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# Specialisation hierarchy within the Children's Specialised Services National Definition Set

## Report for the Department of Health

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# Specialisation hierarchy within the Children's SSNDS

*Introduction*

Our work is designed to assess the additional costs of associated with particular types of specialised care. There are twenty different types, corresponding to the set to twenty Specialised Services National Definition Sets (SSNDS). A "specialist marker" of a particular type is assigned to any individual if they have one of the diagnosis or procedure codes identified in that SSNDS. To determine the additional costs, controlling for the Healthcare Resource Group to which they are allocated, we compare the cost of patients with a particular specialist marker to those who do not receive specialised care. This produces an estimate of the ***average*** additional cost associated with the receipt of each type of specialised care.

There are, of course, likely to be differences among patients who receive particular types of specialised care: some patients might require more resource intensive forms of specialised care than others. If these patients are more likely to be treated in specific hospitals, top-up payments based on the average additional costs may financially disadvantage these hospitals. The UK Children's Healthcare Alliance (UK CHA) has raised this concern for children's services, suggesting that the set of diagnosis and procedure codes that make up the Children's SSNDS imply different levels of specialisation. In this note, we explore this possibility and assess the financial impact of improved differentiation.

*Differentiating the Children's SSNDS*

The Department of Health (DH) proposed differentiating the Children's SSNDS according to the observed concentration of diagnosis and procedures across English hospitals. This is faithful to the primary definition that guided the construction of the SSNDS, where specialised care should be geographically concentrated, requiring a planning population of 1 million. By extension, the more the specialised the care, the larger the planning population, and the more care should be concentrated among fewer providers. Consequently, the Children's SSNDS is differentiated into the following categories as proposed by the DH:

- High = 5 or fewer providers (any provider, not just eligible)
- Medium = greater than 5 but less than 16 providers (any provider, not just eligible)
- Low = greater than 15 providers (any provider, not just eligible)

*Regression models*

We define our dependent variable as the patient's standardised cost $y_{ik} = {}^{c_{ihk}}/_{\widehat{c_h}}$ where $c_{ihk}$ is the cost of patient *i* in HRG *h* in hospital *k* and $\widehat{c_h}$ is the national average cost of all patients allocated to HRG *h.* Our original analysis involved regressing each patient's standardised cost against the set (*n*=1…*N*) of specialised care markers (*S*) indicating the type of specialised care received (if any). The model takes the form:

$$y_i = \propto + \sum_{n=1}^{N} \beta_n S_{ni} + \varepsilon_i \qquad \text{(EQ1)}$$

where $\beta$ are the parameters to be estimated: if positive and significant, a patient with the specialist care marker has higher costs than do other patients allocated to the same HRG.

Information in each patient's first diagnostic and procedural fields is examined to ascertain whether or not specialised care was received. A patient is assigned a specialised care marker if:

- One of the ICD10 or OPCS codes[1] designated in the SSNDS is present in their HES record (an individual might have more than one marker);
- They were treated at an eligible provider, because non-eligible providers should not be providing specialised services.

We also allowed for clustering of patients within hospitals by specifying a hierarchical model of the form:

$$y_{ik} = \propto + \sum_{n=1}^{N} \beta_n S_{nik} + u_k + v_{ik} \qquad \text{(EQ2)}$$

This is a multi-level model that recognises that patients (*i*=1…*I*) are clustered within hospitals (*k*=1…*K*). $u_k$ is the hospital random effect: patients treated in hospitals with higher effects have higher costs than those treated elsewhere.

In these analyses there was just a single children's specialised marker identifying receipt (or not) of children's specialised care. We now substitute this single marker with three dummy variables identifying children's specialised as of "high", "medium" or "low" specialisation, in line with the DH definition.

For comparative purposes, we also run analyses in which the condition that specialised care must be delivered in eligible providers is relaxed.

[1] ICD10: International Statistical Classification of Diseases and Related Health Problems 10th Revision; OPCS: Office for Population Censuses and Surveys Classification of Surgical Operations and Procedures

*Results*

*Descriptive statistics*

The table below reports descriptive details of the distribution of children receiving specialised care across the five members of UK CHA and nationally. These figures can be interpreted as proportions.

