

1 **Older patients are more likely to breach the four-hour target in Scotland**

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53 **Older patients are more likely to breach the four-hour target in Scotland**

56 **Abstract**

58 **Objective:** To determine if age is a factor in a patients' likelihood of breaching the 4-hour  
59 time target to admission/discharge in Emergency Departments (EDs) within NHS Scotland.

61 **Methods:** We used data from the Information Service Division Scotland to analyse all ED  
62 attendances in Scotland between January 2015 and September 2018 (n= 5,596,642). We  
63 assessed the likelihood of time to admission/discharge being within 4 hours, 8 hours and 12  
64 hours for all age categories (reference category 20-24 years). Univariable logistic regressions  
65 were carried out for sex, Scottish Index of Multiple Deprivation level and both major  
66 (potentially life threatening) and minor (not immediately life threatening) incidences.

68 **Results:** The likelihood of breaching the four-hour target increased linearly with age from  
69 15-19 years upward. Patients  $\geq 85$  years were significantly ( $p < 0.001$ ) more likely to have  
70 breached than patients aged 20-24 years (Odds Ratio 3.80, 95% Confidence Interval: 3.73–  
71 3.86). When considering major incidents, patients aged  $\geq 85$  years were more likely to have  
72 breached than those aged 20-24 years (Odds ratio 2.05, 95% Confidence Interval: 2.01–2.09,  
73  $p < 0.001$ ). The same was true of minor incidents (Odds Ratio 2.85, 95% Confidence Interval:  
74 2.73-2.98,  $p < 0.001$ ).

76 **Conclusions:** Older age is associated with a higher probability of breaching waiting time  
77 targets in a linear fashion within NHS Scotland, which is consistent with previous single  
78 hospital or regional studies. This association may be due to the higher proportion of elderly  
79 patients being admitted or a more systemic issue, but regardless, the elderly are being put  
80 more at risk.

What is already known on this subject:

- Previous studies have shown longer Emergency Department waits are associated with poorer patient outcomes.
- Previous studies have come to differing conclusions of the effects of age on emergency department waiting times.
- Previous studies have covered either single hospitals or regions.

What this study adds:

- In this study covering all hospitals in Scotland, over 5.5 million Emergency Department attendances were analysed.
- Our study shows that age is associated with longer waits in Emergency Departments to admission or discharge. This has implications for the configuration of our hospitals in relation to the ageing population.

## 84 **Background**

85

86 The ageing population brings increased complexity of patient presentation to Emergency  
87 Departments (EDs), with greater comorbidities, frailty and increasing use of acute services:  
88 65% of hospital beds in England are filled with adults over 65 [1] and 75% of delayed  
89 transfers from acute care, to a stepdown level of care or to the patient's home, are attributed  
90 to adults over 75 [2].

91

92 The ED waiting time (otherwise known as length of stay) from arrival to admission/discharge  
93 target is used as a whole system barometer of performance for hospital care. Longer ED  
94 stays are associated with patient dissatisfaction [3] and poorer patient outcomes, [4] [5]  
95 including increased mortality [6].

96

97 The NHS target states that 95% of all ED attendees should be admitted, transferred or  
98 discharged within four hours [7]. Within NHS Scotland, only 53 months (40%) of 131  
99 months between July 2007 and May 2018 met the 95% 4-hour target in EDs [8].

100

101 Ideally, mature healthcare systems should be configured to meet the needs of their  
102 population, without age bias. Therefore, we should expect that ability of hospitals to meet  
103 the four-hour target would not differ by age.

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## 105 **Methods**

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107 We retrospectively analysed anonymised data extracted from the Information Service  
108 Division (ISD) Scotland, covering all ED attendances from across Scotland between January  
109 2015 and September 2018 (n=5,596,642). These data includes breaching percentage for 4, 8  
110 and 12 hour waiting times and for major (potentially life threatening) or minor (not  
111 immediately life threatening) attendances, split by age into 5 year categories (and an 85+  
112 category). The percentage of patients in each age group that were admitted was also  
113 analysed, however individual level data was not available, thus multivariable analyses could  
114 not be performed.

115

116 Gender and Scottish Index of Multiple Deprivation (SIMD) were also recorded, but not split  
117 by age. SIMD 1 indicates a patient is from a more deprived area, up to SIMD 5 which is the  
118 least deprived. SIMD from 2016 was used and was calculated based on the patient's  
119 postcode. SIMD data were not recorded in 46,416 (0.83%) attendances.

