Abstract

Objectives The NHS Plan has a target that no patient should spend longer than 4 hours in Accident and Emergency (A&E) by the end of 2004. The aim of this study is to describe the attendance characteristics of patients spending less than and more than 4 hours total time in A&E.

Methods Data were collected from 10 A&E departments in the West Midlands NHS region for the period 1 April 2001 to 31 March 2002. Patients were split into three groups; those spending less than 4 hours, between 4 and 8 hours and over 8 hours in A&E. The groups were compared in terms of their attendance characteristics, these being demography, temporal patterns, arrival mode and disposal. The data were also entered into a multinomial logistic regression using SPSS.

Results Overall, 83.0 per cent (range 76.7–94.0 per cent) of patients spent less than 4 hours in A&E; 3.6 per cent (range 0.3–8.6 per cent) spent longer than 8 hours in A&E. The risk factors for spending over 4 hours in A&E were requiring admission, arriving by ambulance, arriving during the night, increasing age and higher levels of deprivation. Being admitted had the greatest effect on time spent in A&E, with a patient being 2.64 times more likely to spend 4–8 hours and 4.84 times more likely to spend over 8 hours in the department.

Conclusions This study points to admission and service provision at night as factors leading to long periods in A&E. However, these results can only act as a guide as the problems are different in different Trusts and each should analyse their problem before taking action.

Keywords: Accident and Emergency, total time, 4 hour target, patients, attendance characteristics

Introduction

Over 14 million people use Accident and Emergency (A&E) services in the United Kingdom each year.1 In a recent MORI survey waiting times were the most important issue for improvement for A&E attenders (T. Jennings, personal communication). Patients’ perception of their care in A&E and their satisfaction with the service are highly dependent on their perception of their wait.2

Measuring the time spent waiting to see a doctor or to be found a hospital bed does not give an accurate indication of the service provided by A&E. Total time from arrival in the hospital to admission or discharge is a much more robust indicator of performance, as it gives an indication of how the whole process is performing rather than just one part of the process. This measurement of total time in A&E has been adopted by the government as one of their new targets set out in the NHS Plan.3 The plan states that no patient should spend more than 4 hours in the A&E department by the end of 2004 and a milestone of no more than 10 per cent of patients by the end of March 2003.

A wide variety of solutions have been suggested for decreasing delays in A&E4–6 and a systematic review of innovations is underway.7 To reduce the time spent in A&E it is important to understand the characteristics of those who currently endure longer stays in the department. The aim of this study is to describe the characteristics of the patients spending less than and more than 4 hours total time in A&E departments.

Data and methods

The A&E Commissioning Data Set (CDS) is collected in computerized A&E departments and records information on every attendance made. In the West Midlands NHS region the CDS from each A&E department is collected by the West Midlands Accident & Emergency Surveillance Centre, located at the University of Birmingham. For the purposes of this study, data on all A&E attendances (new and return) were obtained from the Surveillance Centre for 10 departments (out of a total of 20 across the region) for the period 1 April 2001 to 31 March 2002. Of the others, six did not submit data for the period of study and a further four were excluded due to having incomplete data (less than 95 per cent completeness of ‘Arrival time’ and ‘Departure time’ fields). Total time spent in A&E was calculated by subtracting the ‘Arrival time’ from the ‘Departure time’.

1Department of Public Health and Epidemiology, University of Birmingham, Edgbaston B15 2TT.
2South Birmingham Primary Care Trust, Moseley Hall Hospital, Birmingham B13 8JL.
3Warwick Medical School, University of Warwick, Coventry CV4 7AL.
Amy Downing,1 Research Associate
Dr Richard C. Wilson,2 Senior Public Health Information Analyst
Dr Matthew W. Cooke,3 Reader in Emergency Medicine
Address correspondence to Amy Downing.
E-mail: a.downing@bham.ac.uk

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were grouped into three categories, less than 4 hours, between 4 and 8 hours and over 8 hours.

