Practical experiences in the use of modelling and smart Decision Support Systems in Mental health planning

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Relative Technical Efficiency
In the context of mental health integrated care, it is essential to have Decision Support System (DSS) for health planning and resources management.

Our DSS is based in the analysis of relative technical efficiency (ETR) of Small health geographical areas.

Relative technical efficiency is the assessment of the proportion of outputs produced (i.e. hospital bed utilisation) related to the inputs or resources available (i.e. hospital bed availability) in a set of Decision Making Units (small mental health areas).
The design of a Decision Support System for:

1. analysing of RTE of Small Mental Health Areas using Monte Carlo-DEA approach.

2. assessing the effect of micro-management interventions on the RTE through the comparison with the real situation.

Demonstration study in the Bizkaia mental health network in Spain composed of 19 small mental health areas.
• **Experts’ knowledge** is taken into account in the analysis design and interpretation of the results.

• **Rules** and **restrictions** for the analysis according to an **expert-driven Model of Basic Mental Health Community Care (B-MHCC)**.

• Selection of indicators which will be **inputs and outputs** in the analyses.

• **Multi-dimensional approach** because it considers different combinations of inputs and outputs (**scenarios**).

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**Salvador-Carulla et al., 2007**
**Gibert et al., 2010**
Health database are frequently limited, incomplete, unreliability, or difficult to explain. Besides, the selection of inputs or outputs is not always obvious but it is crucial aspect which depends on experts’ knowledge.

Information from ‘Integral Map of Mental Health of Bizkaia’ for 19 small mental health areas. DESDE-LTC was used to describe their mental health services.

Finally, 52 inputs and outputs were sectioned to describe small health areas:

- Inputs: provision of types of care and professionals.
- Outputs: use of services.
Scenarios are different combinations of inputs/outputs variables designed by experts.

Different technical points of view based on the model of community care.

Fifteen scenarios were designed based on large groups of types of care, placement and workforce capacity, and the integrated health model.
**Description of the scenarios.**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Inputs</th>
<th>Outputs</th>
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<tbody>
<tr>
<td><strong>S1: Acute hospital</strong></td>
<td>TR2, PR2</td>
<td>ProfR2psyct, ProfR2psycl+DUE, ProfR2Tot</td>
</tr>
<tr>
<td><strong>S2: Non-acute residential</strong></td>
<td>TR4-R7, ProfR4-R7Tot</td>
<td>ProfR4-R7psyct, ProfR4-R7psycl</td>
</tr>
<tr>
<td><strong>S3: Community residential</strong></td>
<td>TR8+R11, TR12, ProfR8+R11psycl, ProfR8+R11DUE</td>
<td>ProfR8+R11Tot</td>
</tr>
<tr>
<td><strong>S4: Health day care</strong></td>
<td>TD1, TD41, ProfD1+D41Tot</td>
<td>ProfD1+D41psycl, ProfD1+D41psycl+DUE</td>
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<tr>
<td><strong>S5: Non-health day care</strong></td>
<td>TD4other, TD2+D3, ProfD4otherTot</td>
<td>ProfD2-D3Tot</td>
</tr>
<tr>
<td><strong>S6: Outpatient care</strong></td>
<td>TOc, ProfOcpsyct, ProfOcpsycl</td>
<td>ProfOcDUE, ProfOcTot</td>
</tr>
<tr>
<td><strong>S7: Places and beds</strong></td>
<td>PR2, PR8+R11, PD1+D41</td>
<td>POther+D2-D3, PDother+D2-D3Tot</td>
</tr>
<tr>
<td><strong>S8: Places and beds</strong></td>
<td>PR2, PR4-R7, PD1</td>
<td>PD41</td>
</tr>
<tr>
<td><strong>S9: Professionals</strong></td>
<td>ProfR2psyct+nurs, ProfR4-R7psyct, ProfR4-R7psycl+nurs, ProfR4-R7psycl+nurs+DUE, ProfR4-R7psycl+DUE, ProfD1+D41Tot, ProfD4other+D2-D3Tot, ProfOcTot</td>
<td>ProfR2Tot, ProfR4-R7Tot, ProfR4-R7Tot, ProfR8-R13Tot, ProfR8-R13Tot, ProfOcTot</td>
</tr>
<tr>
<td><strong>S10: Availability of care</strong></td>
<td>PR2, PR4-R7, PD1+D41, TOc</td>
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<tr>
<td><strong>S11: Integrated care1</strong></td>
<td>PR2, PR4-R7, PD1+D41, TOc</td>
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<tr>
<td><strong>S12: Integrated care2</strong></td>
<td>PR2, PR8-R13, PD1+D41, TOc</td>
<td></td>
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<tr>
<td><strong>S13: Integrated care3</strong></td>
<td>PR2, PD1+D41, PDother+D2-D3, PDother+D2-D3Tot, PR8+R11, PR12</td>
<td></td>
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<tr>
<td><strong>S14: Integrated care4</strong></td>
<td>PR2, PD1+D41, PR4-R7, ProfR2psyct, ProfR4-R7Tot, ProfOcTot</td>
<td></td>
</tr>
<tr>
<td><strong>S15: Integrated care5</strong></td>
<td>PR2-R7, PR8-R13, ProfR2-R7Tot, ProfR8-R13Tot, ProfOcTot</td>
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Expert-driven operational Model of Community Care

