

Capacity pooling in Health Care Systems – A study of obstacles and future potential

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ABSTRACT

Pooling is a theoretically based strategy for capacity planning that can be used to create a higher service level at a given total capacity in service industries. The purpose of this study is to explore opportunities and obstacles for such a strategy in a regional health care system. Ten interviews with specialty department managers at Sahlgrenska University hospital were conducted, and perceived opportunities and obstacles for capacity pooling were mapped through qualitative content analysis. Six different categories of potential obstacles for capacity pooling were identified, namely competence, geography, culture, system, planning, and recruitment. In order to introduce capacity pooling successfully in a health care system, these obstacles need to be addressed. Most of the informants regarded pooling as a general opportunity for the future, but there were few specific ideas on how it should be introduced beside reduction or removal of the aforementioned obstacles. Future research should investigate the relevance of the different obstacles in different parts of the health care system in general.

1. INTRODUCTION

Resource scarcity in the healthcare sector makes it necessary to increase utilization and efficiency of existing resources by improving the system design and overcome inefficiencies in the present processes (Noon et al 2003; Terwiesch, et al 2011). It is then fundamental to understand the impact of variations on the healthcare system (Walley, 2007). The most significant source to variation in healthcare systems is variation in demand and capacity (Walley et al. 2007). According to Walley et al (2007), the most variation is caused by the healthcare system itself and not by unplanned demand. Operations management can help to improve the system, for example by introducing tools that create volume flexibility to reduce or to better manage variations (e.g. Jack and Powers, 2004, 2006; Noon et al, 2003; Terwiesch, et al 2011).

One example of such a tool for managing variations is capacity pools (e.g. Cattani and Schmidt, 2005; Dziuba-Ellis, 2006; Mahar et al. 2011, Kuntz et al, 2015; Terwiesch, et al 2011). A capacity pool is a general capacity that can be allocated to parts of the system where the existing workload and demand for capacity is unusually high (Hopp and Lovejoy, 2013; Kuntz et al., 2015; Vanberkel et al., 2012). Therefore, capacity pools are a method to improve capacity utilisation of current resources, which is particularly important for bottlenecks in the system (e.g. doctors and specialist nurses). The use of capacity pools is a well-known and extensively used method to improve capacity utilization and the service level in manufacturing firms and service organisations (see e.g. Cagliano et al., 2014; Kalleberg, 2001; Qjn et al., 2015).

Capacity pools are also a method to effectively achieve the goal of matching current resources and the healthcare demand, resulting in gains in terms of shorter waiting times for patients, increased service level, and patient safety (Alvekrans et al., 2016; Lupien et al., 2007; Mahar et al., 2011; Kc and Terwiesch, 2009; Kuntz, 2015; SOU 2016: 2). In addition, capacity pools can be a tool for creating a better working environment and a more attractive workplace. According to Hultberg (2007), a reasonable workload without large variations and overtime work with the possibility of recovery is one of the most important factors for a good psychosocial work environment. Improved production and capacity planning leads to reduced variations in workload and less overtime work (Brandt and Palmgren, 2015). However, it requires that plans can be realised smoothly, even if short-term deviations occur, such as sick leave and occasions with unexpected high demand. Capacity pools are tools that create volume flexibility to manage such deviations, and thus as well tools for creating a better working environment (Hultberg, 2007; Kuntz et al., 2015; Mahar et al., 2015; Noon et al., 2003).

From a theoretical perspective, there are several types of advantages that can be achieved with capacity pooling in healthcare systems (Ata and Van Mieghem, 2009; Cattani and Schmidt, 2005; Hopp and Lovejoy, 2013; Vanberkel et al., 2012). Firstly, the average waiting times can be reduced, sometimes substantially, when a system is characterised by one single queue to all servers rather than individual queues for different servers. Secondly, when different parts of the system lack different types of basic capacity (for example, one unit needs more physicians, while another needs more specialist nurses), a better utilisation can be achieved on an aggregate level through synergy. Thirdly, centralisation of safety capacity can reduce, sometimes drastically, the need (and therefore the cost) for safety capacity without reducing the service level as some of the variations in actual demand among units will cancel out on an aggregate level.

