</td>
<td>110 (98)</td>
<td>122 (109)</td>
</tr>
<tr>
<td>February</td>
<td>147 (131)</td>
<td>128 (114)</td>
<td>117 (104)</td>
<td>111 (99)</td>
<td>117 (104)</td>
<td>124 (110)</td>
</tr>
<tr>
<td>March</td>
<td>160 (142)</td>
<td>129 (115)</td>
<td>129 (115)</td>
<td>121 (107)</td>
<td>112 (99)</td>
<td>130 (116)</td>
</tr>
<tr>
<td>April</td>
<td>152 (135)</td>
<td>111 (99)</td>
<td>109 (97)</td>
<td>100 (89)</td>
<td>100 (89)</td>
<td>114 (102)</td>
</tr>
<tr>
<td>May</td>
<td>114 (101)</td>
<td>107 (95)</td>
<td>94 (81)</td>
<td>98 (87)</td>
<td>97 (86)</td>
<td>102 (90)</td>
</tr>
<tr>
<td>June</td>
<td>117 (104)</td>
<td>95 (84)</td>
<td>77 (68)</td>
<td>88 (78)</td>
<td>87 (77)</td>
<td>93 (82)</td>
</tr>
<tr>
<td>July</td>
<td>126 (112)</td>
<td>105 (93)</td>
<td>81 (72)</td>
<td>87 (77)</td>
<td>86 (76)</td>
<td>97 (86)</td>
</tr>
<tr>
<td>August</td>
<td>122 (108)</td>
<td>93 (83)</td>
<td>80 (71)</td>
<td>84 (73)</td>
<td>88 (78)</td>
<td>93 (83)</td>
</tr>
<tr>
<td>September</td>
<td>124 (110)</td>
<td>97 (86)</td>
<td>97 (86)</td>
<td>98 (87)</td>
<td>128 (114)</td>
<td>109 (97)</td>
</tr>
<tr>
<td>October</td>
<td>145 (129)</td>
<td>101 (90)</td>
<td>99 (88)</td>
<td>106 (94)</td>
<td>108 (96)</td>
<td>112 (99)</td>
</tr>
<tr>
<td>November</td>
<td>151 (134)</td>
<td>118 (105)</td>
<td>105 (93)</td>
<td>105 (93)</td>
<td>119 (106)</td>
<td>120 (106)</td>
</tr>
<tr>
<td>December</td>
<td>166 (147)</td>
<td>137 (122)</td>
<td>124 (110)</td>
<td>132 (117)</td>
<td>116 (103)</td>
<td>135 (120)</td>
</tr>
<tr>
<td>Average</td>
<td>139 (123)</td>
<td>113 (100)</td>
<td>102 (91)</td>
<td>104 (92)</td>
<td>106 (94)</td>
<td>113 (100)</td>
</tr>
</tbody>
</table>

*Note:* Numbers in parentheses represent percent of the average same-day appointments per day of 113.
5%. Appointments for April through June were 3% to 7% more than the predicted numbers. The ad-
justment factor for this period was 8% for April and May, and 5% for June (Table 2).

On average, the number of daily appointments made and held were 8% more than predicted dur-
ing the 6-month period. The highest daily variation occurred in January, where, on average, there were 29 more actual appointments made and held than predicted. The least daily variation was observed in March and June where, on average, there were 4 fewer actual appointments made and held (March) and 3 more actual appointments made and held (June) than predicted (Table 2).

**Discussion**

Access to health care in a timely manner has been the subject of much discussion, particularly in the primary care setting. Previously defined in terms of

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**Table 2. Comparison of Predicted and Actual Appointments Made by Patients.**

