

## Abstract

**Introduction:** The current global nursing staff shortage is challenging healthcare systems everywhere to provide adequate care. Major barriers to both retention and recruitment of qualified staff include poor working conditions and high workloads.

This issue is particularly critical in labour and delivery, where shrinking numbers of midwives and registered nurses put birthing women and newborns at risk. For both new mothers and neonates, outcomes of insufficient staffing can include mortality, compromised health, and limited birth choices. Further, as current patient resource measurement methods, e.g., diagnosis-related groups, do not fully account for nursing care demand, mismatches exist between available resources and patient needs. And while studies highlight higher nurse staffing levels' positive correlations with patient outcomes, recommendations for optimal staffing remain limited.

**Aim:** Therefore, this project aims to describe care demand in detail and identify signs of changes in demand, enabling managers to proactively match nurse supply to patient demand.

**Methods:** Using data from a large university hospital in Switzerland, this study will examine the nursing time allocated to women and newborns in maternity care with different clinical characteristics. Advanced machine learning techniques will be employed to uncover hidden patterns and heterogeneity within complex, high-dimensional datasets. The project will employ statistical network modeling methodology to analyze detailed nursing activity data extracted from patient electronic health records.

The study addresses three objectives: 1) Validate care activity times and identify care activity modules through network analysis; 2) Analyze individual contributions to discover individual subgroups using clustering methods, then comprehensively describe both modules and subgroups; and finally, 3) Identify significant signals and care activities associated with higher demand, and integrate this signal detection into the record system.

**Expected results:** Complex patterns of relationships among care activities will be visualized and described. Exploring the relationships between individual characteristics and care time in maternity units will deliver primary indicators for higher care demand. For instance, activities that are centrally located or heavily interconnected across modules can serve as indicators of increased care requirements, as they involve other activities. Additionally, individual characteristics associated with higher care demands can be analyzed regarding their predictive value.

**Impact:** Considering the increase in demand for nursing staff, reducing supply-demand imbalances is crucial to prevent excessive workload and staff attrition. By assessing core features of care activity demand and visualizing multidimensional care demands, this project aims to improve the planning and assessment of maternity care. The ultimate goal is to integrate the project's findings into existing electronic health record systems. Developing an approach to identify demand signals in care documentation will be a major step toward predicting increased care needs. Subsequently, providing feedback to unit managers will allow for timely staffing adjustments, thereby preventing discrepancies between care supply and demand.