

# **Efficiency and efficacy of the nursing process**

*'Efficiency is doing things right; effectiveness is doing the right things'* – Peter Drucker

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## **Executive summary**

Department F7Z of the AMC academic hospital, specialized in lung and gastro intestinal diseases, approximately admits 9500 patients a year with 38 FTE. For the past years the nursing ward has been saving 1% on an annual basis, which is about 10.000 euro's.

These small 1% savings, using the 'cheese slicer method', will not provide a long-term sustainable efficient and effective nursing process. In order to improve efficiency and efficacy, the DMAIC method of Lean Six Sigma was used to go through the process according to the five phases of a project:

- Define: Specify project objectives.
- Measure: Define and validate the measurements.
- Analyze: Analyze the problem and identify influence factors.
- Improve: Establish effects of influence factors and define improvement actions.
- Control: Implement improvements, assure quality, and close the project.

Project objectives were to improve productivity of personnel and allocate the right functional level of personnel dependent of the task. CTQ's were developed; processing time per task, time lost on irrelevant activities, idle time due to overstaffing and weight of the task. Data were collected during 33 shifts. Current FTE 38,82, costing 2.069.831 euros/year.

Table I: potential savings F7Z

	Standard/ nurse	Measurement/ nurse	FTE saving	Euro/year saving
<b>Processing time</b>				
Personal time	45 min/shift	66,72 min/shift	0,78	
Meeting	45 min/shift	74,8 min/shift	1,06	
Logistics	0	31,2 min/shift	0 (shift to nurse assistant)	7654
<b>Disturbances</b>		210min /day		
Colleagues	0	38 min/shift	1,38	
Patient	0	34,1 min/shift	1,24	
Searching	0	15,2 min/shift	0,56	
<b>Idle time</b>			0,6	
<b>Total</b>			5,62	307.676,17

Recommendations cover a broad scope of interventions to deal with these issues.

Several causes of disturbances were elaborated to find suitable solutions. Differentiated practice was introduced in order to level activities to the right functional level groups, which also reduces disturbances and improves quality of care. Another intervention was intended for structuring meetings. In total there is a potential saving of 14.9% on personnel costs, which is equal to 307.676,17 euros on an annual basis.

**Table of contents**

	Page:
Executive summary	2
Table of contents	4
I. Introduction	5
II. Framing	
A. Define	10
B. Measure	11
C. Analyze	12
D. Improve	13
E. Control	14
III. Case description	
A. Define	15
B. Measure	19
C. Analyze	21
D. Improve	28
E. Control	34
IV. Results	37
V. Recommendation	38
References	39

## **I. Introduction – research topic, importance and relevance**

Since 1983 an evolution has developed to improve efficiency and effectiveness of care in the Netherlands. The driver this development was the changed funding structure of the healthcare system from a function oriented budgeting system towards a declaration system of diagnosis and treatment combinations (DBC). With the old system more production of care, in the form of hospital days, surgeries, treatments, resulted in more funding for hospitals. There was no limit in financing the hospital losses through higher expenses. This type of budgeting resulted in more production of care and an exponential growth of costs in the Dutch healthcare system. The introduction of the DBC system also improved market forces. The DBC price consists of hospital costs and a fee for the medical specialist. A diagnose and treatment combination is based on mean costs of a specific treatment. Not every scan, consult, or treatment is charged. The rates are set by the Dutch Care Authorities (NZa). Care providers and care purchasers are able to negotiate about conditions as quality, price, number of treatments. In the end the customer is to benefit (or to lose) from the agreements between care provider en care purchasers in terms of affordable and good care as citizens pay for the system through taxes and insurance premiums (Broertjes F(1992)).

Despite this change of financing healthcare, costs have doubled from 44 billion euro in 1999 to 89 billion euro in 2011. This corresponds with an annual growth of 6%. This growth is explained by demographic development (18%), increase in prices (35%) and a range of factors as extended indications, growth of patient volumes, more intensive treatments and implementation of new medical technology (47%) (CBS) (Kommer G (2010)) (Horst A (2011)) (CPB(2013)).

These developments are demanding all parties within the healthcare sector to work together and create a plan for a sustainable healthcare in the future.

The AMC hospital is one of seven academic hospitals within the Netherlands. With 1002 beds, treating 56.000 patients a year with 6050 FTE, the AMC is the largest hospital in the Amsterdam region (CIBG) (AMC(2014)).

While preparing for collaboration with another academic hospital, also the nursing process is subject of transformation.

Department F7Z, specialized in lung and gastro intestinal diseases, approximately admits 9500 patients a year with 38 FTE. For the past years the nursing ward F7Z has been saving 1% on an annual basis, which is about 10.000 euro's. This saving was achieved by reducing temporary employees, saving on waste of medicine and other materials, using the Lean tool 5S to make the work environment more efficient. Now we have reached the point that this small 1% saving using the 'cheese slicer method' will not provide a long-term sustainable efficient and effective nursing ward.

Thereby doctors, nurses and nursing assistant point out that care has been changing over the last couple of decades. Where we spend less time taking care of patients and more time on administration, meetings and logistics.

Improvements made and templates developed during this company project might also be applicable for other units in both hospitals.

## **II. Framing – concepts and frameworks used, how will they help answer the question**

We live in times of unprecedented change. As competitive pressures mount, organizations need more than ever to operate at peak levels of performance.

Excellence today is no guarantee of excellence tomorrow. McKinsey investigated 43 companies who were identified as excellent performers in 1982. Twelve years later only 18 companies were believed that they had what it took for long-term success. In 2006 twenty percent no longer existed, 46 percent were struggling, and only 33 percent were still high performers (Cranier S(2006)).

Macroeconomic forces, industry factors, and pure luck are causes why only a third of excellent companies manage to stay successful. But these play a relatively minor part. It turns out that more than 70 percent of the difference in performance between companies is caused by the different business management strategies.

By mastering change - how to make it happen, sustain it, and create an organization that can constantly adapt to and shape its environment - organizations are able to survive (Kotter J(1996)).

Various business management strategies were developed to improve the organization's processes and with that their performance. Operations management increases efficiency and effectiveness, in order to reduce inefficient practices and mistakes. The origins of operations management roots in manufacturing industries and are now extended to other settings such as financial services and healthcare (Schweikhart S(2009)).

