Feasibility of a web based benchmarking tool for community care organisations including technical and user requirements

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SUMMARY

The IBenC Project

IBenC is a cross-European research project and stands for Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care.

The aim of IBenC is to identify best practices in community care for care-dependent elderly people, by benchmarking the cost-effectiveness of community care delivery systems in Europe. The project provides comprehensive insight into the functioning of the European community care system by considering patient outcomes, costs of care, organizational performances, and the structure and care processes of care providing organisations.

The Feasibility Study

The aim of this study is to explore the feasibility of an interactive web based benchmarking tool on community care, which would ‘transfer’ online the benchmarking method developed by the IBenC Consortium. To provide a complete overview on the feasibility of the web based tool, the study has been structured in the most comprehensive way, covering general requirements and development processes, definition of a possible tool architecture, an analysis of an already developed comparable web benchmarking tool (Your Health System by CIHI), stakeholder feedbacks and identification of possible challenges and points of attention.

The hypothetical tool architecture, developed following brainstorming sessions and exchanges at both internal level and with the external partners, entails in general terms four key steps, covering the key stages of an effective web-based benchmarking tool, together with the identification of possible challenges and obstacles: data collection and data upload; data cleansing and validation; calculation and metrics; results visualization.

Findings

The Feasibility Study results show that the development of an online benchmarking tool based on the IBenC methodology is not only possible, but also advisable and extremely valuable to improve quality in healthcare at European level.

However, the scope of the project and the complexity behind the innovative benchmarking method developed by IBenC, makes it necessary to carefully focus on some stages and aspects of its development and utilisation that might pose particular challenges, as data handling and necessary human and financial resources.
1 THE IBENC PROJECT – IDENTIFYING BEST PRACTICES FOR CARE-DEPENDENT ELDERLY BY BENCHMARKING COSTS AND OUTCOMES OF COMMUNITY CARE

1.1 General information about the project

IBenC is a cross-European research project and stands for Identifying best practices for care-dependent elderly by Benchmarking Costs and outcomes of community care.

The need for cost effective health systems in Europe is imperative in the context of an increasing demand for health care by growing numbers of elderly people and a shrinking working force. Many health care systems are changing and looking for mechanisms to ensure, measure and improve the quality of care. However, it is unclear which models of care delivery are the most cost-effective. To enable lower public spending and advance the economic efficiency of community care organisations, policymakers need information on which type of community care delivery provides best outcomes against reasonable costs.

The aim of IBenC is to identify best practices in community care for care-dependent elderly people, by benchmarking the cost-effectiveness of community care delivery systems in Europe. The project provides comprehensive insight into the functioning of the European community care system by considering patient outcomes, costs of care, organizational performances, and the structure and care processes of care providing organisations.

Within a prospective longitudinal design, a novel method to benchmark community care organisations has been developed: quality and cost of community care will be combined into one measure. Based on a standardised instrument, the Resident Assessment Instrument for Home Care (interRAI-HC), this summary measure for organisation performance, based on quality indicators, and costs of care will be developed. Within the project, the interRAI-HC is validated for costs of care assessments from a societal perspective. To enable an in-depth interpretation of best performing practices, the contexts and characteristics of community care organisations has also been studied rigorously.

The novel method for benchmarking community care practices on macro and meso levels on costs and quality of care aims to improve insight into the cost effectiveness of European health care delivery, and provides an objective method to identify best practices.

Furthermore, the benchmark method could be suitable for (inter)national cost of care comparisons and applicable in the future for benchmarking care models in other care settings.
1.2 IBenC Project Methodology

1.2.1 The IBenC Methodology in brief

The benchmarking method developed by the IBenC consortium combines and compares performance on quality indicators and costs of community care models through interRAI-HC data. interRAI-HC is one of the most diffused home care assessment systems, and it entails over three hundred items, comprising physical, functional, cognitive, psychosocial, formal and informal care use.

The IBenC method aggregates client data per organisation and calculates and compares organisations on:

1. 23 quality of care indicators (QIs), extracted from the interRAI-HC assessment system; reflecting functional, clinical and psychosocial outcomes (see Appendix 1),
2. two main summary QI scales to provide a global insight in the performance of an organisation:
   a. Patients’ quality Independence scale,
   b. Clinical balance quality scale;
3. costs of formal and informal care, such as hours of nursing, hospital visits and family care.
4. The organizations can be classified in one of six different categories through a simple seven item questionnaire form which reflect the type services offered (IADL, ADL, other), level of patient orientation, and specialisation (palliative care, dementia case management).
5. For statistical reasons, the method applies to community care organizations with a minimum number of twenty clients (including patients baseline and follow up).

1.2.2 interRAI Home Care instrument

The consortium efforts capitalise on a standardised instrument, the interRAI Home Care (interRAI-HC), which is used in routine care provisioning to assess patient outcomes, care use and quality of care.

Building on existing data and new evidence collection, an innovative method to benchmark community care organisations will be generated in order that quality and cost of community care will be compared into one measure.

Even though not all EU regions are represented, elements of common interest for delivery of health care will be considering in order that a rising innovative methodology to benchmark.
cost effectiveness and quality of community care will be applied to divergent community care systems.

A summary measure for organisation performance, based on quality indicators, will be developed and the interRAI-HC will be validated for costs of care assessments from a collective perspective. Targeted actors and stakeholders will benefit from the information fed back to them about what the project has achieved and how its results could be put in use by and for the same community.
2 FEASIBILITY STUDY OF A WEB-BASED BENCHMARKING TOOL – RATIONALE AND METHODOLOGY

2.1 Rationale and introduction to the feasibility study

The aim of this study is to explore the feasibility of an interactive web-based benchmarking tool on community care, which would ‘transfer’ online the benchmarking method developed by the IBenC Consortium.

The web-based tool should thus be capable of benchmarking cost-effectiveness of healthcare organisations and to identify differences between organisational characteristic. The tool should also provide easy access to healthcare policy makers and healthcare providers to the generated knowledge on cost-effectiveness and in depth information on the organisation of European community care.

The study encompasses both user and technical requirements, opportunities and threats, needs and acceptability of such a tool, therewith providing a ‘controlled’ way of introducing innovation in the sector without the blind investment in a costly and under-researched instrument.

2.2 Methodology and processes

To provide a complete overview on the feasibility of the web-based tool, the study has been structured in the most comprehensive way, covering general technical requirements and development processes, definition of a possible tool architecture, an analysis of an already developed comparable web benchmarking tool (Your Health System by CIHI), stakeholder feedbacks and identification of possible challenges and points of attention.
In the first phase of the study, EHMA, together with VUmc, IBenC project leader organization, identified a shortlist of possible support partner organizations and companies to support the development of the study. The shortlist, developed with the idea of covering the different requirements of an online tool development, includes different kind of organisations from IT-focused companies to consultancies to health information institutes, all with established and certified experience in developing and managing web-based benchmarking platforms.

The second phase of the study featured brainstorming sessions at internal level between VUmc and EHMA, with the objective of appropriately identifying the core topics to be discussed and investigated with the partner organizations.

In the third phase, EHMA and VUmc set up rounds of teleconferences and exchanges with the partner organizations, providing them with background data and presentations about the IBenC project and its methodology, while exchanging views and information based on their experience and work on web-based benchmarking tools. These feedbacks have been then collected both through report-styled documents and ad-hoc templates developed by EHMA.