An overly simple example may be used to illustrate these advantages. Assume that a healthcare division consists of four units that are similar in terms of competence requirements for nurses. Further, assume that the expected daily demand for nurses and its variation has been estimated for each unit as shown in table 1 below, and that demand is shown to be approximately normally distributed and independent across units. In order for each unit to reach a 90% service level without a pooling approach, a safety capacity of 1.28 standard deviations is required at each unit. Thus, the total safety capacity required at the division is 19 nurses.

Table 1: Example of capacity pooling

	Unit			
	1	2	3	4
Mean	10	15	20	5
Standard deviation	3.1	3.9	5.5	2.4
Safety capacity required for a 90% service level	4	5	7	3

Now, suppose that capacity planning with a pooling approach is used instead. The expected daily demand for nurses for the division as a whole is simply the sum of the expected demand for the units, that is, 50 nurses. However, the standard deviation for the division as a whole is the square root of the sum of the squared standard deviations for the units. This can be calculated to be 7.8 nurses. Hence, to reach a 90% service level for the division as a whole, using capacity pooling, a total safety capacity of 10 nurses is required. In other words, a pooling approach can reduce the required safety capacity by almost 50% without lowering the service level.

However, in practice, the theoretical analysis may for several reasons not be fully applicable in a real-life health care system such as the Swedish. One such a reason, in the example above, is that the units in the pool should have similar competence requirements for their nurses. Theoretically, the pooling effect becomes stronger when the pool consists of more units, everything else being equal. On the other hand, the marginal effect of another unit in the pool diminishes, and it is in general more challenging to build pools with more units from a practical perspective as, for example, the required competence similarity, organisational issues, geographical issues, and other factors. (Ata and Mieghem, 2009; Cattani and Schmidt, 2005; Creemers, 2007). According to Utley and Worthington (2012) there is a trade-off in terms of capacity needs for a given service level between smaller pools dedicated to more homogeneous patient groups and larger pools dedicated to more heterogeneous patient or care mix.

Hence, we need to elaborately explore the practical potential to implement capacity pools in a healthcare system and study how many and which types of units in different contexts should be included in the same pool and at what level in the system the pools should be located. Previous research in this area is mainly directed towards the so-called float pools (pools of nurses) and is almost exclusively anecdotal (e.g. Bates, 2013; Lebanik and Britt, 2015; Linzer et al., 2011; Ruby and Sions, 2003). Limited is known about how they are organised and structured. This is particularly true in relation to pooling in multi-hospital systems. Thus, there is a lack of systematic research on support of the implementation of capacity pools in healthcare systems (Cattani and Schmidt, 2005; Dziuba-Ellis, 2006; Mahar et al., 2011; Mazurenko et al, 2015; Smith-Daniels et al., 1988).

Therefore, there is a significant need to systematically analyse the prerequisites for pooling capacity in a healthcare system. Hence, the aim of this paper is to explore the perceived potential of capacity pooling among middle- and top-level managers in a healthcare system. Empirical knowledge is developed about perceived opportunities and obstacles for capacity pooling in different types of specialties and at different levels of the healthcare system.

The remainder of this paper is organized as follows. Section 2, contains an introduction of the healthcare system in Region Västra Götaland. In Sections 3 and 4, we present the research

methodology and empirical findings. We discuss the results in Section 5. Finally, in Section 6, we present our conclusions with recommendations for future research

2. THE HEALTHCARE SYSTEM IN REGION VÄSTRA GÖTALAND

Region Västra Götaland consists of four multihospital groups with a total of 16 hospitals, 202 health centers and 28 emergency centers. In addition, there are four private hospitals with contractual agreement with the health care provider in the region. The Sahlgrenska University Hospital is one of the four multihospital groups in the region and also the biggest university hospital in Sweden, with 50 specialty departments. It covers all the specialties in the region and account for almost 50% of total healthcare costs in the region.