Since the 1880s healthcare organizations began developing quality management methods such as Total Quality Management (TQM) and Consumer Quality Index (CQI) (Berwick D(1989)) (Laffel G(1989)) (McLaughlin C(1990)). TQM was broadened towards organizational efficiency, in example to improve processes and work flows (Young G(2001)). Furthermore, care became more patient focused by using more customer-focused quality measurement systems including patient questionnaires, quality and appropriateness reviews, performance appraisals, patient monitoring reports, infection rate surveillance, and other quality-oriented metrics (Lin B(1995)).

During the 1990s it became clear that TQM had little effect on multiple outcomes of care for coronary bypass patients and quality improvement (Shortell(2000)) (Blumenthal(1998)). From there Lean and Six Sigma came into existence and outcomes became more patient focused, tangible and measurable (Black(2006)).

Since 2000, several cases prove that Lean and Six Sigma improve the quality of care. In Intermountain Healthcare projects resulted in reduced turnaround time for pathologist reports from an anatomical pathology lab, reducing IV backlog in the pharmacy, reducing the time needed to perform glucose checks on patients, decreasing time to enter new medication orders and complete chart entries, and streamlining electronic payment for large vendor accounts (Jimmerson C(2005)).

Also in Dutch hospitals Lean Six Sigma is applicable. There projects resulted in reduced hiring of part-time clinical staff, optimizing operating room scheduling by designing a new pre-surgical admissions process, and developing a new work planning system to expedited completion of equipment maintenance requests (De Koning(2006)).

In the Bolton Hospital (U.K.) the time to collect en process blood samples was reduced (Jones D(2006)). And many other successful projects were reported in other healthcare settings (King D(2006)) Chassin M(1998)) (Womack J(2005)) (Sewail L(2003)) (Arnold C(2005)) (Young T(2004)).

Both Lean and Six Sigma are strategies to improve quality and efficiency but there are some differences. Motorola developed six Sigma in 1986 and was famous for the use within General Electric. Their focus was to make processes uniform to reduce defects in order to meet the customers' expectations (Bendell T(2006)). Thereby Six Sigma is distinctive by the use of financial metrics to translate quality improvement into value. Lean was developed for Toyota to improve efficiency by streamlining processes and reduce waste. The focus was on processes that do not add value to the customer (Ohno T(1989))(Womack J(1996)).

A combination of both strategies is used to focus systematically on a data driven way on processes, which is customer oriented and reduces waste at the same time (Arnheiter E(2005)) (George M(2002)).



Furthermore there are other strategies to improve processes and efficiency. In example Business Process Modeling (BPM), Business Process Reengineering (BPR), Workflow Mapping (WM), as well as a variety of TQM and CQI-oriented techniques and Shewhart cycles (PDCA). Depending on the specific circumstances and needs a certain approach is more applicable then the other.

DMAIC is the basic problem solving process of Six Sigma. It includes five steps, which are: Define, Measure, Analyze, Improve and Control (Table 2). This problem solving process can be described as “A rigorous, step-by-step, logical discipline for defining the most critical business improvement issues, converting them into statistical problems, and then resolving them as standardized daily work practices” (Watson G(2004)).

Table I. DMAIC steps (Watson G(2004)).

Step	Y=f(X)	Explanation
Define	Identify Y	Identify and choose most critical business issues and concerns.
Measure	Characterize Y and identify X's	Eliminate factors that are not controllable from the analysis.
Analyze	Translate Y into X's	Eliminate factors that do not contribute much to the overall performance.
Improve	Optimize X	Identify the critical factors that drive the desired state of the process.
Control	Manage X and monitor Y	Set the process under control and implement management and monitoring tools that ensures future control.

## A. **Define**

The first step of DMAIC process is called Define. This step starts with problem identification. The problem can for example be related to any of the following: financial concern, customer problem, process inefficiency, and product failure or flow bottleneck. It is important to understand and define who the customer of the project is so that the goals can be set appropriately. In addition, the scope of the project and resources needed have to be defined. Project resources include the personnel for the project as well as other costs that can be seen at this stage. Well-estimated costs and benefits enable the team to critically evaluate the project's potential (Watson G(2004)) (Pham H(2006)) (Watson G(2005)).

During this step a project charter is created to keep relevant information up to date and easily available for all involved participants. This charter includes basic information about the project, scope and description of the project, project team structure, key measures and project milestones. The charter is created during the define phase, but it will be updated during the project and after the project is finished, it will act as a part of the documentation of the project (Pham H(2006)) (Watson G(2004)) (Watson G(2005)).

Some of the most commonly used tools at the Define phase (Kamrani A(2008)) (Pyzdek T(2003)) (Watson G(2004)):

- Theory of Constraints
- Operational Definitions
- CTQ Characteristics
- Process Map
- SIPOC

## **B. Measure**

Once the business problem is defined the project proceeds to the measure phase. During this phase the project team identifies processes related to the problem. Using this information the processes can then be divided into logical models that provide quantitative understanding of the process. Process evaluation can then be executed using actual process data to ensure reliable process evaluation (Watson G(2004)). Process evaluation also means that data about the processes' performance is needed. A major part of the measure phase is focused on ensuring that the data needed is available and accurate. It is not uncommon that the data needed has not been measured or collected before the project or the data is simply not accurate enough. Thus, sometimes the project requires setting up a new measurement system or improving the existing one. All this is done to ensure that the improvement efforts are focused to those areas that exhibit the greatest improvement potential for the chosen business problem. This also means that the decisions will be based on data and facts rather than guesswork. Once the current performance level is known, it will then be compared to the best performance possible without major investments. The best performance baseline can for example be a historical best performance, benchmarking with similar process or engineering maximum capacity calculations. When the current performance and ideal performance are known, the potential benefits for the project can be estimated more precisely (Pham H(2006)) (Pyzdek T(2003)) (Watson G(2004)) (Watson G(2005)).

Some of the tools used at measure phase (George M(2003)) (Watson G(2004)) :

- Process Analysis
- Failure Analysis
- Performance Baseline
- Capability Analysis
- Measurement System Analysis
- Pareto Chart

### **C. Analyze**

After the first two steps of DMAIC the business problem has been defined, related processes identified and current performance evaluated. The objective of the analyze step is to locate the greatest sources of controllable variation from the identified processes, after which the improvement opportunities and root causes of the problem can be determined. In other words this means that now the output performance of the processes' is known and the focus will shift on studying the inputs that drive the output performance (Kamrani K(2008)) (Watson G(2004)).

Some amount of the work done during this step is based on statistical analysis tools. Sometimes the number of factors is really high and in this situation for example a Pareto chart can be used to prioritize the hypothesis testing (George M(2003)) (Kamrani A(2008)) (Watson G(2004)).