In parallel, EHMA and the consortium partners also gathered key comments from the stakeholders involved in the IBenC National Stakeholders Webinars, organized by VUmc (The Netherlands), KU Leuven (Belgium) and Università Cattolica del Sacro Cuore (Italy).

2.3 Objective

The novel method for benchmarking community care practices developed by the IBenC consortium on macro and meso levels on costs and quality of care has the potential to improve insight into the cost effectiveness of European health care delivery, and to provide an objective method to identify best practices. In addition, the benchmark method is suitable for (inter)national cost of care comparisons and can be applicable in the future for benchmarking care models in other care settings as well.

For these reasons, the project consortium strongly believed in the necessity of thoroughly studying the feasibility of an online web-based benchmarking tool, therewith providing a ‘controlled’ way of introducing innovation in the sector, avoiding blind investment in a costly and under-researched instrument.

The online tool, if structured on the correct user and technical criteria, could indeed represent an easily accessible and user-friendly way to digitally compare quality and cost-effectiveness of community care models from different devices (e.g. PCs, smartphones, and tablets) for policy-makers, healthcare professionals and any other stakeholders, providing an easier and more effective way to identify and disseminate best practices in Europe.
2.4 Partners Identification

As mentioned in the introduction to the Feasibility Study, its first phase, has been dedicated to identify a shortlist of possible support partner organizations and companies to support the development of the study. The shortlist, developed with the idea of covering the different requirements of an online tool development, includes different types of organisations from IT-focused companies to consultancies to health information institutes, all with established and certified experience in developing and managing web-based benchmarking platforms.

The final list, defined through an analysis of the above mentioned web-based benchmarking-related competences and experiences, and supported by a PQQ – Pre-Qualification Questionnaire (see Appendix III) includes three key partners: Pyxima, Optimity Advisors and CIHI – Canadian Institute for Health Information.

2.4.1 Pyxima

Founded as a Leuven University spin-off in 2009, Pyxima\(^1\) it is a ‘social care software’ company with large experience both in working and co-ordinating numerous EU projects and in developing care-related online platforms. Pyxima’s mission is to improve quality of life of vulnerable persons through software innovation.

Pyxima’s main product in health care, Pyxicare, is a platform for mobile care assessment using interRAI instruments. Pyxicare platform runs on tablet computers allowing caregivers to perform assessments close to the client with direct outputs and its online connectivity allows data exchanges with care professionals. Pyxima also developed the Belgian national interRAI database.

2.4.2 Optimity Advisors

Optimity Advisors\(^2\) is a leading international advisory firm that focuses on strategy, operations and IT. Using its industry experience and integrated solutions, Optimity Advisors helps clients in complex industries navigate rapid market and technological changes, working with them to enhance stakeholder value, improve operational efficiencies, and address performance and risk-related challenges.

Optimity has an extensive experience in developing web based benchmarking tools, with more than ten year of engagement in the development of data-driven web applications for

\(^1\) [http://www.pyxima.nl/](http://www.pyxima.nl/)
\(^2\) [http://optimityadvisors.com/](http://optimityadvisors.com/)
reporting and benchmarking. Optimity has also over 25 years’ experience working in health care, for clients including Public Health England (PHE), Department of Health (DH), NHS England, National Institute for Health and Care (NICE), Primary Care Trusts (PCTs) and Clinical Commissioning Groups (CCGs), DG Sante, the European Parliament and CHAFEA.

Among the main web-based healthcare-related projects, Optimity worked on:

- Used national Hospital Episode Statistics (HES) database, which covers all inpatient admissions, A&E attendances and outpatient visits in England, to benchmark and identify opportunities for improvement when working with NHS trusts and CCGs;
- developing a mental health patient data model based on data extracts from NHS trust patient administrative systems (PAS) to calculate performance indicators linked to key patient characteristics such as employment, accommodation and condition severity;
- Primary Care and Public Health Measures – Web Portals: data-driven web portals which use maps and other visualisations to compare data on doctor’s surgeries and public health data by locality.

Optimity Advisors has also significant experience in terms of data protection, having worked with restricted data on behalf of the UK Ministry of Justice for nearly ten years.

2.4.3 CIHI – Canadian Institute for Health Information

CIHI\(^3\) is an independent, not-for-profit organization that provides essential information on Canada’s health system and the health of Canadians.

Founded in 1994, CIHI provides its stakeholders with a broad range of health databases, measurements and standards, together with our evidence-based reports and analyses, in their day-to-day decision-making. The privacy of Canadians is deemed as central by CIHI, who ensure the confidentiality, integrity and availability of its health care information.

CIHI manages 28 pan-Canadian databases across health sectors and collaborates with stakeholders across Canada to advance the health system use of electronic health data in new and innovative ways. Working with Canada Health Infoway and others to create the knowledge base CIHI aims to improve patient experiences, support front-line care providers and build a more effective and efficient health system.

CIHI developed and managed “Your Health System”\(^4\), a one-of-a-kind web-based benchmarking tool with an array of health system data on hospitals, long-term care facilities and the health of Canadians across the country.

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\(^3\) [https://www.cihi.ca/en/about-cihi](https://www.cihi.ca/en/about-cihi)

\(^4\) [http://yourhealthsystem.cihi.ca/](http://yourhealthsystem.cihi.ca/)
“Your Health System” structure and characteristics have been analysed with the support of CIHI’s staff and is part of this Feasibility Study.
3 FEASIBILITY STUDY OF A WEB-BASED BENCHMARKING TOOL – DEVELOPMENT, ANALYSIS AND RESULTS

3.1 Analysis of a successful interRAI-based web-based benchmarking tool experience: CIHI’s “Your Health System”

3.1.1 Background of a comparable tool

The Canadian Institute for Health Information (CIHI)\(^5\) has developed an online tool highly comparable to the one envisioned by the IBenC project. This tool for care comparison is called YourHealthSystem (YHS) and is publicly accessible at: http://yourhealthsystem.cihi.ca/.

YHS was developed with the Canadian public in mind, and aims to provide targeted information to this targeted audience. It has three components: ‘In Brief’; ‘In Depth’ and ‘Insight’. The ‘In Brief’ section is the most accessible and is targeted for the public. It uses lighter visuals. The ‘In Depth’ is more elaborate and deals with fourteen quality based interRAI indicators for benchmarking and comparison and includes indicators on acute care and sector data. ‘Insight’ is a secure tool to drill down to granular levels of data and it requires.

*Your Health System – ‘In Depth’ results main visualization (Please see Annex V for additional screenshot examples)*

\(^5\) Canadian Institute for Health Information, [https://www.cihi.ca/en](https://www.cihi.ca/en)
3.1.2 Features of Your Health System

YHS compares health providers in several ways. It compares an individual organisation to its peers in order to identify best performers. Such a comparison is possible on different levels. A care organisation can be compared with a single other organisation or with a group of organisations on the local, regional and national level.

YHS also allows comparison over time. In this way, trends of improvement or decline for a single organisation can be identified early on. Moreover, YHS allows not only the identification of the best performers at a static point in time, but it is possible to see which organisations consistently score among the best performance for a longer period (three years for YHS). This is a more meaningful and reliable approach to identifying best practice.

YHS offers descriptive information to contextualize the hard data. This comprises for instance the type of organization (e.g. teaching hospital in the broader category hospital), number of beds, number of emergency visits, percentage of long-term care residents older than X years, etc.