<table>
<thead>
<tr>
<th>Month of the Year 2000</th>
<th>Day of the Week</th>
<th>Predicted Appointments for 2000*</th>
<th>Actual Patient Appointments Made and Held for 2000</th>
<th>Difference (Actual-Predicted)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Same-Day Within 24 h Average Daily Average</td>
<td>Daily Average Percent Difference</td>
</tr>
<tr>
<td>January</td>
<td>Mon</td>
<td>150</td>
<td>188 190 189</td>
<td>39 29 18</td>
</tr>
<tr>
<td></td>
<td>Tues</td>
<td>134</td>
<td>159 189 174</td>
<td>40 18 2</td>
</tr>
<tr>
<td></td>
<td>Wed</td>
<td>123</td>
<td>137 157 147</td>
<td>24 10 1</td>
</tr>
<tr>
<td></td>
<td>Thurs</td>
<td>120</td>
<td>129 150 140</td>
<td>20 6 1</td>
</tr>
<tr>
<td></td>
<td>Fri</td>
<td>116</td>
<td>126 147 137</td>
<td>21 9 1</td>
</tr>
<tr>
<td>February</td>
<td>Mon</td>
<td>154</td>
<td>162 165 164</td>
<td>10 5 4</td>
</tr>
<tr>
<td></td>
<td>Tues</td>
<td>134</td>
<td>125 150 138</td>
<td>4 2 2</td>
</tr>
<tr>
<td></td>
<td>Wed</td>
<td>123</td>
<td>127 159 143</td>
<td>20 6 1</td>
</tr>
<tr>
<td></td>
<td>Thurs</td>
<td>117</td>
<td>104 127 116</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>Fri</td>
<td>123</td>
<td>108 128 118</td>
<td>(5)</td>
</tr>
<tr>
<td>March</td>
<td>Mon</td>
<td>168</td>
<td>171 171 171</td>
<td>3 (4)</td>
</tr>
<tr>
<td></td>
<td>Tues</td>
<td>135</td>
<td>118 157 138</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Wed</td>
<td>135</td>
<td>104 130 117</td>
<td>(18)</td>
</tr>
<tr>
<td></td>
<td>Thurs</td>
<td>127</td>
<td>110 136 123</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>Fri</td>
<td>118</td>
<td>101 129 115</td>
<td>(3)</td>
</tr>
<tr>
<td>April</td>
<td>Mon</td>
<td>164</td>
<td>166 166 166</td>
<td>2 7 5</td>
</tr>
<tr>
<td></td>
<td>Tues</td>
<td>120</td>
<td>118 155 137</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Wed</td>
<td>118</td>
<td>108 134 121</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Thurs</td>
<td>108</td>
<td>98 122 110</td>
<td>2</td>
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<td></td>
<td>Fri</td>
<td>108</td>
<td>104 131 118</td>
<td>10</td>
</tr>
<tr>
<td>May</td>
<td>Mon</td>
<td>123</td>
<td>133 133 133</td>
<td>10 8 7</td>
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<td></td>
<td>Tues</td>
<td>116</td>
<td>121 149 135</td>
<td>19</td>
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<td>Wed</td>
<td>102</td>
<td>100 131 116</td>
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<td>Thurs</td>
<td>106</td>
<td>94 117 106</td>
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<td></td>
<td>Fri</td>
<td>105</td>
<td>94 116 105</td>
<td>0</td>
</tr>
<tr>
<td>June</td>
<td>Mon</td>
<td>123</td>
<td>118 119 119</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>Tues</td>
<td>100</td>
<td>97 131 114</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Wed</td>
<td>81</td>
<td>76 97 87</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Thurs</td>
<td>92</td>
<td>87 105 96</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Fri</td>
<td>91</td>
<td>78 96 87</td>
<td>(4)</td>
</tr>
</tbody>
</table>

*Inflated by 5% adjustment factor for January through March, by 8% for April and May, and by 5% for June.
†Denotes negative numbers.
the ease with which insured persons received care, access has been redefined as "the ability to seek care from the provider of choice at the time a patient chooses." Consequently, several methods to improve access to health care have also recently been described. Although the open-access appointment-scheduling concept has been touted as one of the acceptable and promising methods, it is still in a developmental stage. Based on the premise that demand for health care is predictable, we sought to develop a patient appointment demand prediction grid for future appointments at one of our 18 regional clinics. The grid we chose was similar to those developed by pioneers of the open-access appointment-scheduling concept. Actual appointments made and held in our clinic overall for the 6 months were 6% more than our demand predictions but compared well with an 8.1% prediction accuracy reported in one clinic setting in Denver, Colo, which used a simple prediction equation.

In our prediction grid, we selected 5% as the adjustment factor for the first 3 months. The choice of 5%, although somewhat arbitrary, was partly based on the change in our health plan population, which accounts for about 70% of all visits to this clinic. Although the overall actual appointments made and held for the first quarter of 2000 was 6% more than our demand predictions, a statistic which is higher than our adjustment factor, we decided to use a higher adjustment factor for predicting the demand for subsequent months. This decision was based on the gradual drop from 18% more than our predictions in January to 3% less than our predictions in March. We believe that our predictions for January might have been inaccurate because we did not factor in the major holiday before the first Monday in January. Not surprisingly, when we increased the adjustment factor to 8% for April and May, the actual appointments made and held started to top our predictions again, leading us to revert to a 5% adjustment factor for June. Because of the acceptance of the concept by our physicians, however, even when demand exceeded predictions, we were generally able to see all...
accessing patients the same day without any of them being turned away at any day.