Some of the most commonly used tools at analyze phase (Kamrani A(2008)) (Pham H(2006)) (Watson G(2004)):

- Hypothesis Testing
- Multi-Vari Analysis
- Cycle-Time Analysis
- Regression Analysis
- Analysis of Variance
- Brainstorming

#### **D. Improve**

As a result of the previous steps, the improvement focus has been agreed-upon. During the Improve phase the factors that drive the process towards the statistical solution are identified and validated, the statistical solution being either variation reduction, mean shift or both. The solution is not validated before the desired change is actually observed as a result of changing the factors. The validation is often done through some type of testing, often referred as design of experiments (DOE). After the solution has been validated, the critical factors will be controlled in a way that ensures robust performance. It should also be noted that not all changes come without negative effects. Thus it is important to evaluate the solution effects on the whole system's performance (George M(2003)) (Pham H(2006)) (Watson G(2004)) (Watson G(2005)).

Some of the most commonly used tools at the Improvement phase (Watson G (2004)):

- Shainin Methods
- Taguchi Methods
- Simulation Analysis
- Design of Experiments (DOE)
- Tolerance Analysis

## **E. Control**

The last step of DMAIC is called control. Now that the solutions have been found and validated they need to be implemented and maintained. This means that the critical inputs need to be set under control and process outputs monitored. Monitoring will ensure that the process does not drift back to the old performance (Pham H(2006)) (Watson G(2004)).

The goal of the control phase is to ensure that the improvements stick and become part of the normal way of doing things. Only reason why the improvements should be revoked is if an even better way of doing things is found and validated (George M(2003)).

Some of the most commonly used tools at the Control phase (Pham H(2006)) (Watson G(2004)):

- Mistake Proofing
- Lean Production
- Work Standardization
- Preventive Maintenance
- Statistical Process Control (SPC)

### **III. Case description – what is the case you are investigating**

#### **A. Define**

Hospitals are under pressure to develop the process of care and cure more efficient and effective. Every year the AMC hospital demands the division to economize. The amount of cut back is distributed to the wards.

For the past years the nursing ward F7Z has been saving 1% on an annual basis, which is about 10.000 euro's. This saving was achieved by reducing temporary employees, saving on waste of medicine and other materials, using the Lean tool 5S to make the work environment more efficient. Now we reached the point that this small 1% saving using the 'cheese slicer method' will not provide a long-term sustainable efficient and effective nursing ward.

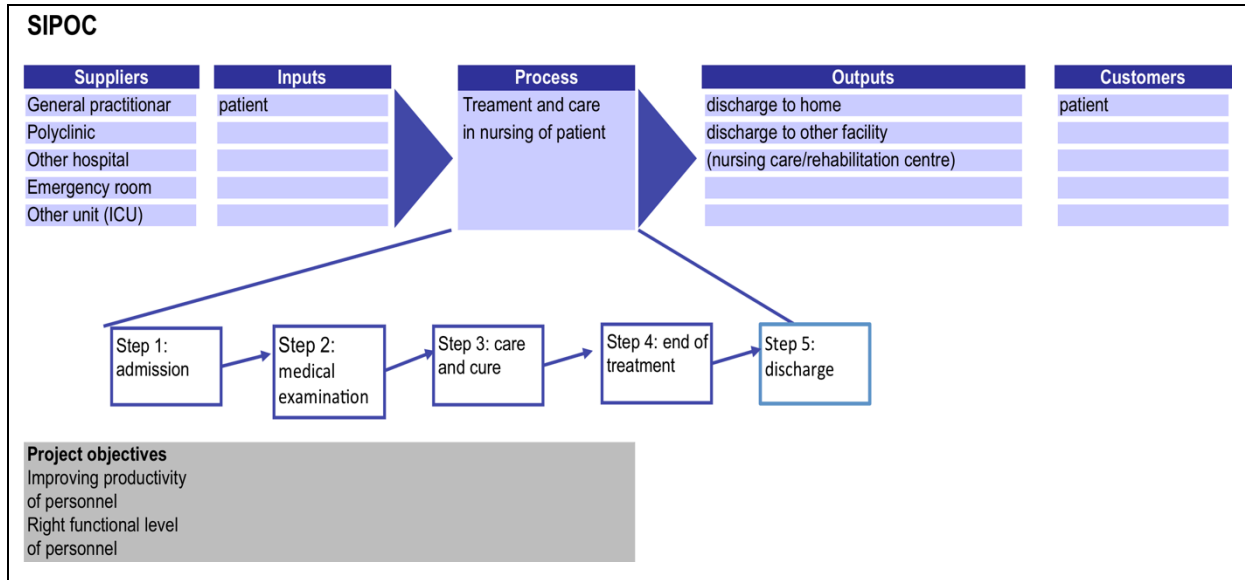
Thereby doctors, nurses and nursing assistant point out that care has been changing over the last couple of decades. Where we spend less time taking care of patients and more time on administration, meetings and logistics.

Another point under investigation is how much we are being disturbed during our activities. As we know every disturbance increases the risk to make a mistake. Conducting a literature review, nurses are being disturbed six till seven times a hour during medication rounds. Causes of disturbances are diverse: self-initiated, colleagues, ambient noises and logistic issues (Smeulders M(2013)) (Biron A(2009)).

The occurrence and frequency of disturbances are significantly correlated with the incidence of procedural and clinical errors. Every disturbance is paired with 12% increase in procedural and clinical errors. Furthermore the severity of the error increases as the frequency of the disturbances extends. Without disturbances the possibility of a major error is 2.3%, with four disturbances the possibility doubled to 4.7% (Westbroek J(2013)).

Process under investigation will be the nursing process altogether. SIPOC method was used to define de process.

Table II – SIPOC nursing process



Benefit analysis was executed to set goals for the project in terms of hard, soft benefits and strategic benefits.