YHS currently comprises a comparison for cost of acute care; a comparison for long term care cost is in development. It should be noted that YHS is in constant development, with as its current main goal to realise a real-time relation between back-end data and front-end visuals. This is now not the case, as back-end data needs to be manually structured for graphic visualisation.

YHS is strictly focussed on comparison and does not set benchmarks for performance indicators. However, the Canadian province Ontario has taken it a step further. Ontario has mandated the organisation Health Quality Ontario (HQO)\(^6\) to realise performance improvements using the YHS data. To this end, HQO does set benchmarks for care using indicators from the YHS. In addition to YHS indicators, they use additional measures for comparison based on regionally defined priorities. HQO requires care facilities to provide annual care improvement plans and to set targets based on HQO benchmarks. Something similar is imaginable in Europe, with different nations taking the obligations attached to performance information as far as they see fit, or supplementing it with nationally prioritised data, as the Dutch Omaha system as discussed in the Dutch IBenC stakeholder webinar\(^7\).

3.1.3 Continued engagement

After the YHS website was launched, CIHI continued their efforts on the website in several work streams. First, a large part of CIHI’s ongoing work involves capacity building among

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\(^6\) Health Quality Ontario website, [www.hqontario.ca](http://www.hqontario.ca)

stakeholders. Capacity concerns the skills of clinicians to code data and submit it, and how care organisations can interpret the information on the YHS website to improve their decision making and their performance management. Capacity building can be administered through different channels:

- The CIHI worked in collaboration with the Health Regions to provide workshops for care stakeholders. During these three-day workshops, coding practices were taught, as well as the relation between the data and the visual outputs on the website. The workshops were designed based on a workshop by the European Health Observatory. Initially the workshops were offered free of charge by CIHI, and at a later point on a cost recovery basis;
- After the launch of the tool, the CIHI is sometimes asked by individual stakeholders to help them understand the results on the website, for which face-to-face meetings or webinars can be organised.
- CIHI developed e-learning tools to improve care organisation’s capacity to use YHS. E-learning is freely available, and has as advantaged that it offers self-paced and on-demand learning opportunities.
- CIHI is currently setting up thematic peer-to-peer learning, facilitating dialogue between the experienced users and novice users, and between top performers and sub-optimal performers. These meetings might discuss interventions implemented to improve performance on specific aspects of care provision.

Second, CIHI is continuously involved in the processing of data:

1. CIHI assembles the data collected by health facilities and stores these in flat files in a data warehouse;
2. CIHI then processes and prepares this data for visualisation:
   a. Through manual validity and quality checks of the raw data, on top of those installed in the vendor software at the input location
3. Upload to the YHS website

CIHI is currently working on the automatization of these processes. The ambitious goal is to fully automate the steps between submission of data by facilities up until visualisation on the website, which will allow for real time connection. The processing tools used by CIHI send out warning emails to facilities if there is a suspicion the data submitted contains errors (for instance, due to coding interpretation errors). Sometimes solving such issues requires additional attention from CIHI staff, and could necessitate new training sessions for the facility. CIHI experts emphasised that the best way to secure a continued input of correct data, is by training clinicians in such a way that they are invested in the data collection and reporting.

Third, ongoing work by CIHI related to YHS concerns the continuous development and expansion of the tool.

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3.1.4 Lessons on developing an online care benchmarking tool from Your Health System

The development of YHS by CIHI took about a year and a half with more than fifty CIHI staff members involved alongside external subcontractors (e.g. IT companies). A lot of effort went into stakeholder consultation to optimize graphical visualisation\(^9\), and in the preparation of stakeholders for use of the tool: informing them so that they understand the tool and its use, and that they do not feel the tool is not about blame and judgement but about learning and sharing.

CIHI worked together with subcontractors for the development of the website, and picked an external company with high-level expertise in visualisation of data. After the launch of the website, a five-year plan was set in place for the automatization of data processing from input to output.

During our brainstorming session, CIHI emphasised that any party responsible for an online tool assessing care facility performance, needs to have high standards for data validity. It therefore excludes any organization for which quality checks suggest any issue with the data. The most complicated part of developing the website, according to CIHI, was the risk adjustment.

Finally, all decisions on funding and costs of the YHS, which constitutes part of CIHI’s mission implementation, were made in collaboration with the Canadian government, who provides direct financial support to the organization. Alongside Third party vendors are responsible for the distribution of the software used for data input. In some regions, there is a single vendor, in others facilities can choose between multiple vendors.

3.2 Web-Based Benchmarking tool structure: overview of a possible effectual web-based tool workflow

Following brainstorming sessions and exchanges at both internal level and with the external partners\(^{10}\), a possible workflow structure has been identified. The structure entails four key steps, covering the key stages of an effective web-based benchmarking tool:

- Data collection and data upload;
- Data cleaning and validation;
- Calculation and metrics;
- Results visualization.

\(^9\) E.g. which visualisations are intuitive, which colours should be used to illustrate certain levels of performance

\(^{10}\) Pyxima and Optimity Advisors
Based on these four steps, the IBenC consortium worked with Optimity Advisors to develop a more detailed workflow, as illustrated below:

Data collection and data upload

Analysing the different steps, the first phase, data collection and data input, covers all the necessary actions and points of attention regarding the procedures and technical specifications to be adopted in relation to costs information and patients’ data (quality) collected on site.

Organizations interested in using the tool should be able to input their (de-identified) interRAI-HC client data through an easy upload of standardised files (e.g. Excel or alternative internationally used database file extensions), manually filled in with sensible information based on the abovementioned indicators and cost items.

Moreover, in order to classify the organizations, an additional brief data input form (entailing up to six or seven focused questions) should made available for completion when uploading the costs-quality data. The combination of significant quality-costs data, crossed with the identification of the typology of care service being benchmarked, would allow more accurate and focused results.

In addition to the above addressed issue regarding the format for data collection and upload, data management and security represent an issue that needs to be carefully tackled in order to guarantee compliance in terms of privacy and sensible data protection.

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11 IBenC Report, Optimity Advisors, September 2016
Hence, data must be collected, handled and uploaded in a way which does not violate member state or EU level data legislation. To ensure this level of protection, Optimity Advisors\(^\text{12}\) suggested that user-level data should be stored in ‘internal’ databases directly controlled and operated by the collecting organisation before the final upload on the web portal. The next step in terms of data management, would then be to validate, anonymise and aggregate that data, under appropriate controls which ensure they meet legal standards.

To cover the aforementioned levels of data interaction, a designated data protection – data controller officer should be appointed. Its tasks would be to guarantee that each data-related task, from collection to anonymization to aggregation and upload, should be correctly taken care of. An automatized web-based control should then always integrate human actions and, at the same time, the online tool should use the most advanced secure SSL\(^\text{13}\) connection to safeguard data transfers.

**Data cleaning and validation**

The second phase, data cleansing and validation, covers all the necessary actions and issues regarding the procedures and technical specifications to be adopted in relation to ensure that the uploaded data is efficiently ‘cleaned’ and validated for use.

During this process, any record in which data is erroneous, conflicting or incomplete should be corrected or rejected in order to allow the tool calculation processes, based on the IBenC methodology (third phase), to run smoothly. To reach this objective quality and appropriateness of the data must be thoroughly analysed by the most efficient procedures available.

