Models of Primary Care Organization and the Use of Emergency Departments

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MODELS OF PRIMARY CARE ORGANIZATION AND THE USE OF EMERGENCY DEPARTMENTS

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ABSTRACT

Overcrowding in hospitals’ emergency department (ED) has often been attributed to lack of appropriate response in other parts of the health system, namely primary healthcare (PHC) institutions, but there is no definitive evidence supporting this assertion.

We use patient-level data of 117,391 ED visits from two non-urban hospitals in Portugal to assess the effect that the model of PHC organization may have on ED utilization. PHC organization for the patients in our sample differed in two dimensions: patients may be enrolled in three different types of functional units - Personalized Healthcare Unit, Family Health Unit (FHU) Type A and B; and patients may have (or not) a specific family physician assigned.

We estimate three different models using three dependent variables that describe the use of EDs: inappropriate use, rate of utilization and severity of patients.

We conclude that the model of primary care organization exerts a significant influence on the use of EDs. FHUs have a significant positive effect on reducing the rate of utilization and inappropriate attendance of EDs. FHUs also have patients with lower severity conditions. We also conclude that patients with an assigned family physician make more appropriate use of the ED.

Keywords: Overcrowding, Emergency Department, Primary care, family physician

JEL Classification: I18, I11
1. INTRODUCTION

Overcrowding in hospitals’ emergency department (ED) is one of the most reported weaknesses of the Portuguese National Health Service (NHS), and has been a feature of other health systems, especially those that share Lord Beveridge’s inspiration. In many countries, overuse of emergency departments can be explained by access and quality issues in other parts of the health system (EXPH, 2014). This paper provides an empirical contribution to the debate of whether overuse of EDs depends on the model of primary care (PHC) organization.

Portugal is the country with the highest rate of ED attendances (of the sample of 21 countries presented by Berchet, 2015), with approximately 70 visits per 100 inhabitants. This result suggests that the overcrowding of the Portuguese hospitals’ EDs may be more a result of excessive and possibly inappropriate attendance than a result of under provision of capacity in EDs. ED overcrowding in Portugal is usually attributed to the easy and flexible access to EDs compared to other sources of care in the NHS. EDs offer a simple and guaranteed access, quick and with flexible admission times. Given the generally free of charge access to the NHS, citizens can use EDs when this service is not the most appropriate given their medical condition, leading to increasing operational costs that do not counterbalance the additional value that it may bring to the well-being of the citizens (Barros et al., 2015).

Successive Portuguese governments acknowledged the ED overcrowding problem, and have promoted PHC reforms as part of the solution. Ever since the World Health Organization Alma-Ata Declaration (WHO, 1978), strengthening PHC has been regarded as the central pillar of health system reforms, and promoted as the first-contact level of the health system (Starfield, 1994). A healthcare system that is focused on PHC is better at preventing illness and death, ensuring equitable access and achieving better health outcomes (Starfield et al., 2005). The aim of hospitals, including EDs, is to give a differential response that meets the population needs. The correct articulation between PHC and hospitals enhances health improvements through an efficient and accurate continuity of care.

The articulation of PHC and hospitals, specifically the ability of PHC to promote the correct use of EDs, has been widely discussed in the literature, but without definitive conclusions. Some literature suggests an association between ED and PHC use, with ED visits appearing to be complementary, rather than substitutes, to PHC visits, suggesting that PHC-focused
interventions aimed at reducing ED use are unlikely to have a major impact (Maeng et al., 2017). Byrne et al. (2003) concluded that frequent attenders to the ED are also heavy users of general practice services, other primary care services, and other hospital services. Chan and Ovens (2002) also found that most frequent users of EDs have periodic contact with primary care physicians.

