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Statistical Approach to Assess the Impact of Hospital Settings on Optimal Staffing Levels

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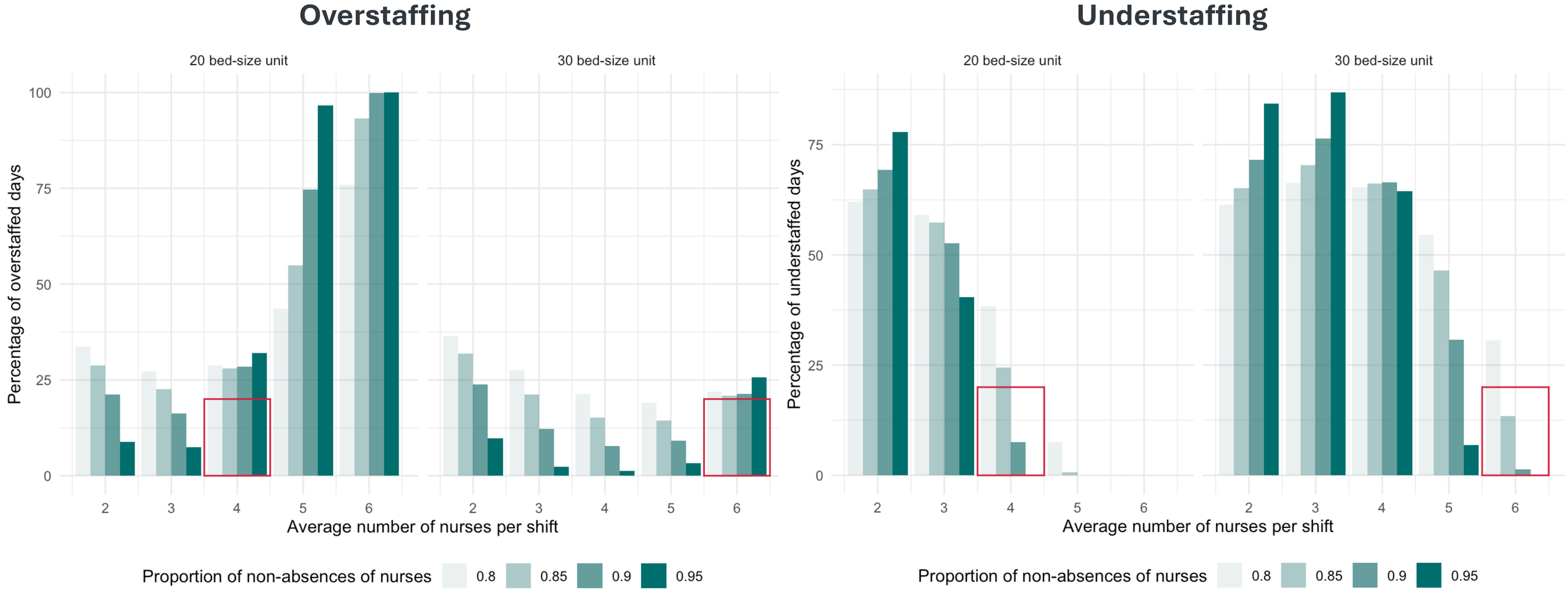
Background

The patient-to-nurse ratio (PNR) is a key indicator of **hospital staffing, which influences healthcare quality and patient outcomes**. PNR variation could be caused by variation either in demand, or supply or both. Understanding and quantifying these influences is crucial for the **evaluation of current staffing policies and developing strategies** to achieve and maintain optimal staffing.

Methods

Assuming that daily bed occupancy and staff numbers in a shift follow a binomial distribution with the key parameters unit size, occupancy rate, number of nurses, and staff absence rate, the **key properties of the PNR probability distribution can be derived**. In a **theoretical study**, unit size (20,30) and nurse non-absences (80–95%) are varied **to approximate over- and understaffing** based on the PNR distribution. For morning shift scenarios with 80% occupancy rate, where a optimal staffing by a PNR of 5 is assumed, the proportion of days outside of an optimal PNR range of (4,6) was calculated to **assess the impact of supply variations**.

Results



Even with standard staffing schemes, smaller units are more prone to overstaffing; however **more than 20% of days are overstaffed in both**. Furthermore, nurse absence rates have a more significant influence on overstaffing variability **in smaller units**.

Overall, there is a high risk of understaffing due to staff absences, and this effect is more notable **in smaller units**. By applying standard staffing schemes in smaller units, **more than 20% of the days are understaffed** when the absence rate exceeds 15%.

Discussion

The study demonstrates how **PNR is caused by the fluctuation in demand and supply**. Calculations revealed a notable number of over- and understaffed shifts with **a high risk of understaffing resulting** from nurse absences compared to standard PNR schemes. It underlines the **need for flexible staffing strategies in hospitals** to e.g. decrease staff absence rates aiming to decrease risk of patients for e.g. medication errors, infections or falls, by achieving optimal care. This approach supports informed policy decisions to optimize resource usage.