The data cleansing and validation step has been identified not only as a key stage of the online benchmarking tool workflow, but also as rather challenging in terms of how it should be implemented. Indeed, a completely automatized procedure would represent the optimal solution, both in terms of resources and efficiency.

However, based on the analysis of already established web-based benchmarking tools (e.g. CIHI’s “Your Health System”) the current level of technology accessibility does not allow to adopt such an entirely automatized procedure and requires a hybrid solution, with a degree of human intervention on the data.

An additional possible issue related to this second step of the workflow is related to the European-wide scope of the online tool itself. Particular attention should be indeed placed on the challenges constituted by possible differences in terms of data collection and data clustering between the different EU countries. This problem might also be tackled at source

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\(^{12}\) IBenC Report, Optimity Advisors, September 2016

\(^{13}\) SSL (Secure Sockets Layer) is the standard security technology for establishing an encrypted link between a web server and a browser. This link ensures that all data passed between the web server and browsers remain private and integral. Source: [http://info.ssl.com/article.aspx?id=10241](http://info.ssl.com/article.aspx?id=10241)
through, for example, specific training aimed at creating EU-wide consistency and harmonization.

The practical organisation of the data collection and data flow was at the centre of the round of stakeholder webinars organised by the IBenC consortium\(^\text{14}\). Project Coordinator Hein van Hout, led a discussion focused on the following steps, identified as the optimal workflow:

1. A local patient observation digitally stored in the local database of the own organisation;
2. There should be data checks and anonymization of on this information;
3. Upload to a specially designed web portal. Ideally, this should be done by an authorized main user for each health organisation;
4. New data check on central database level and, in case of irregularities, data should be sent back to the submitter;
5. Calculation of indicators with the appropriate algorithms and ideally in real time;
6. Real time reporting and visualisation of the updated database on a dynamic website, providing information about the performance of the health organisation in comparison to others.

The initial collection of patient data during the study took around an hour. Follow up meetings to record data took shorter. Among the stakeholders’ key comments, one pointed out that the investment and administrative burden to collect data can be lowered if the collection of data with the purpose of benchmarking is recorded combined with the data collection for the ‘standard’ patient intake, and with other data collection moments in the care process. Also with respect to the discomfort experienced by the patient, avoiding duplication was demarcated as paramount.

**Calculation and metrics**

Once the data is correctly collected, uploaded, cleansed and validated, the third phase of the workflow is intended to use the methodology developed by the IBenC consortium to transform the submitted data into direct feedback on the cost-effectiveness of the organization being analysed and thus benchmarked at European level.

A brief description of the calculations, based on John Morris’ 2013 paper on the new generation Home care QIs including stratifications and regression based case mix adjustments is contained in Annex IV.

Discussing this third phase with the Feasibility Study partners, EHMA and VUmc have identified several points of attention, to be taken into careful consideration in case of a future development of the IBenC web-based benchmarking tool. Indeed, the nature of the IBenC benchmarking tool, mixing cost and quality indicators, makes necessary an adequate level of flexibility and computing power to handle the amount of data. In particular, the

complexity of the Quality-related code, might pose a challenge in terms of real-time calculation process, which would represent the ideal and most advisable solution for an innovative online benchmarking tool.

**Results visualization**

The last step of the online tool workflow involves the online visualization of benchmarking results based on the IBenC method calculations. Dynamic, clear and easy-to-understand visualizations is a cornerstone of the online tool as they can provide the stakeholder with core information about cost-effectiveness while avoiding long and redundant detailed reports.

Based on its modern web frameworks for visualisations are capable of generating a wide range of possible visualisations, including:

- Scatter plots, with customised “star” markers to identify organisations;
- Stacked bar charts to display segregated distributions (for example types of care);
- Radar charts allowing the comparison of organisations across multiple metrics;
- Customised lists of metrics with user-friendly design

What has been identified as a possible optimal solution, would be to adopt the same results visualisations as the CIHI *Your Health System*, analysed within the Study.

### 3.3 Additional evaluations: data-related risks

The main risk in developing a benchmarking tool is undoubtedly related to a correct and safe use of data, from collection and storage to uploading and cleansing, as unanimously recognized by all the partners involved in the study.

In particular, thanks to Optimity Advisors, we have been able to identify some of the key data-related issues.

**Sensitive Data and approval to use**

Data should be uploaded and stored in a way which does not violate the terms under which the data was collected, or member state or EU data legislation. Therefore, it would be necessary that participants in the benchmarking study, responsible for data upload, accept or decline to allow their data, in an anonymised and aggregated form, be used by the IBenC tool.

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15 IBenC Report, Optimity Advisors, September 2016
16 Ibid.
However, this would not be necessary for all Member States, as the General Data Protection Regulation (GDPR) - which will come into force on the 25th May 2018 – stipulates that an organisation does not have to rely on consent as its ground for processing sensitive personal data if the processing is necessary for the provisioning of health or social care. However, Member States Law in Lithuania, France and Norway require that the patient give consent for secondary research. Further, Sweden and the UK provide that the patient be given opportunity to opt-out of allowing their data be used for secondary research. 

Web Portal Data Storage and Retention

Legislation surrounding the retention of identifiable medical data varies significantly among Member States, including disparities around who can view the data, levels of security and server location. Given this lack of harmonisation, it would not be practical to retain identifiable user data in a central IBenC database. In any case, storing anonymised or aggregated data within the web portal would present far less risk. Therefore, a possible solution would be that user-level data should be stored in databases controlled and operated by the organisation in which they were collected, if available. These databases should already fulfil the legal requirements for the jurisdiction in which they are situated.

Only aggregated and de-identified data should be stored in the central IBenC web portal database, since this is not considered ‘sensitive’ under the terms of the GDPR or EU Member State Legislation. Therefore, such data would no longer be covered by privacy laws, allowing it to be used and disclosed for our secondary purpose (subject to the possible consent requirement mentioned above).

If these did not already exist, it would be advisable to develop tools for the exclusive use of the web portal administrator which would import patient-level data from organisations and output anonymised data suitable for upload to the web portal. However, there would less risk associated with requiring case organisations to supply anonymised data, so that patient details are never required to leave their local jurisdiction.

Data-related Risks Analysis - Data breach

19 Ibid.
20 Ibid.
A data breach happens when personal health information data is either accidentally or maliciously revealed to an unauthorised third party – in a way which violates Member State of EU data protection laws. The breach would have to be reported to the relevant regulatory authority(s) in a timely way, which may incur a fine. Under the new GDPR this fine could be up to 20 million EUR. Further, if the unlawful release of data about an individual causes damage to that individual – then the organisation responsible for the breach is liable to repay those damages.

As suggested by Optimity Advisors, it would be possible to mitigate this risk by creating an architecture which prevents the accidental or malicious upload of sensitive data to the IBenC database. In addition, storing on the tool only non-sensitive data (e.g. costs), the risk of data breach is effectively eliminated. However, if the portal system administrator or data uploader retains a copy of patient level data, this risk must be considered.

**Data-related Risks Analysis - Data out of date and/or incomplete**

This situation can happen when inaccurate data is uploaded to the application and subsequently used to generate false statistics. This would challenge the credibility of the application, and in a worst-case scenario, lead to decisions being made on the basis of inaccurate information. As data would be uploaded to the tool central database in an anonymised and aggregated form to ensure data protection, it might be difficult to ensure its quality/accuracy. However, it is possible to take a number of steps to mitigate this risk.