But other evidence is mixed. Cunningham et al. (2017) compared frequent and infrequent ED visitors' primary care utilization and perceptions of primary care access, continuity, and connectedness and examines primary care utilization and perceptions as predictors of ED use, and found that despite similar primary care access and continuity, frequent ED visitors are less likely to report that they get what they need from their PHC. Bolibar et al. (1996) found that users of health centers that had been the target of organizational reform attended less the ED than those who had not been the target of intervention, but ED use was inappropriate regardless of the PHC model. Falik et al. (2001) concluded that having a regular source of care can significantly reduce the likelihood of resorting to the ED, and the need for admission, for patients that could be treated in primary care. Gill et al. (2000) demonstrated that when there is continuity of care, the likelihood of the physician to know the patients’ health condition and their preferences is greater, and that is associated with better clinical results and a decrease in inappropriate visits to the ED. However, there are several reasons that lead users to choose the ED instead of the PHC, namely easy access to healthcare services. Yoon et al. (2015) concluded that more same-day access and continuity of care in PHC, was associated with fewer non-emergent and primary care treatable ED visits, but the same was not observed for not preventable visits and for visits related to mental health problems.

In the Portuguese NHS, one may find several models of PHC organization, since the reform initiated in 2005 is ongoing and has not yet reached the entire NHS. In 2005, the first Family Health Units (FHU) were created, alongside the existing Personalized Healthcare Units (PHU). Both FHU and PHU provide personalized medical and nursing care to a given list of patients from a given geographical area, but there are two main differences between FHU and PHU. First, FHU are voluntary and self-organized multi-professional teams, that operate as a team with functional and organizational autonomy, while in PHU physicians tend to work individually, following the rules and the action plan set by the central administration. Second, in FHU there are incentive schemes, while members of PHU do not have incentives (they have
a fixed remuneration based on category and career grade). There are two types of FHU with different levels of autonomy and different incentive schemes. PHU that convert into FHU start as FHU model A, and after some time, if the performance is deemed good, FHU A may convert into FHU model B. FHU B have more autonomy, but also a more demanding contractual process based on performance. In FHU B there is a special remuneration scheme for physicians and financial incentives for nurses and clinical secretaries. In FHU A there are only institutional incentives, i.e. incentives that benefit the team but not its members (ERS, 2016).

In theory, all NHS patients should have an assigned family physician, but that is not the case for about 10% of the population, almost all of them assigned to PHUs. According to ERS (2016), 13% of patients in Portugal did not have an assigned family physician in 2014. However, these patients do have access to primary healthcare, although they do not have continued care by the same physician but must see any physician that may be available at the time.

FHUs are supposed to enable better access of patients to PHC, better follow-up by the family physician and, therefore, improved health, given their organizational autonomy and contractual obligations with performance indicators. This creates potential asymmetries in access to PHC among users, since some users are registered in FHU A, others in FHU B and others in PHU, and some users have an assigned family physician and others do not (Tribunal de Contas, 2014).

Given the asymmetries in access, it is expected that the type of functional unit in which the user is registered has an influence on the use of ED. A patient enrolled in a PHU does not have the same access to PHC and to a family physician compared with FHU, therefore, it is expected that the patient inappropriately refers more often to the ED.

2. METHODOLOGY

In this paper, we use patient-level data from two non-urban hospitals in Portugal to assess the effect that the model of PHC organization may have on ED utilization. Three models were developed to study the possible relationship between ED utilization and the type of PHC access patients have. PHC access for the patients in our sample differed in two dimensions: patients may be enrolled in three different types of functional units (PHU, FHU A, FHU B); and patients may have (or not) a specific family physician assigned.
A sample of 117,391 visits to the ED departments of two hospitals for the year 2104 was analysed. The two hospitals belong to the same hospital centre (CHTS - Centro Hospitalar de Tâmega e Sousa), but are located 32 km apart. The Hospital de Amarante has a basic ED, while Hospital Padre Américo has a medical-surgical ED.