120

121 Using the age group 20-24 years as the reference category, we assessed the likelihood of time  
122 to admission/discharge exceeding 4, 8 and 12 hours for all age categories. Data were  
123 stratified by age for overall, major incident and minor incident time to admission/discharge,  
124 and also by gender & SIMD category. Univariable logistic regression models were  
125 constructed to calculate odds ratios (ORs) and 95% confidence intervals (CIs), with  
126 breaching the 4-hour target as the outcome and age, gender and SIMD category as predictor  
127 variables. Statistical significance was assumed if  $p < 0.05$ .

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## 129 **Results**

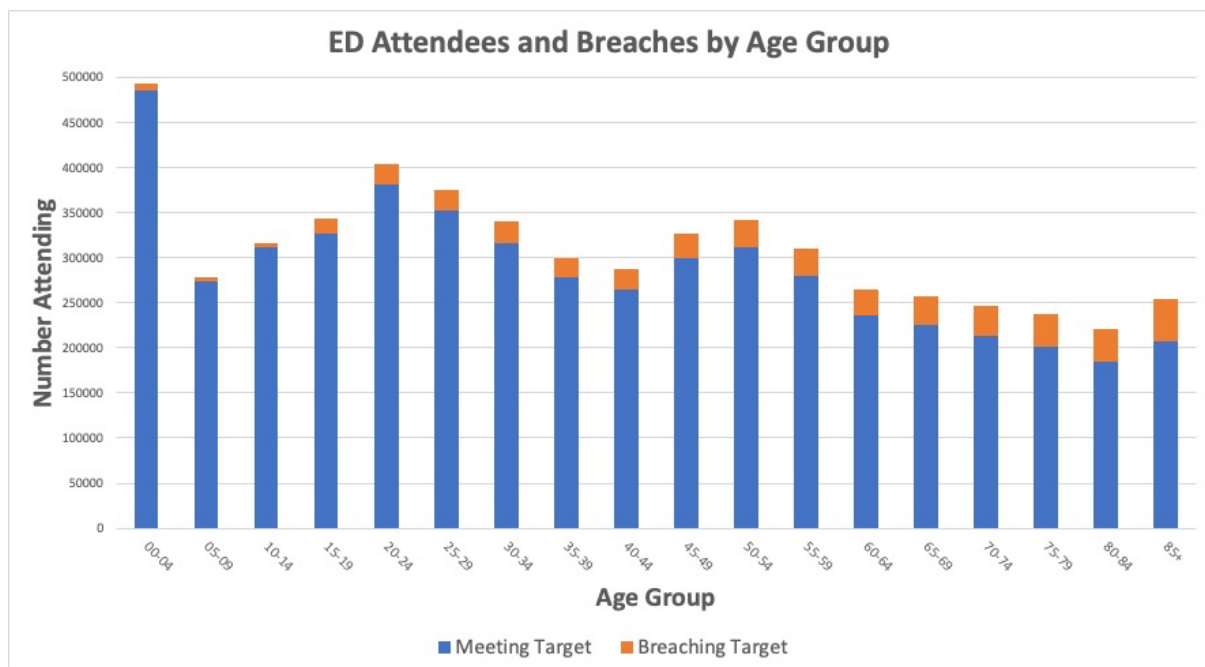
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131 The total number of attendances was 5,596,642, of which 51.1% were male. The median age  
132 of attendances was 36.8 years. Overall 8.03% of attendances breached the 4-hour target  
133 (Table 1).

Characteristic	Number of Attendances	Percentage Breaching 4 Hour Target Time
Age (Median, IQR)	38.6 (42.0)	8.03%
<b>Gender</b>		
Male	2,860,212	7.57%
Female	2,736,430	8.50%
<b>Majors/Minors</b>		
Majors	2,584,076	13.84%
Minors	3,012,566	2.13%
<b>SIMD Code</b>		
SIMD 1	1,585,758	8.49%
SIMD 2	1,264,478	7.86%
SIMD 3	1,004,983	7.06%
SIMD 4	882,127	6.63%
SIMD 5	812,880	6.80%
Missing	46,416	-

134 Table 1: Characteristics of ED attendances in Scotland from January 2015 to September 2018  
 135 (n=5,596,642) and the status of four-hour ED target. IQR = Interquartile Range, SIMD =  
 136 Scottish Index of Multiple Deprivation.  
 137