The three groups were compared in terms of their attendance characteristics, these being demography, temporal patterns, arrival mode and disposal. The data were also entered into a multinomial logistic regression using SPSS. Arrival time (categorized as during the day (between 07:00 and 23:59) or during the night (between 0:00 and 06:59)), disposal (categorized as admitted or not admitted) and arrival mode (categorized as ambulance or other) were entered as factors, and age and Townsend score (as a measure of deprivation) as covariates. The reference category was the less than 4 hours group.

Results

There were a total of 694,962 attendances during the study period, ranging from 31,978 to 115,345 across the 10 Trusts. Five thousand nine hundred and fifty (0.9 per cent) of the records were missing the necessary time of arrival and time of departure information leaving 689,012 for analysis.

Inter-Trust variation

Overall, 83.0 per cent (range 76.7–94.0 per cent) of patients spent less than the government target of 4 hours in A&E; 3.6 per cent (range 0.3–8.6 per cent) spent longer than 8 hours in A&E (Table 1).

Age

The proportion of patients spending less than 4 hours in A&E decreased with age from 94.4 per cent in the 0–4 age group to 61.0 per cent in the over 85s (Fig. 1). Conversely, the proportions in the 4–8 hours and over 8 hours groups increased with age; 39.0 per cent of the over 85s spent longer than 4 hours in the A&E department.

Temporal patterns

The percentage of patients being discharged within 4 hours was highest for those arriving between the hours of 08:00 and 09:59 (89.0 per cent) (Fig. 2). This dropped below 80 per cent twice during the day, between 04:00 and 06:59 and between 12:00 and 13:59. The percentage of patients spending more than 8 hours in the department was highest for those arriving throughout the night (between 00:00 and 06:59).

There was some variation in the time spent in A&E by day of week. The proportion of patients spending less than 4 hours in A&E was highest at the weekend (84.5 per cent on a Saturday and 84.0 per cent on a Sunday) and lowest on a Monday (80.4 per cent).

Arrival mode

23.1 per cent of patients spending less than 4 hours in A&E arrived by ambulance and 76.9 per cent arrived by other means of transport, compared with those spending over 8 hours in the department where 66 per cent arrived by ambulance and 34 per cent by other means (Table 2). The percentage arriving by ambulance increased with age, this being most noticeable in the over 8 hours group. The average age of the patients arriving by ambulance was 52 years compared with 31 years in those arriving by other means.

Disposal

The percentage of patients discharged or referred decreased as time spent in A&E increased (Table 3). 14.7 per cent of patients in the less than 4 hours group were admitted compared with 38.5 per cent in the 4–8 hours group and 60.1 per cent in the over

### Table 1

<table>
<thead>
<tr>
<th>A&amp;E department</th>
<th>&lt;4 h (%)</th>
<th>4–8 h (%)</th>
<th>&gt;8 h (%)</th>
<th>% Over 65s</th>
<th>% Arriving by ambulance</th>
<th>% Admitted</th>
<th>Total attendances</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76.7</td>
<td>19.5</td>
<td>3.8</td>
<td>18.9</td>
<td>26.9</td>
<td>23.0</td>
<td>135099</td>
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<td>2</td>
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<td>19.6</td>
<td>3.7</td>
<td>19.0</td>
<td>42.1</td>
<td>23.0</td>
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<tr>
<td>8</td>
<td>78.9</td>
<td>12.5</td>
<td>8.6</td>
<td>19.4</td>
<td>27.0</td>
<td>18.8</td>
<td>115345</td>
</tr>
<tr>
<td>7</td>
<td>80.7</td>
<td>13.6</td>
<td>5.8</td>
<td>20.0</td>
<td>25.2</td>
<td>16.3</td>
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<td>9</td>
<td>85.4</td>
<td>12.9</td>
<td>1.8</td>
<td>15.9</td>
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<tr>
<td>6</td>
<td>87.8</td>
<td>11.2</td>
<td>1.0</td>
<td>15.7</td>
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<td>14.2</td>
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<tr>
<td>10</td>
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<td>10.3</td>
<td>2.0</td>
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<tr>
<td>3</td>
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<td>9.3</td>
<td>1.8</td>
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<tr>
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<td>8.9</td>
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<td>22.2</td>
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<tr>
<td>4</td>
<td>94.0</td>
<td>5.7</td>
<td>0.3</td>
<td>11.3</td>
<td>20.5</td>
<td>15.8</td>
<td>45039</td>
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<tr>
<td>All Departments</td>
<td>83.0</td>
<td>13.3</td>
<td>3.6</td>
<td>17.8</td>
<td>27.4</td>
<td>19.0</td>
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### Table 2