The application could be set to reject all incomplete or self-conflicting records. Key way data validity could be ensured by only allowing registered and valid users to upload data to the application. The web-based tool will clearly state the methodology for data upload and assurance, so as to allow decision makers to make an informed decision about whether to use the data. Moreover, as mentioned in the analysis of the “data collection and data input” workflow phase, full automated data cleansing procedure are currently not possible. Hence, the quality of data check would be further ensured by a designated officer or team of experts.

Any further “business rules” for the data could be encoded and automated as part of the upload process, and the results of data validation can be presented back to the user as a report.

### 3.4 Users consideration, stakeholder feedbacks and dissemination
In order to guarantee wide accessibility and usability, the web-based benchmarking tool should be designed and developed integrating the most user-friendly digital techniques in terms of web standards, responsiveness, languages and training opportunities.

Moreover, once the online tool is developed and running, tailored dissemination campaigns should be launched, coordinated and managed to raise awareness about not only the existence of the tool itself but, above all, about its potential benefits for stakeholders.

Accessibility, optimisation and localisation

Accessibility refers to designing a website to cater for the needs of all users, including those with restricted abilities or old technology. For example, ensuring text could be dynamically scaled to be easier to read and be identified by screen reading software for those with hearing impairments.

If developed as part of the ‘EUROPA’ portal, for example, the tool website should comply with Web Content Accessibility Guidelines 2.0 (WAG2) at a conformance level of AA. Moreover, the web portal should be developed in compliance with modern web standards, ensuring compatibility with all modern browsers.

An increasing number of users prefer to access content via mobile devices (e.g. phone or tablet). It would be thus necessary to consider whether to make the application accessible by mobile. If the user is likely to access the site on mobile devices and on-the-go, then a specific investment in mobile friendly responsive design and content would be recommended. If there are only key areas that will be accessed on mobile, then these can be mobile optimised, leaving the bulk of content for desktop only.

In general, as identified by Optimity Advisors, designing a web portal to be responsive to displaying on different devices would not add significantly to cost, as long as this is considered from the outset. Developing additional, mobile-specific versions of web portals, or dedicated mobile applications (apps) could increase cost significantly.

As concerns the tool localisation, the number of languages required of the application interface would have a significant impact on the cost of development due to the cost of specialist translation services and additional testing.

A minimum viable product might use English only, but it would be advisable to also develop alternative versions of the application including French and German – as these cover a large portion of the EU’s population. However, developing the tool, it would be necessary to carefully consider the core user groups in order to correctly identify their needs in terms of translation, character sets, reading order and page layout.

Dissemination and stakeholder feedbacks

22 Ibid.
In order to maintain the IBenC visual identity, the tool should be developed with the same design of the project. Moreover, as mentioned above, it should also be the subject of tailored disseminated activities through different digital and traditional communication platforms and means, as for example:

- workshops and participation in high-level conferences;
- social-media campaign;
- identification of a European-wide network of key stakeholders;
- webinars.

The utilisation of these means should be defined in advance and aimed at cover different levels of the tool development process, from the testing phase to its launch to its actual use as a European-wide benchmarking platform.

For example, a subcategory of the abovementioned network of key stakeholders could be directly involved in the testing phase of the tool, in order to eventually tune the platform according to their direct feedbacks. At the same time, webinars and workshops could be used both as simple dissemination instruments and as training means.

Indeed, such an innovative tool would require a well-defined and effective training strategy for users, providing them with the right information to correctly use it, with a focus on the challenging and sensible procedures for data collecting, cleansing and aggregation.

In terms of direct stakeholder engagement, during the Dutch stakeholder webinar lead by Project Coordinator Hein van Hout, a number of parties was identified as interested in the implementation of an online benchmarking tool based on the IBenC method based on a wide range of specific motivations, namely:

- **Care organisations**: to get a better insight in their own functioning;
- **Health insurers**: to attain more transparency in care delivery, and perhaps base care purchasing on this information;
- **Dutch national inspection for health (IGZ)**: to improve monitoring of care;
- **Clients and consumers**: to identify best practice, and choosing providers according to needs;
- **Ministry of Health/Policy Makers (VWS/ZIN)**: to promote a good health policy on the national level.

Furthermore, stakeholders highlighted how financial support for such a tool, given both its scope and general public health utility, should be shared among stakeholders (public domain, health care insurers, care organisations) in case of lack of centralized funding.

Even though the above-mentioned discussion was focused around national stakeholder from the Netherlands, engagement with the same categories of professionals in other Member States, and at European level, would be fundamental to successfully support, develop the tool and exploiting its potential.
3.5 Resources, governance and business models

Through exchanges with our partners and collection of feedbacks from stakeholders and Final Conference participants, we have identified three possible business plans for the online tool. The definition of a comprehensive business plan for the online tool would entail not only the development phase but also the management and the improvement processes to guarantee a correct functioning with evolving features, together with constant training opportunities for the users. Indeed, no matter the kind of business model adopted, it would be necessary to obtain what can be described as a ‘multi-step financing’ covering the technical study, development and maintenance, both in terms of infrastructures (e.g. servers, IT platform) and human resources (e.g. the previously mentioned data officers, IT experts and subcontractors, communication, training, day-to-day maintenance).

3.5.1 Business Models

Public Funding

This first business model would involve the use of public funding for the development and the management of the online tool based on the IBenC methodology. This model is based on the experience and on the information exchanged with the Canadian Institute for Health Information about the Your Health Systems tool. In CIHI’s case, the bulk funds received from the Canadian Government are not entirely directed to the tool as they cover the entire functioning cost of the Institute and of its numerous activities.

Public funding for the IBenC tool could thus follow a similar path, being channelled through an institute, university or organization that would be in charge of the development and the consequent management of the tool on a regular basis.

Subscription fees

In this second business model, the tool would be financially supported by regular subscription fees paid by the care organizations interested in using it to benchmark their performances. The fees should be calculated in order to allow to cover the managing costs of the web based tool, also taking into account how broad the ‘audience’ of interested parts would be. Moreover, to correctly define the fees it would also be necessary to conduct a broad analysis of the market for similar tools, in order to better understand how and where to place the product to make it both accessible but also self-sustainable.

The main problem with this specific business model could be related to the initial development of the tool. Indeed, while regular subscription fees could represent the right solution to cover the management costs once the tool is already up and running, this
business model does not solve the issue of subsiding the expensive process of building the web platform.

Financial supporting consortium

The third possible business model entails the creation of a consortium of stakeholders interested in funding the tool. As discussed during the stakeholders’ webinars and as previously mentioned in the study\(^{23}\), stakeholders highlighted how financial support for such a tool should be shared among public domain, health care insurers and care organisations in case of lack of centralized funding. Putting together such a consortium would possibly allow to mix the two business models mentioned above and thus support both the development of the tool and its management. Indeed, with a common effort, it would be possible to raise the necessary amount of money to cover the initial large investment and part of the management phase financial needs. Moreover, consortium’s care organizations and other stakeholders interested in using the tool could also be subject to subscription fees similar to what envisioned in the second business model.

3.5.2 Governance structure

Linked with the identification of possible business models and in relation with what discussed with the Study partners, a key issue connected with the development of an IBenC-based online tool is to identify a functional and efficient governance structure to support, guide and administrate the tool during all the phases of its development and management.