In the Swedish healthcare system, both basic capacity (capacity used to handle expected demand) and safety capacity (capacity used to handle the variations in actual demand) is, to a large extent, planned at the actual unit or clinic where the short-term need for capacity actually arises (Alvekrans et al., 2016). The advantage of this approach is that the control of capacity is directly linked to the current situation on a unit or clinic. The significant disadvantage with such an approach is that capacity in different parts of the system is managed independently. Hence, pooling can create a potential for synergy.

However, there are capacity pools linked to specific parts of the health care system in the region, such as primary care and single hospitals. Sahlgrenska University Hospital has, for example, an internal staffing pool of mainly nurses and assistant nurses. In addition to pools with permanent staff, the use of temporary agency staff is widespread and increasing. The costs incurred by the Swedish regions for temporary agency staff have increased from SEK 1.9 billion in 2010 to SEK 5.2 billion in 2017. This development has caused a lively discussion in the media and profession about the effects of agency staff on patient safety, work environment, and finances (SvT.se. 2016-12-27; SKL.se. 2017-12-08; dagenssamhälle.se, 2018-02-28).

Since the beginning of 2017, all 21 regions in Sweden operate in accordance with an agreement within the Sveriges Kommuner och Landsting (SKL), with the goal to become independent of temporary agency staff in the healthcare sector by 1 January 2019. SKL is an association for municipalities, county councils, and regions in Sweden. Each region decides based on their prerequisites of what actions are to be taken to succeed and develop their own action plan to achieve the goal. However, a common measure for all regions is to increase permanent staff by creating more attractive workplaces (SKL.se. 2017-12-08).

Increasing costs for temporary agency staff is not a unique Swedish phenomenon. For example, in the United States of America (the US), the cost of temporary agency staff has increased to such an extent that it created financial problems in the sector (see, e.g. Dziuba-Ellis, 2006; Diaz et al., 2010; Roach et al., 2011). Approximately 75 % of US hospitals use staffing agencies as a short-term strategy to resolve staff shortages and to create flexibility in staffing planning (Adams et al, 2015). According to case studies that we found in our literature review, a measure to reduce the cost of temporary agency staff is to replace agency staff with less costly internal staffing agency in order to maintain the flexibility that such capacity pools create in staffing planning (see e.g. Adams et al, 2015; Lebanik & Britt, 2015). The establishment of a region-wide internal staffing agency is also a measure that both Region Västra Götaland and Region Värmland decided to investigate in their action plans to be independent of agency staff. Other Swedish regions are investigating similar arrangements

linked to specific parts of their healthcare system, such as primary care and individual hospitals.

3. METHOD

3.1 Setting

The Sahlgrenska University Hospital is a part of Region Västra Götaland and is the biggest university hospital in Sweden, with approximately 16,500 employees and 2,000 beds. It has 50 specialty departments such as Cardiology, Clinical Physiology, Children's medicine, and Psychiatry. A designated manager heads each specialty department. The specialty department managers have the overall responsibility for the departments' capacity planning.

3.2. Design

A qualitative design is useful to provide an initial and explorative overview of an area. Therefore, a descriptive study using content analysis (Graneheim & Lundman, 2004) was conducted to provide an overview of the perceived potential barriers and future potential of capacity pooling in the regional health care system. An inductive methodological approach was used to analyse data from ten interviews based on the content of specialty department manager's thoughts and experiences regarding capacity planning in general and capacity pooling in particular (Graneheim & Lundman, 2004).

3.3. Data collection

In order to ensure sample representativeness, the specialty departments at the hospital were first classified in three different dimensions:

- Mainly acute/emergency or mainly planned activities
- Mainly inpatient or mainly outpatient activities
- Mainly medical or mainly surgical activities

The respondents were chosen from the total of 50 specialty department managers at Sahlgrenska University hospital so that all eight possible combinations of dimensions, presented in figure 1 below, would be covered during the interviews. For example, combination one includes mainly medical specialties with mainly inpatient and emergency activities.