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>&lt;4 h (%)</th>
<th>4–8 h (%)</th>
<th>&gt;8 h (%)</th>
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<tr>
<td>0–14</td>
<td>11.1</td>
<td>13.5</td>
<td>15.6</td>
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<tr>
<td>15–64</td>
<td>19.8</td>
<td>34.7</td>
<td>53.0</td>
</tr>
<tr>
<td>65+</td>
<td>56.5</td>
<td>74.9</td>
<td>83.5</td>
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<tr>
<td>All ages</td>
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<td>45.3</td>
<td>66.0</td>
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8 hours group. 43.8 per cent of the over 65s were admitted compared with 13.8 per cent of the under 65s.

### Multinomial logistic regression

Increasing age, arriving by ambulance, being admitted and increasing deprivation had a positive impact on the likelihood of spending more than 4 hours in A&E, with the $B$ coefficients all being significant for both the 4–8 hours and the over 8 hours groups (Table 4). The effect of each variable increased from the 4–8 hours group to the over 8 hours group. Being admitted had the greatest effect on time spent in A&E, with a patient being 2.64 times more likely to spend 4–8 hours and 4.84 times more likely to spend over 8 hours in the department, compared with those not admitted. The model is significant at $p < 0.001$ and has an $r^2$ of 0.11.

## Discussion

The risk factors for spending over 4 hours in A&E in this study were increasing age, arriving during the night, arriving by ambulance, requiring admission and higher levels of deprivation. This was particularly the case for those spending over 8 hours in A&E.

The time spent in A&E changed with age, with older patients generally spending longer in A&E. There are many reasons for
this, such as the fact that they are more likely to require admission to hospital, are more likely to have pre-existing medical conditions and are more likely to have complex multi-system disease, which can complicate the investigation, diagnosis and treatment processes.

The highest proportion of patients spending less than 4 hours in A&E was found in those arriving at the department between 08:00 and 09:59. This is the time when attendance at A&E rises sharply and may also coincide with an increase in the number of staff working in the department. The proportion was lowest between 00:00 and 06:59. This overnight pattern coincides with the lowest staffing levels, as an increasing number of departments only have senior cover until midnight and most have only a single junior doctor on duty in A&E, hence removing any flexibility for fluctuations in workload.8,9 This may affect the amount of time taken to decide to admit a patient to a hospital bed. Patients attending through the night are more likely to be admitted. Although the proportion of attenders arriving after midnight is low the workload during this time may include a higher proportion of major trauma,10 which require a large amount of clinical input and hence have knock-on effects on other patients waiting at this time. Another potential reason for patients spending longer in A&E throughout the night is that it is harder to access support services at these times.

The proportion of patients seen within 4 hours was also relatively low between 12:00 and 13:59. Attendance at A&E peaks between 11:00 and 11:59, therefore the early afternoon is the period of highest occupancy, with more patients waiting for or receiving treatment. This may be one reason for the increased time spent in A&E. Similarly, the longest attendance times were seen on Mondays, which is the busiest day in terms of attendances (16.1 per cent of all attendances) as well as being the day when hospital bed occupancy is highest due to low levels of discharges at weekends. The shortest attendance times were found at weekends when there are fewer attendances (13.1 and 14.0 per cent of all attendances on Saturdays and Sundays, respectively).

In general, patients arriving by ambulance spent longer in A&E than those arriving by other means. Ambulance patients tend to be older and be in a more serious condition, therefore they are more likely to require more complex assessments and to be admitted. 42.2 per cent of ‘Ambulance’ arrivals were admitted compared with 10.4 per cent of ‘Other’ arrivals.