Given the European span of both the project and the tool, the Feasibility study team identified a restricted number of viable governance options able to answer to three key questions: who owns, who maintains and who exploits and communicates the tool. Especially in terms of ownership, the answer is strictly related to the business model that will support the tool itself. Indeed, should the tool be entirely funded by public authorities/grants, the advisable solution would be to have a governance structure equally connected or managed at public level. This solution, which replicates the CIHI structure, would allow to guarantee consistency in terms of funds management and structures.

At the same time, the adoption of the other identified business models could lead to choosing alternative governance structures, possibly adapt better to their characteristics. Indeed, should the business model selection lead to adopt a shared financial support, the optimal governance structure could be constituted by a ‘governance consortium’, conceivably leaded by either a pan-European healthcare organization or a European level University research centre, subjects able to centralise expertise and to ensure that the

\(^{23}\) See Feasibility Study, Section 3.4
development and the consequent management (and dissemination) of the tool. The European dimension of the consortium, or at least of some of its core members, it is fundamental to guarantee a wide dissemination and exploitation of the tool. The same governance structure could also be adopted in the case of a subscription-based business model.

Finally, an additional possible governance structure could be also represented by one single private organization, private company, research centre and/or university, without the support of a broader consortium. This solution would surely allow to have a centralised control of all the aspects of the tool development and might lead to a leaner management through a more focused organizational control. At the same time, having a single organization covering all the aspects of the tool governance would lead to reduced variety in terms of expertise compared to a consortium.

Irrespective of the kind of governance selected, it is important to highlight the necessity of setting up a team dedicated to the tool, covering key competences (above all data analysis, research, IT high-level skills) to provide full support and to ensure the correct functioning and administration of all the previously mentioned key steps, phases, risks and actions related to the tool, from data cleaning to calculation to IT structure and data risks. The dimension of the dedicated staff structure could vary based on factors as subcontracting or tool’s technicalities. However, based for example on the lessons learnt from CIHI, it is clear that such a project requires a large amount of human resources on a long-term basis towards an effective management and a constant improvement process.
4 CONCLUSIONS

Based on the Feasibility Study findings, including brainstorming activities, exchanges with the partners and feedbacks from the stakeholders, the development of an online benchmarking tool based on the IBenC methodology is not only feasible, but also advisable and extremely useful to improve quality in healthcare at European level.

However, the scope of the project and the complexity behind the innovative benchmarking method developed by IBenC, makes it necessary to carefully plan and structure the development of such an online tool. In particular, as mentioned in the previous sections of the Study, some steps and facets of the defined possible tool architecture could pose a challenge and need to be addressed in the correct way.

More specifically, what emerged from our study is that all the stages of data handling have to be carefully managed in order avoid risks and threats to the correct functioning of the tool, especially when it comes to quality data. In fact, while costs data handling is probably easier, the delicate nature of this specific data requires a different level of understanding and attention. The study identified that misconducts when working with patients’ data might not only hinder the validity and legitimacy of the online benchmarking procedures and results, but also lead to severe violation in terms of the EU and National level data protection and privacy legislation.

Finally, in terms of actual development of the tool, the Study highlighted the fact that the entire procedure, from planning to deliver, and to maintaining the platform, would undoubtedly require a large amount of time, financial and human resources. For example, to mention again what emerged from the exchanges with CIHI, the development of their Your Health System Platform, besides the constant flow of Government funds that the organization receives, made necessary efforts from more than fifty people and external consultants over around a year and a half. Optimity Advisors, at the same time, theorise an overall expenditure of around € 300.000 – 350.000, including a discovery phase and the delivery stage.

In order to get the process going and facilitate the development of such a tool in a reasonable time, possible “kick-off” solutions could be, for example, focusing on a limited number of indicators rather than the whole complex IBenC methodology; removing costs from the calculation; launching a pilot version of the tool with a limited geographic scope (e.g. single European State, regional/local authority).

To conclude, despite the possible challenges and the amount of required resources, the IBenC consortium is confident that developing an online tool based on the novel benchmarking method developed throughout the project, would represent an important
step ahead to ameliorate the quality and effectiveness of community care delivery for care-dependent elderly in Europe.
Appendix I: IBenC Home Care Quality Indicators

Description of Home Care Quality Indicators including Stratification and Adjustment Covariates