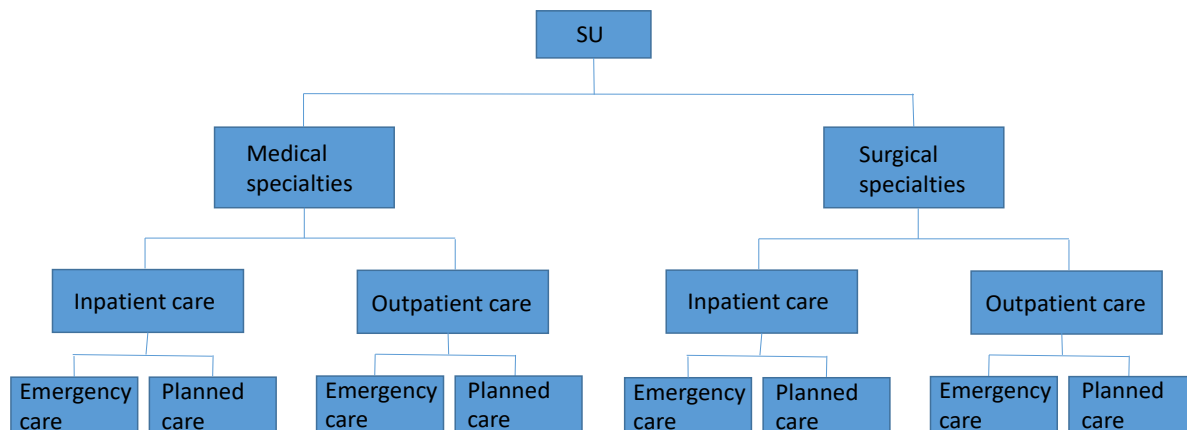


Figure 1: Eight types of specialty departments

Moreover, department managers at Närhälsan (primary care) was added to cover the local aspect of the health care system too. Data were collected during the first half of 2018. All three authors were present at most of the interviews, although a few were conducted by only one or two. All interviews began with a general question on the current situation regarding capacity. During the interviews, focus lay on the perceived need for pooling different categories of staff, if/how pooling is a part of the current capacity management process, and if/how there were plans to develop the pooling perspective within capacity management. All interviews were recorded, transcribed and used as the basis for the data analysis.

3.4. Data analysis

The interview data were analysed using qualitative content analysis (Graneheim and Lundman, 2004) to derive the overall obstacles for capacity pooling in a health care system. The analysis was conducted in four steps (see table x). Firstly, the interview transcriptions were read and re-read in order to generate familiarity with the content. Secondly, meaning units (usually sentences or paragraphs) corresponding to obstacles for capacity pooling in a health care system were selected using an inductive approach. Thirdly, the meaning units were condensed as descriptions of obstacles for capacity pooling in a health care system and labelled with one of 20 codes. Fourthly, six categories of obstacles were identified in which the 20 codes were grouped.

Table 2: Example of analysis of content, with grouping into a category.

<i>Meaning unit</i>	<i>Condensed content</i>	<i>Coding</i>	<i>Category</i>
We have peaks here at our department in Mölndal, especially now in January, February and March when people slip and break their wrists (informant 1)	Predictable peaks in demand	Seasonality	Planning
I have divisions with permanent vacancies and a permanent lack of staff. In such a business, we do not really need a pool, but by more staff (informant 2)	To create a capacity pool, excess capacity is needed but is often missing	No excess capacity	

4. RESULTS

The results formed six categories of obstacles for capacity pooling:

- Competence
- Geography
- Culture
- System
- Planning
- Recruitment

4.1. Obstacles related to competence

The category obstacles related to competence is expressed by specialty department managers in terms of insufficient competence, time required to acquire competence, knowledge regarding practical differences between units, and standardization. To build efficient pools, the staff involved need to have sufficient competence to be able to work in several different units. A nurse who is a specialist in a certain field may need weeks or even months of training before he or she can work independently in another field, not just because of differences regarding health care related issues but also because the organization of work may differ between units. Standardization of health care work may be one way of facilitating capacity pools.

4.2. Obstacles related to geography

The category obstacles related to geography is expressed by specialty department managers in terms of lack of trust and physical distance. Informants stress that it may be difficult to have confidence in a capacity pool that is supposed to cover a large geographical area, and that ad hoc solutions may be preferred instead of relying on the pool. The fact that units far apart in terms of physical distance constitute a pool means that traveling will be necessary, which may be costly in terms of time as well as money.