Patients requiring admission spent longer in A&E. Waiting for a bed to become available and waiting to be transferred from A&E to the ward can add substantially to the time a patient spends in A&E. Some patients may require a period of observation before a decision is taken regarding whether to admit them to hospital. However, it is not clear from the data set whether this period is included in the time recorded, and it is likely that Trusts vary with regard to this.

A high proportion (30 per cent) of patients in the over 8 hours group were discharged, and this may be an indication of patients in low triage categories waiting because of lesser clinical priority. A small proportion of patients left the department without receiving treatment (5.2 per cent) and it is assumed that this is due to long waits.11 It is possible to look at the amount of time patients wait to be seen, as ‘Time seen for treatment’ is recorded. However, this information is less reliable, and for this subset of Trusts it was only available in 73 per cent of cases.

The results of the multinomial logistic regression (see Table 4) reinforce the observation that it is the older patients awaiting admission to a bed that are the long stayers. A 75-year-old from a deprived neighbourhood, arriving by ambulance, arriving during the night and requiring admission has a 51 per cent risk of staying in A&E longer than 8 hours. If this person arrived during the day their risk of staying in A&E over 8 hours would reduce to 41.4 per cent, and if they were not admitted it would reduce to 12.7 per cent. A 25-year-old from the same neighbourhood as the 75-year-old, but who made their own way to A&E, arriving during the night and did not require admission would have a 29.9 per cent risk of staying over 4 hours, but only a 2.1 per cent risk of staying over 8 hours.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Comparison category</th>
<th>Adjusted odds ratio</th>
<th>95% Confidence interval</th>
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<tbody>
<tr>
<td>4–8 h Townsend</td>
<td>One point increase</td>
<td>1.057</td>
<td>1.055, 1.06</td>
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<td>Age (years)</td>
<td>One year increase</td>
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<td>1.014, 1.014</td>
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<td>Out of hours</td>
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<td>0.845</td>
<td>0.822, 0.867</td>
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<td>1.494, 1.549</td>
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<td>Admitted</td>
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<td>&gt;8 h Townsend</td>
<td>One point increase</td>
<td>1.076</td>
<td>1.071, 1.081</td>
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<tr>
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<td>One year increase</td>
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<tr>
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<td>1.489</td>
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<td>2.175, 2.326</td>
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<tr>
<td>Admitted</td>
<td>Yes</td>
<td>4.844</td>
<td>4.695, 4.997</td>
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</tbody>
</table>
It is possible that the age difference in the time spent in A&E reflects diagnostic and investigation process differences, however, this study was unable to use any clinical variables to assess the effect that these may have on the time spent in A&E. Diagnostic information is recorded in the CDS. However, this information is of a lower quality than the attendance information and was only available in 65 per cent of cases.

Inter-Trust variation is an important factor in the generalization of these results. As seen from Table 1, the percentage of patients seen within 4 hours varied considerably. The variables identified here will be found in all A&E departments, but in differing proportions. The problems leading to long periods being spent in A&E are different in different Trusts and so each should analyse their problem before taking action. The model provided in this study can only act as a guide to the cause of long treatment times and, as such, points to the key areas of delays in admission and the service provision at night. However, as the target is 100 per cent, all cases will eventually need addressing.

The reliability of our findings is dependent upon the robustness of the CDS. The data were extracted directly from the A&E computer systems, which are subject to internal validation checks. However, this study has to make the assumption that the information used, such as the times of arrival and departure, have been recorded correctly. Given the consistency and strength of the findings, any failing in data collection would have to be systematic across all Trusts and therefore this gives a degree of reassurance in the quality of the data.

Since this study period many hospitals have introduced initiatives to reduce waits in ambulatory patients, for example ‘See and Treat’, which is aimed at reducing long waits by patients with minor conditions. Further work is underway to determine if delays in these patients have now decreased because of this initiative. National Department of Health figures show that there has been an improvement in the total time spent in A&E – 77 per cent of patients were seen and left the department in under 4 hours in the second quarter of 2002/2003, compared with 90 per cent in the first quarter of 2003/2004. This study has demonstrated that the CDS can play a valuable role in monitoring the success of these and other interventions.

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Conflict of interest

None declared.

References


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