Table III – Benefit analysis

Benefit analysis		Specified performance personnel costs	
Characteristics to be improved (CTQs)	Current performance	FTE	Costs in euro's/year
Time lost on irrelevant activities	unknown	Total 38,82	2.069.831
Processing time per task	unknown	head nurse 1,0	87.272
Idle time due to overstaffing	unknown	senior nurse 3,83	218.230
Weight of the task	unknown	Clinical nurse 29,17	1.543.466
Performance (admissions, takeovers, day treatment, hospitalization days)/year	9.526 patients/year		
Personnel costs	2.069.831 euro's/year	Nurse assistant 2,58	118.723
<b>Benefits of the project for the customer</b>		secretary 2,24	102.140
accurate care on demand, improved safety due to less mistakes in process disturbance (quality)		Total	
speed of accurate care (speed)			
<b>Benefits for the business</b>			
lower cost through effective allocation of personnel, reduce headcount of expensive personnel			
improved scores on patient experience scores (NFU), improved scores on personnel experience scores (MBO)			
increase number of admission with the same resources. F7Z will be able to handle large patient flows from VU.			
<b>Anticipated investments</b>			
Working time for project members. 20% of total savings reward for Black Belt.			
<b>Hard benefits (=direct bottom-line monetary savings)</b>			
10% of 2.069.831 personnel costs = 206.983 euro's/year reduction in costs			
Give a calculation. On which improvement factor is the calculation based?			
<b>Soft benefits (=risk avoidance and nonmonetary benefits)</b>			
motivated personnel			
accurate job description			
clear responsibilities			
For risk avoidance, specify the amount of money that is at stake.			
<b>Strategic benefits (=the project is an enabler)</b>			
increase in cost efficiency strengthens the position of AMC in the market			
entrepreneurship in new nursing care organization will strengthen teh market position			
The project, together with other projects, creates a new market or product.			
Specify the anticipated total revenues of the new market or product.			



The project organization was specified to clarify roles and time management.

Table IV – Project Organization

<b>Project organization</b>			
<b>Supplier</b> Aline Coenraads (the person supplying resources such as time and budget)	<b>Champion</b> Aline Coenraads (the person who owns the problem)	<b>User</b> AMC as an organization (the person who reaps the benefits from the project)	<b>MBB</b> Astrid Goossens (expert in Six Sigma methodology)
<b>Black belt</b> Astrid Bijl	<b>Green belt</b>	<b>Green belt</b>	<b>Green belt</b>
Investment in time (hrs./week) 24	Investment in time (hrs./week)	Investment in time (hrs./week)	Investment in time (hrs./week)
<b>Team members</b> Irha Bireyson, Matthijs van Toor, Wietske Nan (investment in time 8 hours/week)			

The project details were set to define responsibilities in deliverables, side conditions, and scope of the project.

Table V – Project details

<b>Project details</b>	
<b>Type of project</b>	
<input checked="" type="checkbox"/> <b>DMAIC</b> Improve current process/product	<input type="checkbox"/> <b>DIC</b> Improvement only
<input type="checkbox"/> <b>IDOV</b> Design new process/product	
<input type="checkbox"/> <b>DMA</b> Diagnosis only	<b>Other:</b> <input type="text"/>
<b>Deliverables</b>	
<input checked="" type="checkbox"/> Solution / improvement plan on paper	
<input type="checkbox"/> Implementation of the solution	
<input type="checkbox"/> Benefit realisation	
<b>Comments:</b>	Implementation and benefit realization are the responsibilities of the project champion.
<b>Side conditions</b>	
Commitment of senior management Implementation is the responsibility of the champion Using Lean tools to optimize commitment of personnel	
<b>In scope</b>	<b>In scope</b>
<input type="text"/>	<input type="text"/>
<b>Describe possible earlier improvement attempts</b>	
During lean stand-ups some attempts have been made to relocate activities to other personnel category	
<b>Contingencies / complications / worst case scenario</b>	
Is there a <i>sense of urgency</i> ?	Demand for 100.000 euro/year cost reduction
Is there commitment from the workforce? And from senior management?	Demand for more efficient work environment from MBO
Are data available? Is it difficult to obtain data?	No data available, easy to obtain
Do the GB, BB and champion have sufficient authority?	Yes
Could it be possible that the problem is unsolvable on principle?	No
Can the project have negative implications for other stakeholders?	General influence of change

Stakeholder analysis was conducted to specify the positive or negative influence of stakeholder on the project.

Table VI – Stakeholders analysis

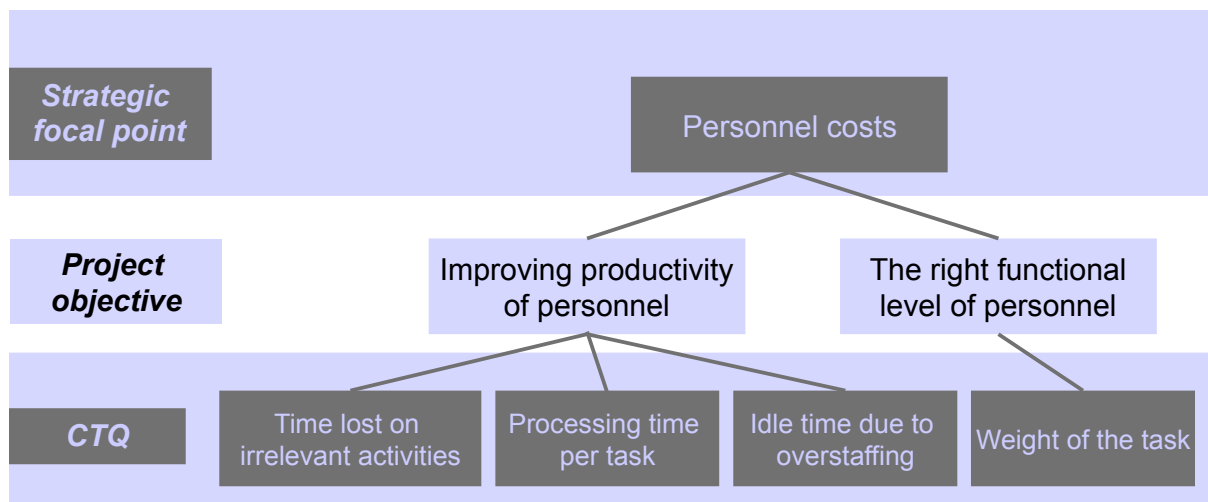
Stakeholder analysis									
Legend:									
x: current situation									
Good as is									
Unclear									
Needs attention									
Stakeholder	Stake	Strongly against	Moderately against	Lets initiative happen	Helps initiative	Makes initiative happen	Influence (-,-,0,+,++)	Strategy	Previous action
Aline Coenraads	Champion, Supplier					x	+	Give full responsibility for side conditions of product	orientation on responsibility
Wietske Nan	Team member				x		0	Encourage	role differentiation
Matthijs van Toor	Team member				x		0	Encourage	role differentiation
Irha Bitreyson	Team member				x		0	Encourage	role differentiation
Astrid Goossens	MBB				x		0	Encourage	role differentiation

## B. Measure

Quantitative characteristics were selected and designed to operationalize the project. CTQ's – Critical to Quality were specified with criteria for this characteristic and the reliability of the measurement method was verified during this stage.