4.3. Obstacles related to culture

The category obstacles related to culture is expressed by specialty department managers in terms of cultural differences, lack of sense of community, tradition, incompatible IT-solutions, and the willingness to be part of a pool. Different cultures among units and/or hospitals may lead to problems when trying to pool them. A sense of community among actors may be a necessary condition in order to make a pooling approach work smoothly. Ideas resembling a pooling approach have previously been used in some parts of the health care system, but the tradition to solve your own problems have traditionally been strong. Differences in IT-solutions between units means that people may be unwilling to work in other units than their home one in order to avoid practical problems. And the general willingness among the staff to be part of a pool is unclear.

4.4. Obstacles related to the system

The category obstacles related to the system is expressed by specialty department managers in terms of unpredictable variation in supply and in demand. The availability of certain categories of staff varies a lot locally in some specialties, resulting in overstaffing during some periods and understaffing at other times. A pooling approach could, at least theoretically, be used to even such variations out on a less local level. Pooling of patients instead of staff is also a useful idea to even out variation, that is, when some unit is understaffed given the demand for health care, patient could be transferred to another unit which is not understaffed.

4.5. Obstacles related to planning

The category obstacles related to planning is expressed by specialty department managers in terms of predictable variation in demand and in the fact that excess capacity is scarce or nonexistent. Predictable seasonality in the demand for care is common in some sectors, for example, orthopedics departments in Sweden typically get many patients in the winter who have slipped and broken their wrists. Since this type of variation is known, it should be part of the capacity planning process. Also, in order to plan a capacity pool, excess capacity is required on an aggregate level. Almost all informants stressed the fact that there is no excess capacity, at least not regarding nurses, and hence that recruitment is necessary.

4.6. Obstacles related to recruitment

The category obstacles related to recruitment is expressed by specialty department managers in terms of bad collective agreement, wage competition, working conditions, shortage of nurses, and pay supplements. Some informants thought that differences between hospitals regarding collective agreements created recruitment problems for some. Wage competition from the private sector was also mentioned as a problem when trying to recruit health care staff. Other aspects of work, for example, training, colleagues, and shift work can also make recruitment difficult. Some informants mentioned that they thought the general shortage of nurses in society should be addressed. Pay supplements for staff who accept working in a pool was also suggested as an incentive for more people to do so.

5. DISCUSSION

Previous research that addresses the possibilities and obstacles for staff pools in healthcare system concerns solely pool of nurses or float pools and is mainly focused on three of our six categories, namely competence, culture and recruitment.

A crucial obstacle to capacity pooling is the category of competence in terms of inadequate professional competence and knowledge regarding practical differences between units. The research literature in this area is mainly directed towards practical issues. Concerning the professional competence, pool staffs can either be acting as temporary assistance to unit-based staff or as replacement staff with full patient assessments (Dziuba-Ellis, 2006). In the first case, no specialist competence is required, which facilitates pooling because more clinical units can be considered together. In the second case, specialist competence is required to ensure patient safety and a good working environment, which obviously limits the potential of pooling. Adams et al (2015) has addressed the problem of temporary agency nurses lack of familiarity of organizational policies and procedures. The authors also note that the lack of

standardization of, for example nursing practice, unit routines, documentation and patient equipment makes it more difficult for pool staff (i.e. nurses) to rotate between different clinical units in the healthcare system. Bates (2013) and Rudy & Sions (2003) describes situations where staff spend a lot of time searching for supplies, asking for codes to locked rooms, and requesting assistance with unit-specific procedures. To avoid such obstacles, it is important to train pool staff to work on multiple units in the healthcare system (so-called orientation programs) and to standardize practice, routines, equipment et cetera within the clinical units in a healthcare system (see e.g. Adams et al, 2015 and Roach et al 2011). In addition, developing unit-specific pocket guides or tip sheets and adequate pool staff support on the receiving unit are useful tools to reduce these practical obstacles (Bates, 2013; Roach et al, 2011). However, implementing appropriate orientation programs and pool staff support may in many cases be difficult due to resource shortages (Roach et al, 2011)

Specialty department managers expressed a lack of trust in a capacity pool that is supposed to cover a large geographical area. Trust is generally an important factor when integrating staffing pools in healthcare systems. According to Mazurenko et al (2015), trust must be built from top to bottom though for example effective communication between the staffing pools and the units where the pool staff will be working, and by complete orientation program to the units on which the pool staff are assigned to work.