138 Figure 1 illustrates an increasing proportion of attendances breaching the 4-hour target as age  
 139 increases.  
 140  
 141



142 Figure 1: Number of ED attendees split by age and number breaching 4-hour target time  
 143 within each age category.  
 144

145 The likelihood of breaching the 4-hour target, compared to the 20-24 year age category,  
 146 increased linearly with increasing age (Table 2).  
 147  
 148

<b>Age Group (Years)</b>	<b>Percentage Admitted or Discharged Within 4 Hours</b>	<b>Odds Ratio (95% CI) of breaching 4-hour target, compared to 20-24 year age category</b>	<b>p Value</b>
00-04	98.25	0.30 (0.29 – 0.31)	<0.001
05-09	98.53	0.25 (0.25 – 0.26)	
10-14	98.29	0.30 (0.29 – 0.31)	
15-19	95.23	0.85 (0.83 – 0.87)	
20-24	94.44	1.00	
25-29	93.93	1.10(1.08 – 1.12)	
30-34	93.21	1.24 (1.21 – 1.26)	
35-39	92.65	1.35 (1.32 – 1.37)	
40-44	91.99	1.48 (1.45 – 1.51)	
45-49	91.63	1.55 (1.52 – 1.58)	
50-54	90.99	1.68 (1.65 – 1.71)	
55-59	90.26	1.83 (1.80 – 1.87)	
60-64	89.12	2.07 (2.04 – 2.11)	
65-69	87.73	2.38 (2.33 – 2.42)	
70-74	86.29	2.70 (2.65 – 2.75)	
75-79	84.92	3.02 (2.96 – 3.07)	
80-84	83.42	3.37 (3.32 – 3.43)	
85+	81.73	3.80 (3.73 – 3.86)	
<b>Gender</b>	<b>Percentage Admitted or Discharged Within 4 Hours</b>	<b>Odds Ratio (95% CI) of breaching 4-hour target compared to females</b>	
Female	91.50	1.00	0.007
Male	92.43	0.98 (0.98 - 0.99)	
<b>SIMD</b>	<b>Percentage Admitted or Discharged Within 4 Hours</b>	<b>Odds Ratio (95% CI) of breaching 4-hour target compared to SIMD category 1</b>	
SIMD 1	91.51	1.00	<0.001
SIMD 2	92.14	0.92 (0.91 - 0.93)	
SIMD 3	92.94	0.82 (0.81 – 0.83)	
SIMD 4	93.37	0.77 (0.76 – 0.77)	
SIMD 5	93.20	0.79 (0.78 – 0.79)	

149 Table 2: Odds of breaching 4-hour target for each age group compared to 20-24 years age  
150 group, odds of breaching for males compared to females and odds of breaching for SIMD  
151 categories 2-5 compared to SIMD category 1. Odds ratios, confidence intervals and p values  
152 calculated using univariable logistic regression models, with breaching the 4-hour target as  
153 the outcome and age, gender and SIMD category as predictor variables. CI = Confidence  
154 Interval, SIMD = Scottish Index of Multiple Deprivation.

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157 The 85+ age group had the highest odds of breaching (OR 3.80, 95% CI 3.73 – 3.86,  
158 p<0.001) compared to the 20-24 years age group. Similar results were observed for both 8

159 hour and 12 hour times to admission/discharge (data not shown). The percentage of patients  
160 admitted increased linearly with age from 20-24 years (12.45% admitted) upwards to the 85+  
161 age group (64.05% admitted) (data in online supplement).

162  
163 When considering major incidents, the 85+ age group again had the highest odds of  
164 breaching (OR 2.05, 95% CI 2.01 – 2.09,  $p < 0.001$ ) compared to the 20-24 years age group.  
165 The same was true of minor incidents (OR 2.85, 95% CI 2.73 – 2.98,  $p < 0.001$ ) (data not  
166 shown).

167  
168 Males were slightly less likely to breach the target compared to females (OR 0.98, 95% CI  
169 0.98 – 0.99,  $p = 0.007$ ).

170  
171 Odds ratios for 4 hour breaches compared to SIMD 1 category were 0.92 (95% CI 0.91-  
172 0.93), 0.82 (0.81 – 0.83), 0.77 (0.76 – 0.77), and 0.79 (0.78 – 0.79) for SIMD 2, 3, 4, and 5,  
173 respectively. In general, breach probability decreased with less deprivation.