Table VII – CTQ flowdown

### CTQ - flowdown



Operational definitions were defined to have a clear and understandable description of what is to be observed and measured.

#### **Processing time per task**

Categories below will be used to allocate the activities to the tasks:

- Care
- Administration
- Logistics
- Feed
- Personal time
- Meeting
- Medication
- Student

Measures by stopwatch from begin till end of task.

### Time lost on irrelevant activities

Disturbances that occur during the task will be measured using the next questions:

- What made you walk away from your task or distracted you from your task
- And how much time did they take (< 5 min, 5-10 min, >10 min)

### Idle time

Is there overstaffing according to the patient/nurse ratio that are set for the department?

- number of personnel during the shift will be measured
- number of patients at start of the shift, end of the shift, patients admitted and discharged will be used to calculate ratio.

### Weight of the task

During a team meeting, where all relevant functional levels will participate, we will allocate all activities that occur during the nursing process to a functional level using discussion and consensus.

Table VIII – Measurement plan

CTQ	Measurement procedure	Unit (per what? per job? per request? per hour? per day?)	Sample size	Who will collect the data?	When?	How will the data be analysed / displayed?	Goal
Time lost on irrelevant activities	time sheet	per employee, per shift	30	green belts, black belts	july	pareto chart	as little as possible
Processing time per task	time sheet	per employee, per shift	30	green belts, black belts	july	pareto chart	as little as possible
Idle time due to overstaffing	time sheet	per employee, per shift	30	green belts, black belts	july	pareto chart	as little as possible
Weight of the task	assign using regulations	per task	once	green belts, black belts	july	pareto chart	corresponding to functional lever of personnel

Measurement procedures were validated according to following criteria:

- Tasks were jointly defined with the team members
- Literature was used to check whether the tasks were complete
- Definition and measurement procedures were tested at random
- Black belt or green belts were supervising during the first samples
- Black belt or green belts were available for questions during measurement phase
- Measurement forms were designed as simple as possible

### C. Analyze

In total we measured 33 shifts. Dayshift measurement was in proportion with the evening shifts.

#### Processing time per task

As figure 1 and 2 represent, nurses spend 30.8% of their working time on direct patient care. The other 69.2% they do not spend with the patient. During a dayshift nurses are responsible for the care of four patients, on average. In the evening shift nurses are responsible for six patients. Every patient has physical contact with a nurse during a day and evening shift for 62 minutes in total.

Administration of care is another major time consuming activity. 25.6% of the nurses' time corresponds with 123 minutes on an eight-hour shift.

Meetings confiscate 75 minutes of an eight-hour shift and personal time takes 67 minutes a nurse/shift.

Figure 1 – Pie chart processing time per task

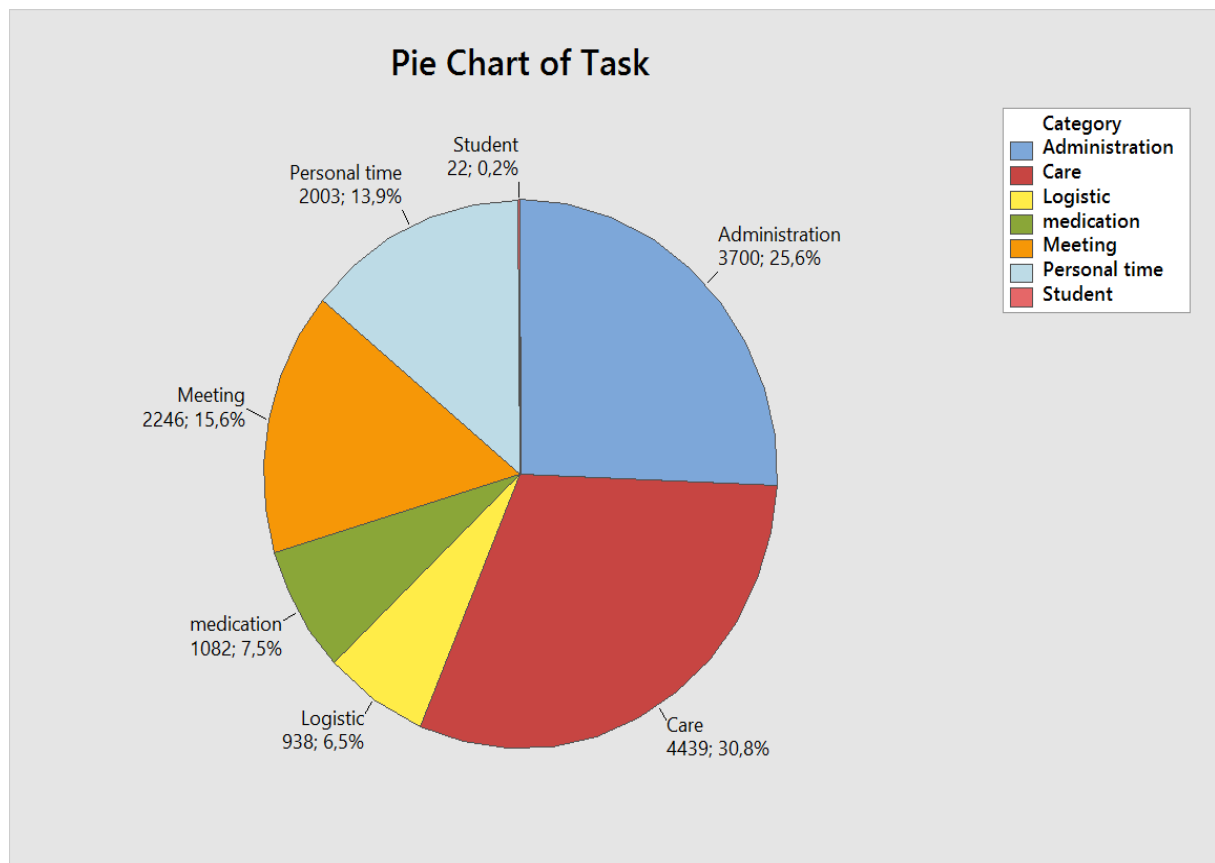
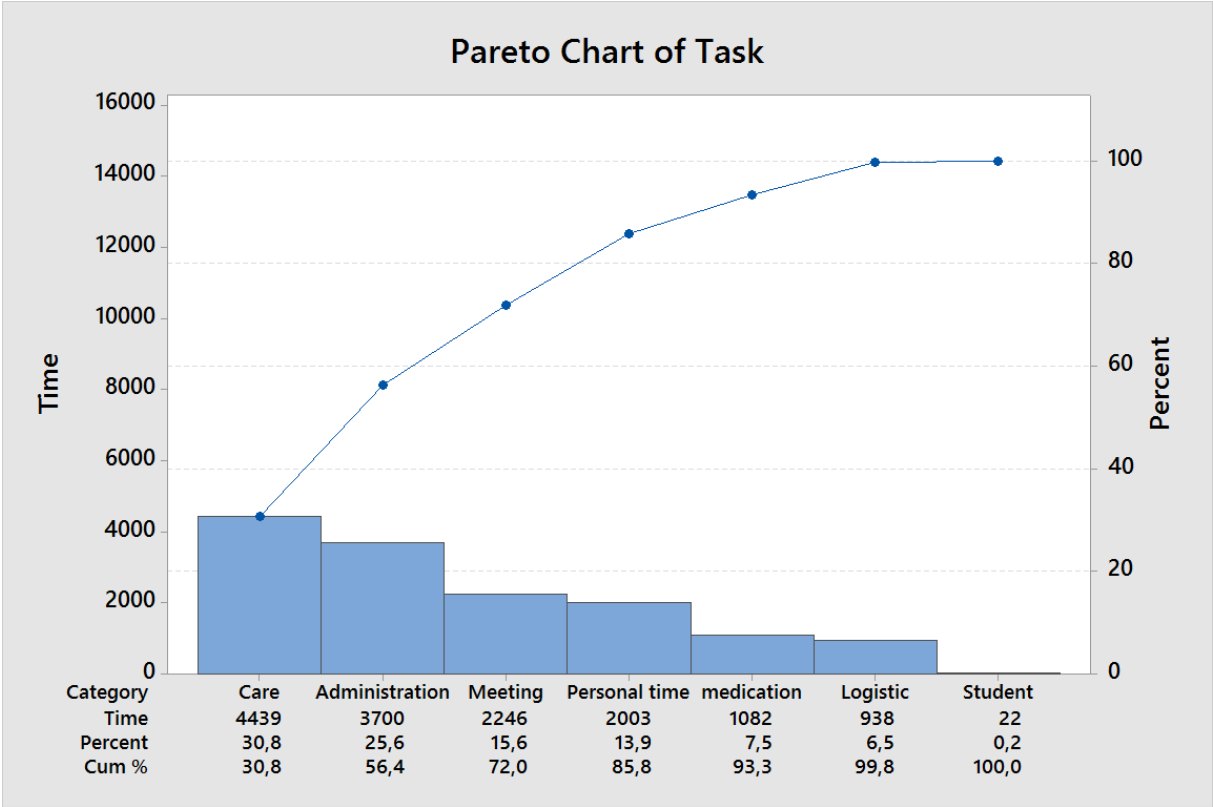