A few limitations in our method deserve mention. First, we believe that our own methodology will change and improve as our data warehouse improves. Definitions of computer fields change with the regular process of problem identification within our medical informatics framework. The development of an appointment demand prediction grid without the use of an electronic data system might well be possible, and, if done rigorously, might even better reflect the true demand. Second, our data collection and analysis were centered around the practice of family physicians. Although we believe that the same principles might eventually be applied to other specialties and subspecialties, we have no data at this time to support that assertion. Third, we do not know whether all the appointments made and held were truly necessary visits.

The ability of the physicians to accept a change in the philosophy of scheduling will have implications to the success or failure of a change of this magnitude. Acceptance from the senior staff was sought, but not measured, as we developed and implemented our open-access appointment-scheduling plan. We have continued to monitor the morale of the physicians during this time, however, and physicians are self-reporting their morale at a level of 4.5 on a simple 5-point Likert scale. This change requires a commitment from the whole staff and willingness on the part of the physicians to exercise less direct control of their daily schedules. We have observed that any one physician has the potential to dampen the success of the program.

Since accurate prediction of patient volume should allow for improved staffing and satisfaction, future studies should incorporate an evaluation component to assess patient and provider satisfaction with the open-access appointment-scheduling concept, paying attention to such outcomes as patient complaints as well as the number of patients leaving without being seen. Our experience is that aggressive daily management of appointment slots is required to capitalize on available physician time. In addition, attention should be given to factors such as the day before or after a major holiday and weather variations.

We have experienced other changes as a result of having implemented open-access appointment scheduling. Because inadequate access to care is one of the major reasons for patient dissatisfaction, we believe the vastly improved access now available to our patients has greatly increased our patient satisfaction, although this outcome has not been measured and could be slightly premature to report at this time. Nevertheless, patient satisfaction is one key reason to make patient appointment

Table 3. Summary of Key Points and Issues in Developing and Implementing Open-Access Appointment Scheduling.

- Patient demand in primary care can be predicted
- Many benefits can be realized from implementing open access
  - Increased patient access
    - Improved patient satisfaction (patients get in whenever they desire)
    - Increased continuity of care (patients are more likely to see their own physician)
    - Decreased future visits (physicians do preventive care during acute care visits)
    - Decreased telephone calls
    - Decreased nursing hours as a result of fewer telephone calls
- Open access requires a philosophical shift to do today’s work today
- Start by assessing panel size and determining the average number of SDAs in the practice, keeping in mind the seasonal variation for SDAs (in our own situation, April and October were the months closest to the average number of SDAs for the year)
  - Inquire from your HMO about the number of patients in your panel
  - Ask your receptionist to start a manual count of SDAs
  - Count active charts to get a rough estimate of panel size
- With an estimated average SDA, multiply by percentage of SDAs (shown in parenthesis of Table 1) to obtain future predictions
- Adjust numbers accordingly using your knowledge of expected growth in your panel
- Continue to monitor closely

SDA = Same-day appointments.
available on demand. The physicians report, exper-
ientially, that they are getting to see their own
patients more often. We have increased the num-
ber of patient visits significantly since the imple-
mentation of the open-access appointment sched-
uling, although this increase is, we believe, also
affected by other minor changes we have made to
become more efficient. The volume of patients
requiring assistance after hours was reduced sub-
stantially because of open access. Another dramatic
improvement we have experienced since the imple-
mentation of open-access appointment scheduling
is the reduction of the number of nurses on tele-
phones. There is less demand for triage services by
a registered nurse in a clinic using an open-access
appointment system.

Conclusions
We believe that there is some seasonality reflected
in the comparison of our data with the Kaiser data.
Although our climate is mild, we believe that the
Kaiser data reflect an even milder climate. These
results underscore the need for each practice to
develop its own demand prediction grid for future
appointments, if possible. Nonetheless, practices
might still depend on a prediction grid developed
in other practices, such as that developed by Kaiser
or reported in this article, provided due consider-
ation is given to practice differences. That our
actual appointments were 6% more than the pre-
dicted numbers overall, with month-to-month fluc-
tuations, reemphasizes the need for continuously
monitoring the demand for visits and for a predic-
tion adjustment factor in the implementation of an
open-access appointment scheduling.

For those who would like to put such a system in
place in their own setting, particularly in the ab-

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