- Thus, for England as a whole, 1.7% of *all patients* and 16% of *all children* received low intensity specialised care.
- By contrast, in GOSH (RP4), 51.5% of children received this type of specialised care.
- For four members of the UK CHA, the proportion of their *children* who receive specialised care, of whatever level of differentiation, is greater the equivalent proportion for *children* nationally.
- The exception is Central Manchester and Manchester Children's University Hospital Trust (RW3), which has a more general caseload. Thus comparison should be to the proportions for all patients rather than just under 19s. This shows that *patients* in this Trust are more likely to receive children's specialised care than are *patients* nationally. This is true whatever the level of intensity.

*Table 1: Descriptive statistics*

| | Children Low | Children Med | Children High |
|---|---|---|---|
| RQ3 | **0.352** | **0.061** | **0.019** |
| | 0.477 | 0.240 | 0.138 |
| RP4 | **0.515** | **0.127** | **0.031** |
| | 0.500 | 0.333 | 0.173 |
| RCU | **0.271** | **0.026** | **0.008** |
| | 0.444 | 0.160 | 0.086 |
| RBS | **0.212** | **0.032** | **0.007** |
| | 0.409 | 0.175 | 0.081 |
| RW3 | **0.055** | **0.007** | **0.002** |
| | 0.227 | 0.081 | 0.042 |
| National <19 | **0.160** | **0.019** | **0.006** |
| | 0.367 | 0.136 | 0.076 |
| National all | **0.017** | **0.002** | **0.001** |
| | 0.129 | 0.044 | 0.025 |

Key: RQ3 Birmingham Children's Hospital NHS Foundation Trust; RP4 Great Ormond Street Hospital For Children NHS Trust; RCU Sheffield Children's NHS Foundation Trust; RBS Royal Liverpool Children's NHS Trust; RW3 Central Manchester and Manchester Children's University Hospitals NHS Trus0.

Bold: mean; Underlined: Standard deviation

*Estimated effects*

Table 2 reports the estimates of the additional costs of specialised care for each specialist marker. The estimates from our "original" models are provided for comparative purposes. The main focus is on the impact of replacing the childrens marker with three dummy variables identifying high, medium and low types of children's specialised care.

There is a clear gradation in the additional costs associated with children's specialised care, with costs increasing in line with low-medium-high differentiation.

The estimates are higher when considering equation 1 than equation 2, because the former model fails to recognise that costs are partially related to the hospital in which care is provided.

Taking equation 2, the additional costs associated with children's care were estimated as 21.5% on average. But for children receiving care that is concentrated in fewer than five providers ("high" specialisation), the additional costs amount to 30.8%; for those whose care is deemed of "medium" specialisation, the additional costs amount to 26.3%; while for the remainder receiving care of "low" specialisation, the additional costs are 20.3%, this latter category comprising the majority.

If the eligibility criterion for defining receipt of specialised care is relaxed, the estimated additional costs of children's specialised care are considerably lower, though the gradation across categories remains.