Both EDs use the Manchester Triage System, implying that each patient admitted to the ED is assigned a colour according to the priority of treatment demanded by her health status: ‘red’ (immediate), ‘orange’ (very urgent), ‘yellow’ (urgent), ‘green’ (standard) or ‘blue’ (non-urgent). In this paper, we use the Manchester Triage colour system to classify each ED visit as ‘appropriate’ or ‘inappropriate’, and to assign the severity of the patient, as in Ramos and Almeida (2016) (where a more detailed discussion on the use of the Manchester Triage colour system in Portuguese NHS hospitals can be found, see pp. 1376-7).

The data about the patients visiting the EDs were obtained from the information systems of CHTS. The data about the PHC unit where the patients are registered were provided by the Central Administration of the Health System (ACSS, Portuguese acronym) and by the three local PHC Groups that supervise the PHC units in the area of influence of the hospitals.

Table 1 presents some descriptive statistics for the continuous variables used in the models, while Table 2 presents the relative frequency for the categorical variables.

**TABLE 1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of patient</td>
<td>53.6</td>
<td>20.3</td>
<td>18</td>
<td>104</td>
</tr>
<tr>
<td>Distance to PHC unit</td>
<td>15.5</td>
<td>10.7</td>
<td>3</td>
<td>59</td>
</tr>
<tr>
<td>PHC appointments</td>
<td>0.003</td>
<td>0.16</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Percfd</td>
<td>85.32</td>
<td>23.46</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

*a Distance in km between the ED and the patient’s PHC unit; *b Number of PHC appointments of the ED patients in 2014; *c Percentage of patients with family physician assigned in each PCH unit.
The first model was designed to estimate the impact of the model of PHC organization on the inappropriate use of the ED. We define an ED visit as ‘appropriate’ when the patient’s Manchester triage resulted in red, orange, or yellow priority. A green or blue triage priority means that the triage system identified the patient’s health status as requiring a standard or non-urgent treatment, which in most cases could be obtained in PHC. As such, we classified ED use by ‘green’ or ‘blue’ patients as ‘inappropriate’. A logistic regression has been used to estimate the factors that influence appropriate visits, using equation 1,

\[
P(\text{Appropriate} = 1|X) = G\left(\beta_0 + \beta_1FHUA + \beta_2FHUB + \beta_3AsgPhy + \sum_{j=4}^{10} \beta_jX_j\right) \quad (eq. 1)
\]

where \(G(\cdot)\) is the logistic function and \(\text{Appropriate}\) is a dummy variable which equals 1 if the ED visit was ‘appropriate’ (red, orange or yellow triage), and equals 0 if the ED visit was ‘inappropriate’ (green or blue triage). \(FHUA\) is a dummy variable which equals 1 if the patient is registered in a FHU model A, and \(FHUB\) equals 1 if the patient is registered in a FHU model B. \(AsgPhy\) is a dummy variable which equals 1 if the patient has an assigned family physician. \(X4\) to \(X10\) are independent variables that may influence the use of the ED by patients, such as the ED type (medical-surgical \(ED=1\)), the sex of the patient (\(\text{female}=1\)), the age of the patient (in years), the distance between the ED and the patient’s PHC unit (in km), the time of day (from 8am to 8pm=1), the day of the week (Monday to Friday=1), the origin of the patient (1 if...
the patient did not have a referral), and the patient’s user fee exemption status (1 if the patient is exempt of paying user fees).

The second model was designed to estimate the impact of the PHC model on the frequency of ED use, measured by the ‘utilization rate’, defined as the number of ED visits by patients registered in a given PHC unit divided by the total number of patients registered in that PHC unit. A OLS regression has been used to estimate the factors that influence the rate of utilization of the ED for each PHC unit, using the model in equation 2.

$$\log(ED \text{ Use}_i) = \beta_0 + \beta_1 FHUA_i + \beta_2 FHUB_i + \beta_3 Percfd_i + \sum_{j=4}^{6} \beta_j X_{ji} + \epsilon \quad (eq. 2)$$

where $ED \text{ Use}$ is the utilization rate of the ED by patients from PHC unit $i$, $FHUA$ is a dummy variable which equals 1 if unit $i$ is a FHU model A, and $FHUB$ equals 1 if the unit is a FHU model B. $Percfd$ is the percentage of patients registered in unit $i$ with an assigned family physician. $X_4$ to $X_6$ are independent variables that may influence the utilization rate of the ED for patients registered in unit $i$, such as the average age of patients, the percentage of female patients, and the distance between the ED and unit $i$. The dependent variable is in log because the utilization rate can never be negative.

