Modeling the Impact of Staff Turnover on Productivity of the Screening System in Critical Care Settings

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Background

Staff burnout and turnover presents a persistent and complex challenge in healthcare, particularly in critical care settings such as Neonatal Intensive Care Units (NICU) and Pediatric Emergency Departments (PED) (Adriaenssens et al., 2015, Bresesti et al., 2020, Choi et al., 2019, Kelly et al., 2021). High turnover disrupts workflows, reduces staff experience levels, threatens the continuity and efficiency of screening systems designed to identify and support at-risk patients (Hayes et al., 2006), and increase operational costs (Duffield et al., 2014). While prior research has documented the negative consequences of burnout (Wang et al., 2020, Chen et al., 2019, Zhang and Feng, 2011), work intensity and turnover (Hancock et al., 2013, Park and Shaw, 2013, De Winne et al., 2019), little attention has been given to modeling how workforce instability dynamically affects system productivity over time. In particular, the different pathways that burnout and turnover can affect productivity and key outcomes remain underexplored. Although some system dynamics studies have explored how factors such as workload and burnout influence each other over time through feedback loops and, in turn, affect staff wellbeing and work quality (Farid et al., 2020), the relationship between burnout and turnover is generally addressed conceptually rather than quantified within a dynamic modeling framework (Homer, 1985).

Objective

This study addresses that gap by developing a system dynamics simulation model to examine the effects of staff turnover on the performance of a hospital-based screening system. The primary outcome variables were the number of caregivers approached and screened per month—key indicators of system effectiveness in delivering timely mental health support.

Methods

We applied a participatory group model building (GMB) approach to construct the system's causal structure in collaboration with stakeholders from the Children's National Hospital in Washington D.C (Sadjadpour et al.). Through GMB sessions, we identified major feedback loops related to hiring, experience accumulation, turnover, and productivity. The model was calibrated using 48 months of empirical data from the hospital's Perinatal Mood and Anxiety Disorders (PMAD) screening program and used to test a range of intervention scenarios.

Results

Seven intervention strategies were simulated including turnover-induced hiring, goal-oriented hiring, endogenous goal-oriented hiring, hiring staff who gain experience more quickly, retention policies, work engagement initiatives, and productivity-enhancing changes. Simulation results showed that turnover-induced hiring alone led to performance declines, primarily due to the rising proportion of inexperienced staff. In contrast, interventions such as (endogenous) goal-oriented hiring, recruiting staff who gain experience faster, and implementing retention policies significantly improved performance. Additionally, strategies that enhanced staff engagement and productivity further mitigate the negative effects of turnover and stabilized system output.

Conclusion

This study uses a system dynamics model to examine the causal pathway between staff turnover and productivity in a screening system. By incorporating feedback loops, delays, and stakeholder-informed structures, the model demonstrates how workforce disruptions unfold over time and highlights ways to mitigate them. Three main pathways were identified linking burnout to productivity loss: immediate reductions in individual performance, diminished staffing capacity from turnover, and the erosion of institutional knowledge. The findings provide healthcare administrators with evidence-based guidance for developing resilient staffing strategies that support the sustainability and effectiveness of screening systems in critical care settings.

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