<table>
<thead>
<tr>
<th>HCQI</th>
<th>Description, Adjusted for and adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL improvement⁷</td>
<td><em>Clients with baseline impairment and a better score on the ADL long form.</em></td>
</tr>
<tr>
<td></td>
<td><strong>Stratification</strong>: IADL capacity scale score</td>
</tr>
<tr>
<td></td>
<td><strong>Adjusted for</strong>: not independent cognition, ADL decline, clinical risk, falls, hospitalizations, ADL hierarchy scale score</td>
</tr>
<tr>
<td>ADL decline⁷</td>
<td><em>Clients with a score of less than 18 on the baseline ADL long form who decline further.</em></td>
</tr>
<tr>
<td></td>
<td><strong>Stratification</strong>: IADL summary scale</td>
</tr>
<tr>
<td></td>
<td><strong>Adjusted for</strong>: difficulty with meal preparation, housework and bathing, unsteady gait, Cognitive Performance Scale score, institutional risk, ADL hierarchy scale score</td>
</tr>
<tr>
<td>Bladder decline⁷</td>
<td><em>Clients who experienced a decline in bladder continence (baseline score is less than 5 and lower than follow-up score). Includes clients who developed a new bladder continence problem.</em></td>
</tr>
<tr>
<td></td>
<td><strong>Stratification</strong>: IADL performance scale</td>
</tr>
<tr>
<td></td>
<td><strong>Adjusted for</strong>: difficulty with meal preparation, clinical risk, ADL hierarchy scale score, age over 80 years</td>
</tr>
<tr>
<td>Bladder improvement⁷</td>
<td><em>Clients who experienced an improvement in bladder continence (baseline score greater than 0 and greater than follow-up score).</em></td>
</tr>
<tr>
<td></td>
<td><strong>Stratification</strong>: ADL hierarchy scale score</td>
</tr>
<tr>
<td></td>
<td><strong>Adjusted for</strong>: not independent cognition, sadness, difficulty bathing, ADL decline, hospitalizations, institutional risk</td>
</tr>
<tr>
<td>Cognitive improvement⁷</td>
<td><em>Clients with some baseline cognitive impairment on the Cognitive Performance Scale who experience an improvement.</em></td>
</tr>
<tr>
<td></td>
<td><strong>Stratification</strong>: IADL summary scale</td>
</tr>
</tbody>
</table>
|                               | **Adjusted for**: difficulty with phone use, impaired decision making,
<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Stratification</th>
<th>Adjusted for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alzheimer’s diagnosis, clinical risk, not independent cognition, less than 2 h of activity daily, Cognitive Performance Scale score</td>
<td><strong>Clients with a score of less than 6 on the Cognitive Performance Scale at baseline who experience a further decline. Includes clients who experience a new cognitive impairment.</strong></td>
<td>Stratification: IADL performance scale</td>
<td>difficulty with phone use, managing finances, meal preparation and bathing, falls</td>
</tr>
<tr>
<td>Communication improvement</td>
<td><strong>Clients with some difficulty in the communication scale (problems understanding others or making themselves understood) at baseline who experience an improvement (lower score on the communication scale).</strong></td>
<td>Stratification: IADL capacity scale</td>
<td>dementia (both Alzheimer’s and non), clinical risk, sadness, Cognitive Performance Scale score, ADL hierarchy scale score, age over 80 years</td>
</tr>
<tr>
<td>Communication decline</td>
<td><strong>Clients with a score of less than 8 on the communication scale at baseline who experience a decline (higher score on the communication scale). Includes clients with new difficulties in communication</strong></td>
<td>Stratification: IADL performance scale</td>
<td>difficulty managing finances, managing medications, and with phone use, Alzheimer’s disease, clinical risk, ADL hierarchy scale score</td>
</tr>
<tr>
<td>Falls</td>
<td><strong>Clients who experienced one or more falls in the last 90 days.</strong></td>
<td>Stratification: clinical risk</td>
<td>use of assistive device, unsteady gait, ADL hierarchy scale, age over 80 years</td>
</tr>
<tr>
<td>IADL improvement</td>
<td><strong>Clients with a score greater than 0 on the IADL self-performance summary scale at baseline who experience an improvement (lower score).</strong></td>
<td>Stratification: clinical risk</td>
<td>clinical risk</td>
</tr>
<tr>
<td>Condition</td>
<td>Description</td>
<td>Stratification</td>
<td>Adjusted for</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IADL decline&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Clients with a score less than 15 on the IADL self-performance summary scale at baseline who declined (had a higher score).</td>
<td>Clinical risk</td>
<td>Difficulty with meal preparation and housework, institutional risk, ADL hierarchy scale score</td>
</tr>
<tr>
<td>Injuries&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Clients with new injuries - fractures, second- or third-degree burns or unexplained injuries – since baseline.</td>
<td>Clinical risk</td>
<td>ADL decline, pain, unsteady gait</td>
</tr>
<tr>
<td>Mood improvement&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Clients with fewer depressive symptoms on the Depression Rating Scale at follow-up.</td>
<td>IADL summary scale</td>
<td>ADL decline, hospitalizations, depression rating scale score</td>
</tr>
<tr>
<td>Mood decline&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Clients with more depressive symptoms on the Depression Rating Scale at follow-up. Includes clients with new depressive symptoms.</td>
<td>ADL hierarchy scale</td>
<td>Clinical risk, difficulty bathing, institutional risk</td>
</tr>
<tr>
<td>Pain not controlled</td>
<td>Clients who have pain and are receiving inadequate pain control or no pain medication.</td>
<td>Clinical risk</td>
<td></td>
</tr>
<tr>
<td>Pain improvement&lt;sup&gt;a&lt;/sup&gt;</td>
<td>A reduction in pain since baseline.</td>
<td>Clinical risk</td>
<td>Unsteady gait, Cognitive Performance Scale score</td>
</tr>
<tr>
<td>Daily severe pain&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Individuals with at least daily episodes of severe pain at follow-up.</td>
<td>Clinical risk</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td>Stratification</td>
<td>Adjusted for</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Continued caregiver distress</strong></td>
<td>Clients with caregivers who express distress, anger and or depression at baseline and follow-up.</td>
<td>Cognitive Performance Scale score</td>
<td>not independent cognition, IADL difficulty, difficulty with locomotion, impaired decision making, difficulty with housework, clinical risk</td>
</tr>
<tr>
<td><strong>Alone and distressed</strong></td>
<td>Clients who are distressed by a decline in social activities and are alone for long periods or all the time at follow-up.</td>
<td>clinical risk</td>
<td>not independent cognition, pain, unsteady gait, Cognitive Performance Scale score, ADL hierarchy scale score, depression rating scale score</td>
</tr>
<tr>
<td><strong>Used to go out</strong></td>
<td>Clients who compared to the baseline assessment, go out less or not at all.</td>
<td>IADL difficulty, Cognitive Performance Scale score</td>
<td></td>
</tr>
<tr>
<td><strong>No flu vaccine</strong></td>
<td>Clients who did not receive an influenza vaccination at either baseline or 6-month follow-up assessments</td>
<td>clinical risk</td>
<td>less than 2 h of daily activity, institutional risk, Cognitive Performance Scale score, depression rating scale score</td>
</tr>
<tr>
<td><strong>Hospitalization and Emergency Department use</strong></td>
<td>Clients who have been hospitalized or visited the emergency department in the 90 day period before the follow-up assessment.</td>
<td>IADL capacity scale score</td>
<td>physician visits, clinical risk, diabetes, depression rating scale score</td>
</tr>
<tr>
<td><strong>Weight loss</strong></td>
<td>Clients with any unintended weight loss at follow-up.</td>
<td>clinical risk</td>
<td></td>
</tr>
</tbody>
</table>
Abbreviations: ADL activities of daily living, IADL instrumental activities of daily living

*aMeasured at the 6-month follow-up assessment

Appendix II: The Feasibility Study as a theme for the National Stakeholders Web-Based Workshops

Theme: Feasibility of a web based benchmarking tool for European community care (WP8 related)

Title: Exploration of the feasibility of an interactive web based benchmarking tool on community care.

Contents:

One of the dissemination-related deliverables of the project is the feasibility study of a web based benchmarking tool on community care according to the method developed in IbenC and with the objective of providing a valid interactive decision-making supporting system.

The study will explore several aspects of the feasibility of such a tool, from technical and user requirements, to costs, usability and acceptability.

These are some of the key issues to be discussed during the Workshops:

- Stakeholders’ prior experiences with this kind of web based tools;
- Needs, requirements and key characteristics of such a tool;
- Expected social impact and usability;
- Potential business model, with focus on costs and possible sources of funding.

Objectives and expected outcomes:

The workshop will provide room for high-level expert discussion among the stakeholders about the features and key aspects of the abovementioned web based tool.

The discussion and its conclusions, together with the technical survey conducted by EHMA with web/IT developers, will constitute an important part of the feasibility study (D8.3), which aims to provide a ‘controlled’ way of introducing innovation in the sector without the blind investment in a costly and under-researched instrument.
Appendix III: Pre-Qualification Questionnaire - Template

| Company: |  |
| Date: |  |
| Contact Person: |  |
| Contact Details: |  |

| 1. What experience has your company had in developing web based benchmarking tools/online benchmarking information? |  |
| 1. If yes, can you briefly describe the benchmarking tools that you have developed and their main elements? For which stakeholders you have developed them? |  |
| 2. What experience has your company had in working with large datasets? |  |
| 3. What experience has your company had in the fields of health and social care? |  |
| 4. What experience has your company had in working across Europe? |  |
| 5. What experience has your company in building web portals for data delivery? |  |
| 6. Please provide us with additional details or information about your expertise on developing/designing web portals. |  |

Notes:
Appendix IV: QIs Indicators – Examples of Outcomes

With the IBenC method care organisations can see what quality of care and average costs of formal and informal care is compared to others. Quality of care is expressed in 23 specific indicators (fig 1) as well as a global indicator (fig 2).

**Figure 1** compares the overall quality of care and average costs of formal and informal care of clients of organisations. The green part is the wanted position, the red part the unwanted.