174

## 175 **Discussion**

176

177 Our analysis shows a patient is more likely to stay longer in the ED the older they are. All  
178 age groups from 20 years upwards did not meet the national target of 95%, and the  
179 percentage of patients waiting longer than four hours increased with age. This is important  
180 and relevant to health services since ED waiting time to admission/discharge is often used as  
181 a hospital performance indicator.

182

183 Our results corroborate those found in a French Study, which showed age greater than 75  
184 years to be associated with increased odds of breaching waiting time within the Paris  
185 metropolitan area [9]. However, they go against the results of a study of a Chinese  
186 University hospital, which showed age greater than 70 years to be associated with higher  
187 odds of time from registration to initial diagnosis being within the target time [10]. The main  
188 difference of our study is the scale, with over 5.5 million ED attendances over approximately  
189 four years used, whereas other studies have used less than half a million attendances [8], [9],  
190 [10]. Our study covered all of Scotland, whereas most previous studies concentrated on either  
191 a single hospital [8], [10] or region [9]. Large data by Mason et al [11], which included 15  
192 NHS trusts within England, has previously shown over 65s were more likely to breach target  
193 than those under 65.

194

195 The lack of other data in our analyses, such as a lack of a measure of disease severity, time to  
196 see physician and number of investigations each patient received in the ED is a recognised  
197 limitation of our study. Unfortunately, these data and other potential confounders are not  
198 available in public domain from ISD Scotland. Perhaps the most significant limitation of our  
199 study is the lack of information on the patients disposition decision, namely if they were  
200 admitted or discharged. The percentage of patients admitted increased with age, which could  
201 account for a significant part of the relationship between age and time to  
202 admission/discharge. However, the lack of individual level data including admission status  
203 precluded the ability to perform a multivariable analysis by admission status. Future studies  
204 should address this limitation by comprehensive data collection, perhaps in a representative  
205 sample, to further explore the findings of the current study.

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207 As age increases, the likelihood of multiple comorbidities, functional deficits, sensory  
208 impairment or dependence also increases. Older patients are more likely to present severely

209 ill, shown by the greater proportion of majors presentations, and they are more likely to be  
210 admitted. This makes them more complex to assess and requires a more multidisciplinary  
211 approach, which has been shown to increase time within the department [12]. A patient with  
212 multiple comorbidities may also require more initial investigations and more discharge  
213 planning. This could provide an explanation as to why likelihood of breaching the 4-hour  
214 target increases with patient age. The higher likelihood of admission for older patients  
215 highlights the systemic challenge of hospital bed availability and its impact on downstream  
216 EDs. The findings may be related to issues specific to older patients such as more complex  
217 work-ups, greater requirement for discharge planning, greater chance of admission or some  
218 combination of all of these factors. Therefore, from the observation of the higher likelihood  
219 of breaching, we cannot make the inference that older patients are not receiving adequate care  
220 in EDs. The findings are however suggestive of the possibility of poorer outcomes in older  
221 patients.

222  
223 Our findings raise important health service delivery questions regarding older patients in  
224 emergency care settings. Whilst there have been suggestions that measures such as ‘Frailty  
225 units’ would take pressure off emergency departments [13], their clinical and cost  
226 effectiveness should be assessed properly prior to making recommendations of such health  
227 care delivery systems pan-NHS. Greater collaboration between ED staff and  
228 multidisciplinary geriatric medicine input at the front door could be a potential solution to  
229 ensure older patients receive optimal care.

230  
231 Our data does not necessarily evidence poor clinical care, since no clinical outcomes were  
232 analysed. Nevertheless, our data still shows “*a health system ill-equipped to cope with the  
233 needs of an aging population with increasingly complex clinical, care and support needs*”  
234 [14]. This therefore necessitates exploration of hospital and wider system configuration and  
235 ED processes to meet the needs of older adults [15].

## 236 **Conclusions**

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239 Older age is associated with a higher probability of breaching waiting time targets in a linear  
240 fashion within NHS Scotland, which is consistent with previous single hospital or regional  
241 studies across the globe. This association may be due to the higher proportion of elderly  
242 patients being admitted or a more systemic issue, but regardless, the elderly are being put  
243 more at risk and services need to address this.

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346 subsequently contributed numerous revisions to the final manuscript. GE is  
347 responsible for the overall content of the manuscript.  
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