

Title	不確実性のもとでのナーススケジューリングとリ スケジューリング問題における職務満足度向上に 関する研究
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Citation	
Issue Date	2022-09
Type	Thesis or Dissertation
Text version	ETD
URL	<a href="http://hdl.handle.net/10119/18120">http://hdl.handle.net/10119/18120</a>
Rights	
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学位の種類	博士（知識科学）		
学位記番号	博知第 307 号		
学位授与年月日	令和 4 年 9 月 22 日		
論文題目	A Study of Nurse Scheduling and Rescheduling Problem under Uncertainty for Job Satisfaction Enhancement		
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### 論文の内容の要旨

Nurses work around the clock in response to hourly medical demands. Their work characteristics include rotational shifts, strenuous workloads, and irregular work hours. Such conditions contribute to fatigue, burn-out, job dissatisfaction, and turnover intention. These are common causes of the intensified nursing shortage faced by hospitals worldwide. To improve nurse retention, hospital management must devise measures to enhance nurses' well-being, job satisfaction, and intention to stay.

Systematic scheduling strategies with proper workload assignment, meeting nurses' preferences and ensuring fairness are among the keys to achieving high job satisfaction. This dissertation develops two satisfaction-enhanced nurse scheduling models using mathematical optimization approaches. The first nurse scheduling model aims to maximize the fulfillment of nurses' individual preferences in shifts and days off. At the same time, deviations in workload and preferred assignments among nurses are minimized for scheduling fairness. Since cost-effectiveness is crucial for implementability, the second model encompasses cost minimization and job satisfaction maximization objectives. This model aims to ensure economic, satisfactory, and fair work schedules. Both models are validated using data collected from actual hospital cases in Thailand. The findings highlight the models capability to promptly generate schedules that fulfill preferences and fairly allocate workload and desirable assignments among nurses. The proposed scheduling models can serve as practical decision-support tools for hospital management.

Hospital operations are dynamic in nature. Unexpected absences or variations in nursing demand emerge daily. Operational variations sometimes lead to mismatches between nursing demand and supply and schedule disruptions. For such cases, rescheduling is needed to maintain operational flow and service quality. This dissertation proposes a practical nurse rescheduling model to minimize the rescheduling penalty under uncertain demand and absenteeism. Under disruptions, the model repairs the original schedule while maintaining service quality and job satisfaction. In order to do so, the operational-related penalty is imposed to maintain an appropriate skill mix. At the same time, the satisfaction-related penalty minimizes undesirable rescheduling impacts via a human judgment shift change penalization. Differences among nurses' rescheduling impacts are also penalized to ensure rescheduling fairness throughout the planning period. The model is tested with multiple uncertain scenarios to verify its ability to handle uncertainties. The results indicate the model's effectiveness in promptly generating modified schedules with minimal rescheduling impacts, adequate service quality, and relatively fair.

**Keywords:** Nurse scheduling problem, Nurse rescheduling problem, Job satisfaction, Fairness, Mathematical optimization, Uncertainty

## 論文審査の結果の要旨

Nurse scheduling is an important and complicated management task within any hospital, which involves assignment of nurses to shifts considering constraints such as time, efficiency, and cost. Systematic strategies for nurse scheduling with proper workload assignment, meeting nurses' preferences and ensuring fairness are essentially important for achieving high job satisfaction. The main objective of this dissertation is to develop job satisfaction-enhanced models for nurse scheduling/rescheduling problem so as to provide computational decision-support tools for hospital resource management. The main contributions are summarized as follows.

Firstly, a satisfaction-enhanced nurse scheduling model that fulfills nurses' shift and day-off preferences while balancing workload and preferred assignments among nurses for scheduling fairness has been proposed. Secondly, since cost-effectiveness is crucial for implementability, the first proposed model has been then extended to encompass both objectives of cost minimization and job satisfaction maximization to ensure economic, satisfactory, and fair work schedules. Thirdly, to deal with such practical situations as unexpected absences or variations in nursing demand that would lead to schedule disruptions, a nurse rescheduling model under uncertain demand and absenteeism has been developed that aims to sustain service quality and job satisfaction. These developed models are validated using data collected from actual hospital cases in Thailand. The findings highlight the models' capability in promptly generating schedules taking nurses' preferences and scheduling fairness into consideration, and in supporting rescheduling decisions to maintain service quality.

This dissertation has made good contributions both theoretically and practically in the area of nurse scheduling for hospital resource management. The research work presented in this dissertation has resulted in 2 journal papers and 2 refereed conference papers.

In summary, Ms. RERKJIRATTIKAL Pavinee has completed all the requirements in the doctoral program of the School of Knowledge Science, JAIST and finished the examination on August 01, 2022, all committee members approved awarding her a doctoral degree in Knowledge Science.