The third model was designed to estimate the impact of the PHC model on the severity of the patients that use the ED. We classified ‘severity’ as a categorical and ordered variable, using the Manchester Triage colour system, associating ‘severity’ with ‘urgency’. Following Ramos & Almeida (2016), we assumed that patients that need more urgent care are the ones with high-severity health status, according to the scale: 1 for high-severity patients (red or orange triage), 2 for medium-severity patients (yellow) and 3 for low-severity patients (green or blue). We grouped ‘red’ patients with ‘orange’ patients and ‘blue’ patients with ‘green’ patients because the percentage of users triaged with ‘red’ and ‘blue’ was very small, and this could lead to unbalanced groups and cause estimation problems.
The severity model was estimated using an ordered probit regression of the type:

\[ Y_i = 1 \text{ if } Y^* \leq \mu_1 \]
\[ Y_i = 2 \text{ if } \mu_1 < Y^* \leq \mu_2 \]
\[ Y_i = 3 \text{ if } Y^* > \mu_2 \]

The latent variable \( Y^* \) is a function of the variables that can influence the severity of the patient visiting the ED: the type of PHC unit in which the user is enrolled, whether or not she has a family physician assigned, age, sex, and the number of PHC appointments during the year.

### 3. RESULTS AND DISCUSSION

The results of the logit estimation of model 1, about appropriate use of the ED, are presented in Table 3. In our sample, 40% of the visits to the ED were classified as inappropriate (‘green’ or ‘blue’ triage).

**TABLE 3**

Logit estimation of Model 1 (dependent variable: appropriate visit = 1)

| Variable                        | Coef. | Standard Deviation | P>|z| | Confidence Interval (95%) |
|---------------------------------|-------|--------------------|-----|--------------------------|
| FHU A                           | 0.03415 | 0.01756            | 0.052 | -0.00026 - 0.06857       |
| FHU B                           | 0.86415 | 0.01912            | 0.000 | 0.04892 - 0.12390        |
| AsgPhy                          | 0.04302 | 0.02201            | 0.051 | -0.00011 - 0.08616       |
| Medical-surgical ED             | -0.32144 | 0.01875           | 0.000 | -0.35820 - 0.28469       |
| Female                          | -0.25389 | 0.01278           | 0.000 | -0.27894 - 0.22883       |
| Age                             | 0.03187 | 0.00033            | 0.000 | 0.03122 - 0.03253        |
| Distance                        | 0.01087 | 0.00072            | 0.000 | 0.00945 - 0.01229        |
| Daytime                         | -0.26578 | 0.01413           | 0.000 | -0.29349 - 0.23807       |
| Week day                        | 0.01528 | 0.01407            | 0.278 | -0.01231 - 0.04287       |
| No referral                     | -1.07166 | 0.25470           | 0.000 | -1.12158 - 1.02174       |
| User fee exemption              | -0.03520 | 0.01544           | 0.023 | -0.06548 - 0.00493       |
| PHC Appointments                | 0.10360 | 0.04227            | 0.014 | 0.02075 - 0.18645        |

**Statistical Tests**

| Pseudo R2                        | 0.0872 |
| LR chi2 (10)                     | 13741  |
| P-value                          | 0.0000 |
The results show that the model of the PHC unit has a significant influence on the appropriate use of the ED. The probability of patients registered in an FHU having a more appropriate use of the ED is higher than that of patients registered with a PHU. Among FHUs, the probability of appropriate use of ED is higher for patients registered with FHUs model B. These results are consistent with the expectation that FHUs improve accessibility to healthcare and improve the continuity of care. If patients have better access to and continuity of care, their health needs can be met by PHC, and have less need to use the ED, referring to the ED only in situations that really require it. The higher coefficient for FHU B is consistent with the fact that model B FHU have more incentives to deliver better healthcare, giving support to the assertion that pay-for-performance programs in primary care may improve quality of care (Gillam & Steel, 2013; Peckham & Wallace, 2010; Allen et al., 2014).