Figure 2 – Pareto chart processing time per task



Within the AMC hospital there is a standard for personal time for nurses, which is 45 minutes/shift. This corresponds with 9,3%/shift. From the analysis could be concluded that nurses spend 21.72 minutes/shift above the standard. When we reduce this towards the standard, there is potential saving of 27,9 hours a week, which corresponds with 0,78 fulltime-equivalent (FTE). This saving is based on the nurses' day- and evening shift corresponding with six respectively five nurses a day working seven days a week.

During team meetings we agreed for a standard of meeting time, which was set on 45 minutes/shift. Reduction from the mean of 74.8 minutes a shift shows us a potential saving of 38,2 hour a week, which corresponds with a 1,06 FTE. This saving is based on the nurses' day- and evening shift corresponding with six respectively five nurses a day working seven days a week.

During team meetings, where all relevant functional levels participated, activities were allocated to the right functional level. Logistics was one of which we agreed on it should be allocated to the nurses assistants instead of the nurses. This change in activity allocation from nurses to nurse assistant has a potential saving:

Logistics take 6,5%/shift which is 31.2 minutes. This corresponds with 40.04 hours a week and 1.11 FTE. Based on the nurses' day- and evening shift corresponding with six respectively five nurses a day working seven days a week.

After subtracting the 1.11 FTE of the nurse assistants' salary from the 1.11 FTE nurses' salary, there is a potential benefit of 7654 euro on a yearly basis. Premium pay has not been taken into account.

### Idle time

In order to calculate overstaffing, comparative research was executed. The patient/nurse ratio standard, which is set by the division, was compared with calculated patient/nurse ratio during the measurements.

Concluding there is a mean overstaffing during a dayshift of 0,66 FTE and a mean shortage of during the evening shift of 0,27 FTE. In total there still is overstaffing during the day of 0,39 FTE, which corresponds with 21,94 hours/week and 0,6 FTE.

### Time lost on irrelevant activities

Analysis, figure 3 and 4, shows us that the total time of disturbances per day: 3,5 hours a nurse during the day and evening shift, which corresponds with 32 disturbances a day/nurse. Further analysis is executed by investigating the potential influence factors.

