Logic Model Early Stage Evaluation of a European Public Health Data Analytic Framework

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Abstract

The multi-national MIDAS (Meaningful Integration of Data Analytics and Services) project is developing a big data platform to facilitate utilisation of a wide range of health and social care data to enable integration of heterogeneous data sources, providing analytics, forecasting tools and bespoke visualisations of actionable epidemiological data. An evaluation framework starting with a logic model and semi-structured interviews using the principles of realist evaluation was developed working with end users and software developers. Parallel case studies were used to address the requirements of stakeholders at critical time points during the project. The objective was to ensure IT systems development is in line with end user requirements. Overall, the early stage interviews findings indicated the logic model is an effective framework for the evaluation of the project.

1.0 Introduction

Health care generates large amounts of data, a proportion of which is stored in some accessible form as usable information, but rather less used to guide practice, planning or policy (Murdoch & Detsky, 2013). Information communications technology (ICT) is a key tool to support this process and to assist with effective decision-making. The need for effective use of data is particularly critical in public health organizations, where it is required to support areas such as epidemiologic surveillance, health outcome assessment, program evaluation and performance measurement, public health planning, and policy analysis (Studnicki et al, 2008).

To take appropriate actions, health policymakers require different kinds of information. To satisfy this need, more flexible health data representation, analysis, querying, and visualization methods (analytic software tools) are desirable (Tilahun et al, 2014). Data analytic tools can support wider and easier access to epidemiological information, which has the potential to increase efficiency, reduce errors, and alter professional roles and responsibilities in a manner, which allows improvement in the delivery of patient care (Fonkych et al, 2005).

End users differ greatly in experience and professional background, yet data analytic tools and other software platforms are seldom designed for a wide range of end users (Ziemkiewicz et al, 2012). A rigorous evaluation of health information systems is of great importance for policy makers and end users (Kaplin et al, 2002). However, there are no gold standard frameworks of evaluation theory and practice (Yen et al, 2017; Rahimi & Vimarlund, 2007). These evaluations are problematic, partly due to the complexity of the health systems, and the challenge of selecting an appropriate evaluation framework (Friedman & Wyatt, 2005; Ammenwerth et al, 2003).

The multi-national MIDAS (Meaningful Integration of Data Analytics & Services) project is developing a big data platform to facilitate utilisation of a wide range of health & social care data. A realist evaluation framework was designed to evaluate the project to ensure the platform tools development is in line with user requirements, utilising a logic model and semi-structured interviews with end users and technical developers. The logic model is utilised to evaluate the outputs, outcomes and impacts of the project in collaboration with the MIDAS project partners, the project policy board, and other

stakeholders to identify potential gaps between framework user's expectations and requirements of the tools with their actual needs.

2.0 The MIDAS Project

MIDAS project is funded from the European Union 2020 programme. The project is developing a big data platform to facilitate the utilisation of a wide range of health and social care data. The platform will enable the integration of heterogeneous data sources, provide privacy-preserving analytics, forecasting tools and bespoke visualisations of actionable epidemiological data. Sources include anonymised patient data, cohort and epidemiological data nationally and regionally from European health authorities, in addition to individual data collected from apps, sensors and social media to test and develop the tools. This data is uploaded to analytics and visualisation systems, and forecasting tools are being developed to assist end users and policy makers formulating policy decisions, to perform data-driven evaluations of the efficiency and effectiveness of proposed policies in terms of expenditure, delivery, well-being, health and socio-economic inequalities, improving policy risk stratification (Rankin et al., 2017).

3.0 The Case Studies

Four case studies are underway with each region having its own particular health-based interest - Republic of Ireland (Diabetes); Basque Region (Child Obesity); Finland (Preventative mental health and intoxicant use problems of young people); Northern Ireland (Children in care). These case studies commenced in September 2016 (duration 40 months) and will continue throughout the duration of the project.