Having an assigned family physician also has a positive influence on the appropriate use of the ED (although this effect is only significant at the 10% level), in line with previous studies that concluded that patients without a regular family physician tend to use EDs in situations not considered appropriate (Starfield et al., 2005; Grumbach et al., 1993; Afilalo et al., 2004) and that having a family physician can prevent unnecessary use of EDs (Gill et al., 2000; Rosenblatt et al., 2000).

The results also show that inappropriate use of the ED is significantly higher for women, for younger people, for patients exempt from paying user fees, for patients that are closer to the ED, and during the daytime. The last three results are likely to reflect the fact that inappropriate use decreases as the opportunity cost of using the ED increases, and are consistent with existing literature (for example, Ramos & Almeida, 2016; Sanz-Barbero et al., 2012).

The effect of the PHC model seems to be quantitatively relevant, as shown by the marginal effect estimates presented in Table 4. The percentage of episodes that correspond to an inappropriate attendance to the ED is 2 percent lower for patients enrolled in a FHU B (and 0.8 percent lower for users of FHU A), when compared with the percentage of inappropriate attendance of users enrolled in PHUs. If this result was replicated on a national scale, once the reform of PHC is complete with all functional units operating as FHU B, it would allow for a reduction of 123,367 emergency episodes. This would result in 10 million euros annual savings (assuming an average cost of 83 euros per emergency episode).
FHU B have higher costs, related to the incentive schemes, but they allow better continuity of care, significantly reducing the inappropriate attendance of the ED, potentially reducing the ED overcrowding and its high costs. It should be noted, however, that this is just one of several positive effects that the conversion of all functional units into FHUs B would generate for the Portuguese NHS. This reinforces the need for adequate monitoring to assess the results of the care provided by these units, namely by performance indicators. This is a key point for a better response of PHC and to ensure that ED are able to fulfil its primary mission, which is to respond to emergency situations or medical emergencies.

The effect of having an assigned family physician is also relevant, since it increases appropriate use of the ED by 1%. This is consistent with the argument that the allocation of family physicians enables an effective continuity of care, allows a better control of chronic diseases and contributes to a better use of the ED.

The results of the OLS estimate of model 2, about the utilization rate of the ED, are presented in Table 5. PHUs have a significantly higher utilization rate of EDs than FHUs, which is consistent with the argument that FHUs guarantee same-day access to physicians, ensure continuity and integration of care, enable access to medical appointments and monitor patients' access to their own family physician, and with other work that found a positive association between financial incentives in primary care and the decrease of ED utilization (Harrison et al., 2014; Iezzi et al., 2014). In contrast, PHUs have a lower appointment rate and a lower accessibility to health care services. Thus, patients registered in PHUs tend to have higher ED use, probably because they do not have access to the care they need in PHC.
### TABLE 5

Results for Model 2 (Dependent variable: ED utilization rate)

| Variable | Coef.  | Standard Diversion | P>|z|  | Confidence Interval (95%) |
|----------|--------|--------------------|------|--------------------------|
| FHU A    | -0.13573 | 0.00792           | 0.000| -0.15127 -0.12019        |
| FHU B    | -0.13994 | 0.00880           | 0.000| -0.15719 -0.1226         |
| Percmf   | -0.00014 | 0.00007           | 0.072| -0.00029 0.00001         |
| Age      | -0.00007 | 0.00005           | 0.167| -0.00017 0.00002         |
| Sex      | 0.00762  | 0.00172           | 0.000| 0.00425 0.01100          |
| Distance | -0.01378 | 0.00074           | 0.000| -0.01525 -0.01232        |