Procedure derived from **Knowledge Discovery from Data** (KDD) to design the basic set of characteristics of three community mental health systems in Spain (Bizkaia, Gipuzkoa and Catalonia).

The model was built based on the experts’ opinion and summarizes the more **appropriate characteristics** for each DESDE-LTC group of codes in a unique framework.

Several cut-off points of over/under **availability** and over/under **utilisation** of mental health services were defined.
Methodological approach

A hybrid model was used to assess the relative technical efficiency of the small mental health care areas in Bizkaia. This model integrates Monte Carlo simulation and Data Envelopment Analysis (DEA).

Monte Carlo simulation was used:

(1) to multiply the number of observations (500 replications of each area and scenario) which makes efficiency analysis more discriminant.

(2) to incorporate uncertainty in variable measuring by using statistical distributions rather than the original variable values (i.e. the original value 0.299 was transformed into triangular distribution $\tau[0.2691, 0.299, 0.3289]$)
Efficiency is assessed by using **Data Envelop Analysis** (DEA). Two different approaches were used:

**A) Input-oriented**: test if an unit can minimize the consumption of inputs keeping constant the production of outputs.

**B) Output-oriented**: test if an unit can maximize the production of inputs keeping constant the consumption of outputs.
Results

Box-plots of relative technical efficiency of mental health areas for each scenario of healthcare (Mental Health System of Bizkaia)

Input-oriented model

Output-oriented model
The differences in the average values of ETR between areas are small.

The room for improvement is larger for the management of the inputs (average ETR is generally lower for input-oriented analysis).
Average RTE is qualified with the probability. There are areas with similar values but, however, the likelihood of overcoming a high value is different (especially in the output-oriented analysis). This conclusion may guide the selection of areas to take action.
1. Re-assigning a psychologist from an Acute Service (DESDE-LTC code R2) in a MHC (Durango) to another Acute Service in other MHC (Ercilla).

2. Re-allocating a place (1 bed) in an Acute Service (DESDE-LTC code R2) located in a MHC (Durango) to another Acute Service in other MHC (Bermeo).

The DSS recommends us these changes.
Concerned MHCs (Relative Technical Efficiency RTE variation %)

Intervention assessment

![Graph showing Relative Technical Efficiency (RTE) for different MHCs before and after intervention, with variation percentages.]
Non-concerned MHCs (Relative Technical Efficiency RTE variation %)

Results: global efficiency (Relative Technical Efficiency RTE variation %)
Conclusions

• The EbCA approach involves experts throughout the process helping to elicit their knowledge and improve the results of the analysis.

• The DSS based on the assessment of the relative technical efficiency provides a ranking of performance of small mental health areas, scenarios and the whole mental health system.

• This approach allows modeling and assessing micromanagement interventions on the mental health systems.

• The results offer policymakers different choices to guide decision making in order to improve the mental health system.