4.0 The Logic Model

The logic model is a framework for the development of the MIDAS project evaluation plan. A logic model is a representation of how a program is intended to work and links processes, theoretical assumptions and deliverables of the MIDAS project. These relationships are represented as diagrams or flow charts that convey relationships between contextual factors, inputs, processes and outcomes presenting the relationships among resources that are required to operate and plan activities that are expected to be achieved to successfully deliver the programme (Kellogg Foundation., 2004).
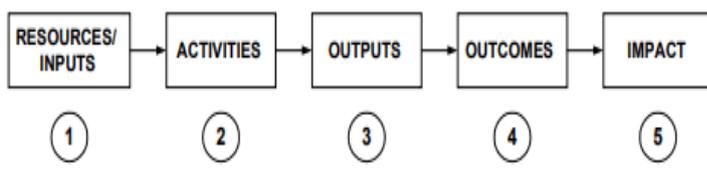

Figure 1. The Basic Logic Model. Source: W.K.Kellogg Foundation Logic Model Development Guide.

The model depicts the logic of translating the technical and programmatic inputs of the integrated information system, including how these inputs produce high-quality activities through liaising with stakeholders. These models force stakeholder serious consideration of desired results over time against expected outputs, outcomes and potential impacts, throughout the duration of the project.

The logic model for MIDAS project was developed based on the grant agreement and project deliverables, circulated to the stakeholders a number of times to get their feedback, and subsequently refined over a period of six months. The final model served as a guide for designing the study protocol and semi-structured interview framework as the basis for the coding, facilitating refinement of themes to aid the development of a clear conceptual framework (Ritchie et al. 2003).

5.0 Methodology

5.1 Experimental Design
The current project uses multiple mixed-method evaluation frameworks (Green et al., 1997). Longitudinal semi-structured interviews are performed over the duration of the project. This involves a novel case study design, interviewing both end users and developers in parallel. The data collection process was developed based on the logic model and uses semi-structured interviews, with developers and end users to evaluate health analytic software acceptance use gaps, at critical time points, throughout the duration of the study.

5.2 Semi-Structured Interviews
The initial rounds of interviews with end users, policy makers, and lead developers were performed during the pre-implementation and first testing stage of the MIDAS platform development. The purpose of this evaluation from the perspective of end users is to identify their expectations, feedback and requirements of the software tools for the purpose of formulating and constructing effective public health decision-making policies from regional and national data from each case study. The focus for developers is on their understanding, evolving over time, of end users' requirements of the software platform. Prior to undertaking the interviews, both stakeholders groups were provided with the general themes of the interview questions in advance to assist them to consider their answers. Two topic guides were developed, one for software developers, and one for end users. Each phase of interviews with both stakeholders groups informs the next round of interviews as a means of identifying gaps between their expectations and utility of the platform. The semi-structured interviews are 30-40 minutes' duration, are recorded with the consent of stakeholders and transcribed verbatim. On completion of each round of interviews, the stakeholders were provided with a copy of their transcript for review and validation.

5.3 Transcript Coding
The transcript coding was based on the framework approach (based on Ritchie, Spencer, & O'Connor, 2003; Smith & Firth, 2011) to qualitative data analysis guided by the logic model, which will be refined over time as the interviews proceed. The final logic model served as a guide for designing the study protocol and semi-structured interview framework. Interview transcripts were subject to independent double coding to verify their content. The initial coding process involved a preliminary review of the transcripts, highlighting relevant phrases and noting possible codes. These codes were compared and contrasted with the logic model codes to identify common themes relating to logic model deliverables.

6.0 Preliminary Results

The logic model deliverables were classified to gauge project progress and the validity of the model at this stage of the project. Logic model outputs that corresponded with end users and technical developers transcript themes related to the relevance of timely delivery of the project's components, successful management of governance risks, and project adherence to ethical and governance practices. End users expect the platform framework to be replicable and allow integration of big data for end users to undertake data analytic modelling and achieve the required results from their data to enhance policy decision making.

The logic model outcomes identified through the end user and technical developers transcripts referred to the successful delivery of technical milestones' corresponding to completion of the first iteration of training and UX testing, completion of key performance indicators for end user requirements and the development of data quality protocols. End users also expressed a wider understanding of the project, which was achieved through workshops. Technical and non-technical white papers created by the technical development teams to capture end user requirements also facilitated end user understanding and project engagement.