Figure 3 – Pie chart of disturbances

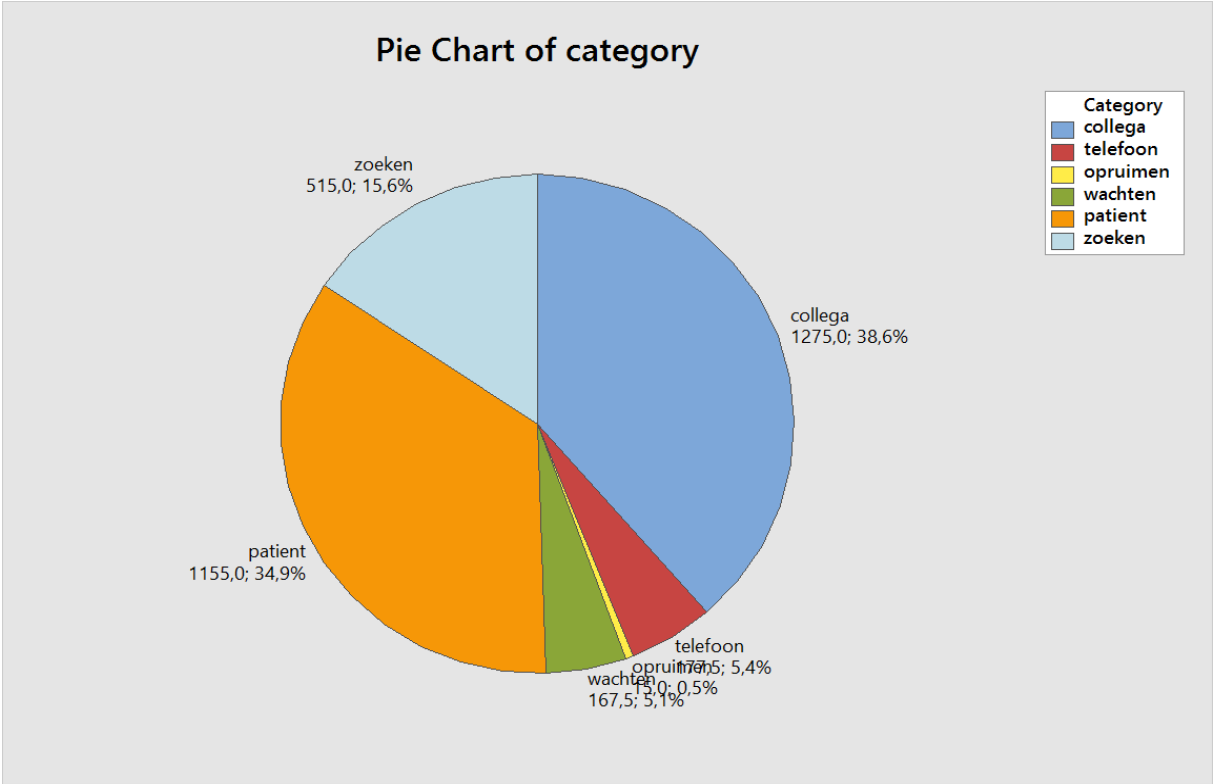
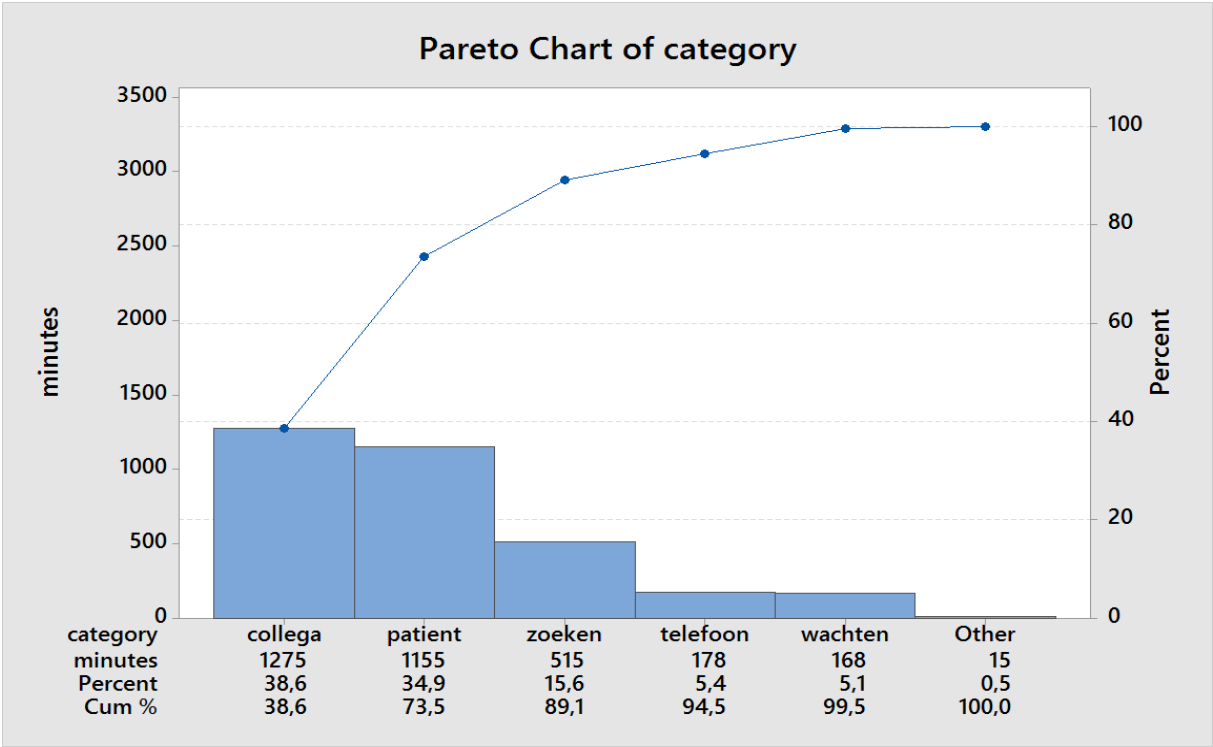


Figure 4 – Pareto chart of disturbances





In order to quantify the figures into more relevant numbers, Table IX shows the influence of the disturbance factors on FTE potential reduction.

Table IX: Quantitative influence disturbance factors

	minutes total	%	min/shift/nurse	min/week/team	hrs/week/team	fte
Colleague	1275	38,6	38	2972,2	49,5	1,38
Phone	177,5	5,4	5,3	415,8	6,9	0,19
Cleaning	15	0,5	0,5	38,5	0,64	0,02
Waiting	167,5	5,1	5	392,7	6,6	0,18
Patient	1155	34,9	34,1	2687,3	44,8	1,24
Searching	515	15,6	15,2	1201,2	20	0,56

FMEA analysis, table X, was used to identify and prioritize the disturbances. Cause and effect of each disturbance is determined. The frequency of the disturbance and the impact of its effect on the CTQ's is taken into account (Mast de J(2012)).

Table X: FMEA analysis

Process FMEA									
Occurrence		Severity		Early warnings					
Failure unlikely. Has never happened.	1	No effect	1	Failure surely and immediately detected.	1				
Very few failures occur.	3	hardly any effect on CTQ.	3	High probability that failure is detected immediately.	3				
Occasional failures.	5	Minor effect on CTQ.	5	Problem is sometimes detected, and sometimes not.	5				
Medium number of failures.	6	Medium effect on CTQ.	6	Reasonable chance the problem is not detected	6				
High number of failures.	8	Major effect onto CTQ or customer dissatisfied.	8	High probability that problem is not detected.	8				
Failures almost constantly.	10	Hazardous effect. Noncompliance with government regulation.	10	Problem will not emerge until too late.	10				
Process:	_____			Person accountable for this process's FMEA:	_____				
Date:	_____			Persons to be consulted:	_____				
Revision:	_____			Persons to be informed:	_____				
Process step	Failure mode	Failure cause	Occur.	Effect of failure (hrs/week/team)	Sev.	Failure detection method	Early warning	RPN	
care and cure	Collega	disturbance	8	49.5 (38.6%)	8	consciousness	10	640	
care and cure	Telefoon	disturbance	5	6.9 (5.4%)	8	consciousness	5	200	
care and cure	Opruimen	disturbance	3	0.64 (0.5%)	8	consciousness	5	120	
care and cure	Wachten	disturbance	5	6.6 (5.1%)	8	consciousness	6	240	
care and cure	Patient	disturbance	8	44.8 (34.9%)	6	consciousness	10	480	
care and cure	Zoeken	disturbance	6	20 (15.9%)	8	consciousness	10	480	

With respect to the FMEA analysis, the failure modes with the highest Risk Priority Number (RPN) were selected to improve.

