25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 9 to 14 July 2023
mssanz.org.au/modsim2023

Stock and flow modelling of a veterinary teaching hospital: How to better embed clinical teaching into patient flow

Erika Meler [a], Daniel Schull [a], Sarah Kelly [b] and Russell Richards [b]

[a] *School of Veterinary Science, Gatton campus, The University of Queensland, Australia*
[b] *Business School, St Lucia campus, The University of Queensland, Australia*
Email: e.meler@uq.edu.au

Abstract: Clinical practice-based training is an essential part of the training of veterinary students which is most commonly delivered in dedicated Veterinary Teaching Hospitals (VTHs). Within VTHs, final year veterinary students learn their craft, managing sick pets presented by the local community, contributing to diagnostics and treatments under the close supervision of clinical teachers. Clinical educators are licensed veterinarians or specialists who are responsible for the care and treatment of the pet patients while delivering one-on-one and small group teaching. With decreasing government funding for universities and intensifying competition from the private sector, VTHs have been increasingly placed under pressure to be financially viable and more operationally efficient, which can compete with their primary educational role.

Previously, Discreet Event Simulation has been used to model patient flow in the emergency room. It was then used as a pure operational tool to help allocate resources and determine bed capacity. Although useful, this method did not allow an understanding of the cause of the systemic issues or of the bottlenecks experienced by the system. To model the complexity of the interactions within a VTH, we employ a System Dynamics (SD) modelling approach. The use of SD to simulate patient flow has been examined before and its use in our particular case was supported by the need to integrate another layer of complexity, which is clinical teaching delivery (Vanderby and Carter, 2010).

The purpose here is to create a Stock and Flow model (SFM), which is the core modelling approach used in SD, to evaluate how the system is currently working in terms of patient flow, locate where and when teaching is delivered, identify bottlenecks, and if any, test alternate ways to operate to improve the integration of clinical education into the hospital workflow.

Model development follows the process outlined by Stermann (2000) utilising an in-depth study of the complex multilayered VTH environment. The SFM was built using the iSee® Stella software and parameterised from data extracted from a medical record database, workflow observations, staff input and literature when the specific data required was not available. Model robustness was tested using standard system dynamics techniques (e.g. parameter evaluation testing, extreme condition testing) and expert review. In this presentation, the SFM will be presented and its leverage points highlighted as defined by Meadows (1999). Finally, several scenarios will be displayed as potential strategic solutions to allow excellent clinical teaching to occur in high performing VTHs.

To the authors' knowledge this is the first time that system dynamics has been used to represent the workings of a teaching hospital, whether human or animal. It is novel in its approach and aim to offer practical short and long-term solutions to the complex issues experienced by the modern VTHs.

REFERENCES

Meadows, D., 1999. Leverage points: Places to intervene in a system. The Sustainability Institute: Hartland, VT.

Sterman, J.D., 2000. Business dynamics: Systems thinking and modelling for a complex world. Irwin McGraw-Hill: Boston, MA.

Vanderby, S., and Carter, M.W., 2010. An evaluation of the applicability of system dynamics to patient flow modelling. Journal of the Operational Research Society 61, 1572–1581.

Keywords: *Veterinary education, workflow, medical training, teaching hospital*