At this stage of the project's development, stakeholders discussed project impacts less frequently than outputs and outcomes. Impacts discussed by end users and technical developers included completion of the first iteration of training and user experience testing and the potential of these sessions to create actionable insights as the project progresses. Stakeholders also discussed the potential for the MIDAS platform tools to enhance structured decision making, which will facilitate effective health policy decision making. It is anticipated that actionable insights will bridge the gap between the end user's expectations of the MIDAS platform tools and technical developers understanding of end users requirements.

7.0 Conclusions

At this early stage of the MIDAS project's development, the logic model signed off by stakeholders (policy board, policy makers, and technical development teams) represents an accurate representation of the project's key outputs, outcomes and (to a lesser extent) impacts identified through logic model transcripts coding process. The logic model was developed through a number of iterations of consultation with the MIDAS consortium as an initial process of evaluating, planning and developing the project. As the project progresses, key indicators (outputs, outcomes and impacts) that were not initially included in the logic model may be identified through interviews with end users and the technical development teams. To narrow the gap between end user requirements of the platform tools and technical developers' expectations of the end user needs, an ongoing process of refining the logic model is required at critical stages of the project's development.

8.0 References

Ammenwerth, E., Gräber, S., Herrmann, G., Bürkle, T., & König, J. (2003). Evaluation of health information systems—problems and challenges. *International Journal of Medical Informatics*, 71(2), 125–135.

Fonkych, K., & Taylor, R. (2005). *The state and pattern of health information technology adoption.* Santa Monica, California, USA: Rand Corporation.

Friedman, C. P., & Wyatt, J. (2005). *Evaluation methods in biomedical informatics.* New York: Springer Science & Business Media.

Greene J.C. and V.J. Caracelli (1997). Advances in Mixed-Method Evaluation: The Challenges and Benefits of Integrating Diverse Paradigms. New Directions for Evaluation, Vol. 74 (Summer 1997) (Jossey-Bass, San Francisco.

Kaplan, B., & Shaw, N. T. (2002). People, Organizational, and Social Issues: Evaluation as an exemplar. In R. Haux & C. Kulikowski (Eds.), *IMIA Yearbook,* 91–102.

Kellogg, Foundation (2004) *Logic model development guide.* Michigan: *WK Kellogg Foundation*, pp.71.

Murdoch, T. B., & Detsky, A. S. (2013). The inevitable application of big data to health care. *Jama,* 309(13), 1351–1352.

Rahimi, B., & Vimarlund, V. (2007). Methods to evaluate health information systems in healthcare settings: a literature review. *Journal of Medical Systems*, 31(5), 397–432.

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Rankin, D, Black. M, Wallace. J, Mulvenna, M, Bond, R and Cleland, B (2017) *The MIDAS Platform: Facilitating the Utilisation of Healthcare Big Data in Northern Ireland and Beyond.*In: 8th Annual Translational Medicine Conference, City Hotel, Derry/Londonderry, Northern Ireland. Clinical Translational Research and Innovation Centre (C-TRIC). [Conference contribution].

Ritchie J, Lewis J (2003). Qualitative research practice: A guide for social science students and researchers. London: Sage.

Studnicki, J., Berndt, D. J., & Fisher, J. W. (2008). *Using information systems for public health administration.* In G. Benjamin (Ed.), Public Health Administration: Principles for Population-Based Management. (2nd ed.). Sudbury, MA: Jones and Bartlett, 353–380.

Tilahun, B., Kauppinen, T., Keßler, C., & Fritz, F. (2014). Design and Development of a Linked Open Databased Health Information Representation and Visualization System: Potentials and Preliminary Evaluation. *JMIR Medical Informatics*, 2(2).

Yen, P.-Y., McAlearney, A. S., Sieck, C. J., Hefner, J. L., & Huerta, T. R. (2017). Health Information Technology (HIT) Adaptation: Refocusing on the Journey to Successful HIT Implementation. *JMIR Medical Informatics*, 5(3) e28.

Ziemkiewicz, C., Ottley, A., Crouser, R. J., Chauncey, K., Su, S. L., & Chang, R. (2012). Understanding visualization by understanding individual users. *IEEE Computer Graphics and Applications*, 32(6), 88–94.