In the category obstacles related to culture the informants, among other things, claims that the willingness to be a part of a pool is low and that there is a lack of sense of community. Several studies indicate a higher job satisfaction and organizational loyalty among permanent nurses compared to temporary agency staff. Temporary agency staff typically experience a higher level of frustration, anxiety, occupational stress and burnout due to, for example, inadequate orientation, lack of trust from unit-based staff and insufficient support from clinical unit management. In clinical unit that use temporary agency staff to a greater extent, there are also more permanent employees who are considering leaving the unit (see e.g. Bates, 2013; Mazurenko et al, 2015; Rudy & Sions, 2003). Obviously, all these circumstances reduce the willingness to become part of a staff pool and according to Diaz et al (2010) many staffing pool solutions have even worsened the staff shortages. According to Bates (2013), one can avoid this by staffing the pool with independent and flexible individuals that enjoy the independence and the variety of challenge and experiences that rotating between multiple clinical units entails. As mentioned above, another important way of making rotation a positive experience is appropriate unit orientation and dedicated pool staff support on the receiving units (see e.g. Roach et al, 2011; Rudy & Sions, 2003).

The category obstacles related to the system is expressed by specialty department managers in terms of high locally variations of the availability of certain categories of staff, resulting in overstaffing during some periods and understaffing at other times. According to Dziuba-Ellis (2006), internal staff pools on an appropriate level in the healthcare system can be a useful approach to balancing understaffed and overstaffed clinical units. Today, a widely used approach when clinical units are understaffed is instead to hire costly staff from external staffing pools (Larson et al., 2012).

The category obstacles related to planning is emphasized by specialty department managers though the fact that excess capacity is more or less non-existent while excess capacity at the same time theoretically is required at an aggregate level in order to plan a capacity pool. In the research literature, on the contrary, internal staffing pools are emphasized as an approach to balance the effect of insufficient staffing levels (i.e. lack of basic capacity) and budget

constraints (Dziuba-Ellis, 2006; Linzer et al, 2011; Roach et al, 2011). According to Roach et al (2011) staffing pools is a short-term measure to ensure adequate staffing on the clinical units on an “as-needed basis” to fill sick leaves, temporary leaves and vacancies et cetera. Staffing pools can also be a tool for reduce overtime and the cost of external agency staff, to maintain minimum nurse-to-patient staffing requirements, to improve work environment and to create flexibility in staffing planning (Hultberg, 2007; Kuntz et al., 2015; Larson et al., 2012; Lebanik and Britt, 2015; Mahar et al., 2015; Noon et al., 2003).

According to the specialty department managers, the lack of nurses is one of the main obstacles related to recruitment. This is no new phenomenon, in the early 2000s the use of internal staffing pools was declining in American hospitals due to difficulties in recruiting qualified staff to the pools or by the fact that pool staff leaving for permanent work in clinical units (Cavouras, 2002). The inability to staff the pool leads to inadequate service levels, that is, inability to fill sick leaves, temporary leaves and vacancies et cetera. Therefore, recruitment and retention of qualified staff are main challenges for staff pool managers in order for the pool to be a reliable facility in the healthcare system. Pay supplements, scheduling flexibility, independence, skill development and networking are widely used incentives for attracting staff to work in staffing pools (Bates, 2013; Cavouras, 2002; Dziuba-Ellis, 2006; Larson et al., 2012; Lebanik and Britt, (2015).

6. CONCLUSION AND FUTURE RESEARCH

This study has identified six different categories of potential obstacles for capacity pooling in a health care system. In order to introduce capacity pooling successfully in a health care system, these obstacles need to be addressed. However, during the interviews, it seemed like some obstacles were more significant in some parts of the system than elsewhere. Hence, in order to provide more general guidelines on capacity pooling, future research should explore more generally how the characteristics of different specialty departments or other organizational units are related to different obstacles.

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