**Statistical Tests**
- R-Squared: 0.3123
- F-Statistic: 149.81
- P-value: 0.0000

A similar conclusion was reached regarding the assignment of a family physician. Units with a higher percentage of patients with a family physician assigned have a lower utilization rates of ED, most probably because there is a greater contact with their physician and thus better control and surveillance of chronic diseases. This is consistent with other studies that found an association between high rates of ED use and difficulties in access to family physicians (Woodward & Pong, 2006), but not with others that have reported that patients with usual sources of care are not necessarily less likely to visit EDs than those without such care (Chan & Ovens, 2002; Genell Andrén, 1988).

The results of the ordered probit estimation of model 3, about the severity of patients using the ED, are presented in Table 6. The results show that FHU patients arrive to the ED with lower severity conditions. This is likely to be related to the fact that PHU users have greater difficulty in getting appointments and regular contact in PHC, leading to worse health status.

The results also show that patients with an assigned family physician also have higher severity conditions, which would not be expected, since an assigned physician should be related with better access and continuity of care in PHC. However, this effect is only significant at the 10% level. The results also show that patients arrive to the ED with higher severity conditions if they
are older and male.

**TABLE 6**

Ordered probit estimation of Model 3  
Dependent variable: patient severity (High=1; Medium=2; Low=3)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Standard Deviation</th>
<th>P-value</th>
<th>Confidence Interval (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FHU A</td>
<td>0.0533</td>
<td>0.0085</td>
<td>0.000</td>
<td>0.0365 - 0.0702</td>
</tr>
<tr>
<td>FHU B</td>
<td>0.0566</td>
<td>0.0087</td>
<td>0.000</td>
<td>0.0394 - 0.0737</td>
</tr>
<tr>
<td>AsgPhy</td>
<td>-0.0190</td>
<td>0.0114</td>
<td>0.096</td>
<td>-0.0414 - 0.0033</td>
</tr>
<tr>
<td>Age</td>
<td>-0.0167</td>
<td>0.0002</td>
<td>0.000</td>
<td>-0.0172 - 0.0162</td>
</tr>
<tr>
<td>Sex</td>
<td>0.2351</td>
<td>0.0192</td>
<td>0.000</td>
<td>0.1972 - 0.2730</td>
</tr>
<tr>
<td>PHC Appointments</td>
<td>0.0138</td>
<td>0.0219</td>
<td>0.529</td>
<td>-0.0291 - 0.0567</td>
</tr>
<tr>
<td>Age*Sex</td>
<td>-0.0013</td>
<td>0.0003</td>
<td>0.000</td>
<td>-0.0019 - 0.0006</td>
</tr>
</tbody>
</table>

|                 | P-value     | 0.000              |
|                 | Pseudo R2   | 0.0492             |

4. **CONCLUSIONS**

We showed that the model of primary care organization exerts a significant influence on the use of emergency departments. Family health units, especially model B, have a significant positive effect on reducing overcrowding and inappropriate attendance of the emergency departments. Therefore, it is important to invest in this type of primary care functional units which, although more costly, can effectively reduce the number of emergency episodes, among other potential health gains.

Furthermore, we conclude that patients with an assigned family physician make more appropriate use of the ED and have their pathologies more controlled.
REFERENCES


Chan, B. T., & Ovens, H. J. (2002). Frequent users of emergency departments - Do they also use family physicians' services? *Canadian Family Physician, 48*, 1654-1660.


ERS - Entidade Reguladora da Saúde (2016). Estudo sobre as Unidades de Saúde Familiar e as Unidades de Cuidados de Saúde Personalizados (pp. 120). Porto: Entidade Reguladora
da Saúde.


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