![Figure 1](image)

**Figure 2** compares organisations in 6 countries on a specific quality indicator ‘prevalence of pain’ (case mix adjusted) against the hours of formal care they provide. Organisations left of the green line perform well (lowest quartile), organisations right of the red line perform worse (highest quartile).
Quality indicators

Figure 3, 4 illustrates the performance of organisations on the on 23 specific indicators. The figures below separate these types of QIs. So in the clinical balance QIs, the larger the surface the better, while second figure higher scores reflect worse performance.
Quality indicators related to decline in independence:

- Hospitalization and Emergency Department use
- Injuries
- Going out decline
- Pain not controlled
- Falls
- Mood decline
- Communication decline
- Cognitive decline
- ADL decline
- IADL decline

Interpretation: larger values and surface indicate worse performance
## Appendix V: Calculation example of costs of Resource use

### Calculation example of costs of Resource use - A typical case

Over the last three months Ms X receives 5 hours home care a week. Her daughter and son provide informal care 20 hours a week. She receives 3 hours of physical therapy a week. She spend 5 nights in a general hospital ward. Costs of her resource use accumulate to 10003,- euros, of which 3538 are attributable to informal care time. Other clients of the home care organisation of Ms X consumed an average 7000,- over 3 months.

<table>
<thead>
<tr>
<th>Resource utilisation categories from interRAI HC</th>
<th>Costs (€) per unit *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home care</strong> Home health and domestic care (including home health care, home nursing and home making services)</td>
<td>38.00 per hour</td>
</tr>
<tr>
<td><strong>Physician visits</strong></td>
<td></td>
</tr>
<tr>
<td>General practitioner visit</td>
<td>30.40 per visit</td>
</tr>
<tr>
<td>Outpatient clinic visits</td>
<td>78.16 per visit</td>
</tr>
<tr>
<td><strong>Other health care services</strong></td>
<td></td>
</tr>
<tr>
<td>Physical therapy</td>
<td>39.08 per session</td>
</tr>
<tr>
<td>Occupational therapy</td>
<td>23.88 per session</td>
</tr>
<tr>
<td>Psychological treatment</td>
<td>86.85 per session</td>
</tr>
<tr>
<td><strong>Hospital admissions</strong></td>
<td></td>
</tr>
<tr>
<td>General ward with overnight stay</td>
<td>496.11 per day with overnight stay</td>
</tr>
<tr>
<td>Intensive care unit with overnight stay</td>
<td>2369.82 per day with overnight stay</td>
</tr>
<tr>
<td>Emergency room visit (without overnight stay)</td>
<td>163.92 per visit</td>
</tr>
<tr>
<td><strong>Supportive care services</strong></td>
<td></td>
</tr>
<tr>
<td>Meals on wheels</td>
<td>7.06 per day</td>
</tr>
<tr>
<td><strong>Informal care</strong></td>
<td>13.57 per hour</td>
</tr>
</tbody>
</table>

* Dutch standard cost prices 2015 ** using OECD countries’ average length of acute stay times
Appendix VI: CIHI's Your Health System (YHS) Web-Based Tool

Screenshots Source: https://yourhealthsystem.cihi.ca

Figure 1 Your Health System (YHS) Homepage
Figure 2 Your Health System – ‘In Brief’ results visualization.

Figure 3 Your Health System – ‘In Depth’ results main visualization
Figure 4 Your Health System – ‘In Depth’ results visualizations - indicators

Figure 5 Your Health System – ‘In Depth’ results visualizations – indicator breakdown (Example 1)

Figure 6 Your Health System – ‘In Depth’ results visualizations – indicator breakdown (Example 2)
Results for All Hospitals Within the Region: Emergency Department Wait Time for Physician Initial Assessment (Hours, 90th Percentile), 2015–2016

Add a province, territory, health region, long-term care organization or hospital using the search boxes below. You can also add a city to find results for the corresponding health region.

<table>
<thead>
<tr>
<th>Hospital Name</th>
<th>Wait Time (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td></td>
</tr>
<tr>
<td>British Columbia</td>
<td></td>
</tr>
<tr>
<td>Hamilton Health Sciences</td>
<td></td>
</tr>
<tr>
<td>Teaching Hospitals</td>
<td></td>
</tr>
<tr>
<td>Lions Gate Hospital</td>
<td></td>
</tr>
<tr>
<td>Provident Health</td>
<td></td>
</tr>
<tr>
<td>The Regional Hospital</td>
<td></td>
</tr>
<tr>
<td>St. Joseph's Health Centre</td>
<td></td>
</tr>
</tbody>
</table>

Add Comparator

Please enter 2 or more characters...

(Source: Canadian Institute for Health Information)
Appendix VII: Samples and screenshots of data-driven web applications developed by Optimity Advisors

The following are a small sample of data-driven web applications developed, hosted and supported by ourselves. Optimity Advisors has a significant track record producing data aggregation and visualisation platforms for both the private and public sector. Here we provide some examples from our portfolio of work.

**Figure 1** A gridded dashboard which quickly draws attention to priorities for decision makers within an organisation (e.g. Hospital CEO, Clinical Lead)
**Figure 2** Timeline of prison population and segmentation of population by type

**Prison population**

The average prison population is currently around 85,000. Hover over the circular diagram to discover how the prison population is broken down.

**Figure 1** A dashboard providing inter-organisation benchmarking, which facilitates better decisions at the policy level
Figure 2 A web portal which generates maps of GP surgeries coloured by various attributes
Figure 5 Summary of audit ratings

Prison inspections
All prisons in England and Wales are routinely inspected and audited against a number of criteria. The resulting audit ratings are generally published on a scale from 1 (worst) to 4 (best). The charts here show how many prisons received each rating.

More Inspections Data

- Safety Rating 3: 74 prisons
- Decency Rating 1: 4 prisons
- Activity Rating 2: 41 prisons
Figure 3 Public-facing visualisations of an NHS organisation's performance

24 https://www.lewishamandgreenwich.nhs.uk/performance - the central visualisations are developed by us and embedded with their website
Appendix VIII: Optimity Advisors proposed development plan

Activities
We propose an initial Discovery phase, encompassing the following activities:

- Initiation meetings
- Document & content review
- Stakeholder meetings
- Stakeholder workshop
- Product Brief presentation

Deliverables
We propose an initial Discovery phase, encompassing the following deliverables:

- Product Brief
- Content Log
- Information Architecture
- Key use cases / user journeys

Schedule
We project a 3-4 week duration, with assumptions provided for volume of content, number of meetings and workshops, and availability of stakeholders.

Upon completion of Discovery the project teams meet to discuss next steps. Assuming there are time and resource constraints, these discussions can be initiated earlier in the phase to ensure minimum delay, a smooth transition to the next phase, and ensure we are designing within resource constraints.

Resource & Cost
For the Discovery phase, we project a cost range of €10,000 to €50,000 - based on a project team of 3 consultants with some input from our Subject Matter Experts (SMEs) and Directors.

These costs will be influenced by assumptions made for volume of content, complexity of the product, number and location of meetings and workshops, and availability of stakeholders (the shorter the duration the better as the aim is to get to MVP launch as quickly as possible).

It is only once a discovery phase has been completed that a true picture of costs for building the web portal can be determined, however the outputs from this phase are valuable in
their own right. In our experience, the budget for data-driven web portals can range from a minimum of €50,000 for a lightweight solution, up to €250,000 or even higher for a complex solution with restrictive data governance arrangements. We would expect this build to fall somewhere between those figures.