*Table 2: Additional costs of specialised care*

| | EQ1 | | | EQ2 | | |
|---|---|---|---|---|---|---|
| | | 3 tier children Specialisation | | | 3 tier children specialisation | |
| | original | eligibility | no eligibility | original | eligibility | no eligibility |
| Cancer | **0.307** | **0.307** | **0.307** | **0.242** | **0.242** | **0.241** |
| BMT | -0.037 | -0.038 | -0.035 | -0.297 | -0.298 | -0.297 |
| Haemophilia | -0.132 | -0.132 | -0.132 | -0.159 | -0.159 | -0.161 |
| Womens | 0.063 | 0.063 | 0.063 | 0.046 | 0.046 | 0.045 |
| Spinal | 0.140 | 0.141 | 0.173 | -0.115 | -0.114 | -0.095 |
| Neurosciences | **0.280** | **0.280** | **0.279** | 0.171 | 0.171 | 0.169 |
| CysticFibrosis | **0.357** | **0.357** | **0.359** | **0.331** | **0.331** | **0.332** |
| Renal | 0.228 | 0.228 | 0.228 | 0.175 | 0.175 | 0.174 |
| IntestinalFailure | -0.003 | -0.003 | -0.003 | 0.008 | 0.008 | 0.008 |
| Cardiology | **0.118** | **0.118** | **0.117** | 0.007 | 0.008 | 0.005 |
| CleftLip | 0.034 | 0.034 | 0.033 | 0.022 | 0.022 | 0.021 |
| InfectiousDiseaes | **0.408** | **0.408** | **0.410** | **0.379** | **0.379** | **0.378** |
| Liver | **0.125** | **0.125** | **0.125** | 0.003 | 0.003 | 0.001 |
| Children | **0.301** | | | **0.215** | | |
| ChildrenLow | | **0.283** | **0.137** | | **0.203** | **0.089** |
| ChildrenMed | | **0.365** | **0.278** | | **0.263** | **0.178** |
| ChildrenHigh | | **0.438** | **0.319** | | **0.308** | **0.207** |
| Dermatology | -0.003 | -0.004 | 0.000 | -0.019 | -0.019 | -0.022 |
| Rheumatology | **0.331** | **0.331** | **0.331** | 0.102 | 0.102 | 0.099 |
| Endocrinology | 0.061 | 0.061 | 0.061 | -0.014 | -0.014 | -0.015 |
| Respiratory | 0.078 | 0.078 | 0.078 | 0.001 | 0.001 | -0.002 |
| VascularDiseases | **0.343** | **0.343** | **0.343** | 0.218 | 0.218 | 0.217 |
| PainManagement | **2.255** | **2.255** | **2.254** | **2.129** | **2.129** | **2.127** |
| EarSurgery | 0.082 | 0.082 | 0.084 | -0.111 | -0.112 | -0.114 |
| Colorectal | **0.129** | **0.128** | **0.128** | **0.112** | **0.112** | **0.111** |
| Orthopaedic | **0.164** | **0.164** | **0.163** | 0.004 | 0.004 | 0.003 |
| MorbidObesity | -0.068 | -0.068 | -0.068 | -0.068 | -0.068 | -0.069 |
| MetabolicDisorders | 0.427 | 0.427 | 0.428 | 0.312 | 0.312 | 0.303 |
| Ophthalmology | 0.074 | 0.074 | 0.073 | 0.057 | 0.057 | 0.056 |
| Haemoglobinopathy | 0.065 | 0.065 | 0.065 | 0.052 | 0.053 | 0.053 |

*Conclusions*

There is evidence of variation in costs among children who receive specialised care, even after accounting for the hospital in which treatment is provided. We have categorised children in receipt of children's specialised care according to the concentration of provision of the particular diagnoses or procedures recorded in their medical record. This categorisation is a refinement but remains within the spirit of the underlying principles by which the original SSNDS were drawn up.

We find that additional costs increase in line with this categorisation. Compared to children allocated to the same HRG, the costs associated those requiring "high" levels of specialisation are some 30% higher, those requiring "medium" specialisation are 26% higher, and those requiring "low" specialisation are 20% higher.

Children falling into these categories are not randomly distributed across the hospital sector. Rather, as would be expected, they tend to be concentrated in particular hospitals. This means that a top-up payment for children's specialised care based on the ***average*** additional costs of children receiving specialised care would financially disadvantage those hospitals providing greater levels of "medium" and "high" forms of specialised care.

Differentiating top-up payments of the basis of these categories would deliver a fairer funding allocation. Modifying top-up payments in this way would be cost neutral, entailing a slight reduction in the payment for children now falling into the "low" category, and increases in payments to those in the "medium" and "high" categories.

A re-allocation on this basis would mean that the top-up payment for children's specialised care would be differentiated according to the specific diagnoses and procedures that fall into the categories of concentration defined by the Department of Health. As these are defined according to observed practice, the specific diagnoses and procedures might vary from year to year. A decision will have to be made as to whether this potential volatility is desirable.

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