CHAPTER I

INTRODUCTION

1.1. Background

Healthcare is one of the important sectors in the country that require government attention and priority. The government of Indonesia, particularly the Minister of Health has initiated to improve healthcare awareness in the country. Budget for Healthcare was increased by 43%, from IDR 74.3 trillion IDR to 106.1 trillion IDR in 2015 (Kompas Health Care: 2015). People awareness of health has increased over time. One of the measures for people's health is in the life expectancy, i.e. the average age of people living in the country. In 2002, Indonesian people life expectancy is around the age of 68. In 2012, the life expectancy has increased to the age of 71 (Kompas Health Care: 2015). The increase of life expectancy shows an improved healthcare service.

There are two parties involved in healthcare services, i.e. Customer and Provider (Arianto, 2011), in which each of them has to bear some costs in receiving and providing the services. From customers' (patients') point of view, healthcare cost is the expenses charged by hospitals, either for out-patient, in-patient and other services. From providers' (hospitals') point of view, all investment on equipment and operational expenses are the cost of providing customer excellence in their daily healthcare services. In order to optimize cost of delivering the service, hospitals should optimize their processes. One of the

processes that play significant component is on planning, including personnel/resources' scheduling.

Resources involve in delivering services to patients include physicians, residents, nurses and administrative staffs. Each role, from physicians to administrative staffs, has its own characteristic and determination for scheduling. Physicians' contributions to hospitals' services are crucial, thus scheduling for physicians plays a significant factor.

Physician scheduling stands out from other resources scheduling in the hospital due to multiple aspects involved (Erhard et al., 2017):

- Physicians, by law, are eligible to have collective labor contracts with several hospitals.
- Physicians' turnover in a hospital has become one of the most critical challenge (Gunawan & Lau, 2009).

It is important in physicians' scheduling that physicians' constraints are captured and addressed accordingly in order to provide excellent service to patients with optimized resources. Therefore, physician's scheduling becomes a tactical component in a hospital's operational process.

In physicians' scheduling, the terms *Staffing*, *Rostering* and *Re-planning* are used to classify physicians' problems corresponding to physicians planning horizons in a hierarchical manner (Erhard et al., 2017)

- Staffing problems lie on determining the required size and compositions of workforce, which are considered long-term plans (annually), e.g. how many physicians are required to service the growing number of patients.

- Rostering problems lie on the operational offline task to produce shift rosters, which are considered mid-terms in the spans of weeks to months.
- Re-planning problems deal with short-term adjustments of physicians working schedules.

This research will primarily focus on physician scheduling on the rostering with the objective to create detailed schedule that covers hospital's time horizon (Erhard et al, 2017). The rest of this paper will use the term scheduling that refers to Rostering of schedules.

There have been multiple researches in physicians' scheduling problems that are specific for:

- Outpatients (Liu et al., 2009; Iezzi, 2006; and (Stam, 2011).
- Inpatients (Jeric et al., 2012).
- Emergency Room (Beaulieu et al., 2000; Devesse et al., 2017 and Gendreau et al., 2006).
- Operating Room (Jebali et al., 2006 and Levine et al., 2015).
- On Call (Samah et al., 2012).

This research will consider multiple assignments of physicians mentioned above while considering physicians' constraints. There are two constraints to be fulfilled, i.e. hard and soft constraints. Hard constraints are linked to regulations and legal aspects from local/ national government and hospital, whereby soft constraints are more related to physicians' preferences towards their professional and personal goals (Rosocha et al., 2015). Hard constraints are mandatory to be

met by the solution, whereby soft constraints are optional, but are expected to be fulfilled as much as possible (Gunawan & Lau, 2010).

According to Erhard et al., (2017), there are two options to solve physicians' scheduling problems; either using Exact Algorithm or Heuristic approach.

- The exact algorithm has its strength on optimal solution, but weakness on processing time for complex model with high number of constraints.
- Heuristic approach wins over exact algorithm in the processing time, but lack of optimization.

Considering that close to optimum result is acceptable in physicians' scheduling, thus heuristic approach is sufficient. This research will review previous researches on metaheuristic approaches and propose for an algorithm to solve the problem and obtain the most optimum schedule.

1.2. Problem Statement

Each hospital has its own complexity in its resources scheduling. By acknowledging the problem that exist today, this research intends to propose some solution to the problem:

1. How to design a physician scheduling model that fulfill hospital requirements/constraints.
2. Which algorithm to use for the automation of the scheduling.
3. What are the recommended parameters to use in solving the model.

This research will focus on how to solve the problems above using a basis physician scheduling data from one of the state hospitals in Wonogiri, Central Java, Indonesia.

1.3. Purpose

1. Propose a mathematical model for physicians' scheduling applicable for the selected hospital. The model will contain constraints from the hospital and objective of the scheduling.
2. Suggest metaheuristic algorithm to solve the scheduling model.
3. Recommend optimum parameter values for the suggested algorithm.

1.4. Benefit

1. Improve the quality of service and management in daily operations in hospitals by automating scheduling process that will eliminate human error and can be produced in a considerably short amount of execution time.
2. Produce optimum schedule with fair and balanced assignments among physicians.

1.5. Scope of Research

The scope of the research is originated from physician scheduling in one of the state hospitals in Wonogiri, Central Java, Indonesia, with further modifications and assumptions, as listed below:

- Physicians considered in the scheduling include general doctors and two types of specialized doctors; (1) Pediatricians and (2) Obstetricians and Gynecology doctors.
- General doctors' assignments include Outpatient clinics and Emergency Room shifts.
- Specialized doctors' assignments include Outpatient clinics and On-call duties for Emergency Room.
- Physicians' schedule is generated for one month, which considers public holidays as non-working days for Outpatient clinics.
- Hard constraints are imposed for a schedule to be accepted. Details of the constraints are listed in Section 4.3.4.