Process matrix, Table XI, was used as a device for keeping track of ideas, organizing and clarifying them. It gives the Black Belt a tool to focus on exploring new directions instead of complications, which is common during brainstorm sessions. In the implementation phase, the matrix can be used for planning subsequent actions and studies (Mast de J(2012)).

Table XI: Process matrix

<b>Disturbances</b> (Mistakes, errors, failures, and other things in the process that go wrong)							
Process step	Failure mode (what goes wrong?)	DMAIC 4: Potential Xs			DMAIC 5: Effects of the Xs		
		Cause	Effect	Comments	Severity	Occurrence	RPN
care and cure	disturbance	collega	49.5 (38.6%)		8	8	640
care and cure	disturbance	telefoon	6.9 (5.4%)		8	5	200
care and cure	disturbance	opruimen	0.64 (0.5%)		8	3	120
care and cure	disturbance	wachten	6.6 (5.1%)		8	5	240
care and cure	disturbance	patient	44.8 (34.9%)		6	8	480
care and cure	disturbance	zoeken	20 (15.9%)		8	6	480

An extra analysis shows that approximately 40% of the colleague disturbances are private conversations, which should be limited within the personal time.

Weight of the task

During a team meeting, where all relevant functional levels participated, all activities that occur during the nursing process were allocated to a functional level using discussion and consensus.

Table XII: Allocating Process activities to functional level

Care:	Nurse and Nurse assistant
Administration:	Nurse
Personal time:	Nurse
Student:	Nurse
Medication:	Nurse
Logistics:	Nurse assistant
Meeting:	Nurse

Table XIII: Allocating Disturbances to functional level

Colleague:	Nurse
Phone:	Nurse assistant
Cleaning:	Nurse assistant
Waiting time:	Nurse
Patient:	Nurse assistant
Searching:	Nurse assistant

### **Total effects**

#### Processing times

Personal time; reduction 0,78 FTE

Meetings; reduction 1.06 FTE

Logistics; reduction 7654 euro annually

#### Idle time

0,6 FTE

#### Disturbances

Colleague; reduction 1.38 FTE

Patient; reduction 1.24 FTE

Searching; reduction 0.56 FTE

Total reduction in disturbances of 89.1%= frequency reduction from 16 -> 2/shift

Total effect: reduction of 5.62 FTE = 300.022,17 euro + 7654 euro = **307.676,17 euro**  
**which is equivalent with 14.9% personnel cost reduction**

## **D. Improve**

### *Personal time*

Bring awareness about personal time to all personnel and the potential benefit reduction of time during a team meeting. Disturbances during personal time is a cause of the inefficient fulfillment of the personal time, having breaks in shifts could be a possible solution.

### *Meetings*

Reduce meetings and structure them to make them more efficient en effective in the given time (45 min/shift).

Every meeting should be structured with an agenda. Team members should have the opportunity to prepare for the meeting with this agenda. The agenda consist of several subject to handle during the meeting. Important aspect of the meeting is to clear the target of the different subjects. Are they only for orientation then the goal is to exchange information. If the subject need is to gather trends of opinions, the goal should be to come to a point of view. If a decision is to be made within the subject, it should be clear how to be reached: unanimity, consensus, majority of opinion or delegation of decision (Korswagen C(1993)) (Steehouder M(1999)) (Swart J(2001)).

### *Idle time*

There are difficulties to optimize the ratio between number of patients and nurses because the numbers of patients are variable. At this moment the number of patient is being controlled. This is only possible on the upper level, as we are not guaranteed of a minimum number of patients. It would be more ideal to control the number of nurses. In that case we could adapt them dependent of the number of admitted patients. In order to achieve this we need some kind of flex team of nurses, which can be organized in various manners. This is out op scope for this article.

### Disturbances

The process needs several moments a day where professionals are able to discuss patient care without disturbing each other. Thereby we need a standard operation procedure (SOP) to reduce disturbance of professional to professional, which distinguishes several issues.

At this moment the physician and nurse discuss the patient care and treatment once a day in the morning. During the day the patients' situation changes which asks for several contact moments during the day. To meet with objections, physicians and nurses should have a second moment during the day to discuss the changing situation in a structured manner. The best moment would be at the end of the day shift and beginning of the evening shift, both shifts will be able to collect questions. The physician will at that time still be available and is well aware of the patient's situation. When these questions arise later in the evening, there will be a physician on call, but he is only available for emergencies. This will jeopardize the quality of care.

During a team meeting awareness should be created of the high numbers of private conversations. Thereby opportunity to consult each other to discuss patient care matters should be facilitated.

As an academic center we work in multidisciplinary teams, many disciplines are involved with the patient. In example a physiotherapist, nutrition assistant, dietitians and several physicians. They all work in their own schedule, which makes it difficult to set consulting time blocks for each of them. We should take into account that the disturbance should not occur there where the highest risk of harm is present. Which is during medication rounds. Nurses are at that time with the patient selecting and preparing medicine. This process needs focus and accuracy. Conduction a literature research the intervention of the use of drug round tabards was selected. Using these tabards provide a reduction of disturbances of 75% (Verweij L(2014)).

### Differentiated practice within nursing care

Differentiated practice within nursing care can be seen as possible solutions for personnel problem and can contribute to improved quality of care (LCVV(2001)). Furthermore does differentiated practice connect to the renewed education system for nurses, which was introduced in 1997. This education system differentiates five levels of quality for the nurses professional group (Commissie kwaliteitsstructuur (1996)).

Differentiated practice is the leveling of activities into new function groups (Kanter H(1999)). The new education system offers possibilities for differentiated practice. Every quality level comes with specific criteria to apply to at the end of the educational programme. Quality levels 1 and 2 are the lowest levels; these levels correspond with function groups as care assistants. Level 3 corresponds with the nurse assistants level, they attended vocational education. Levels 4 and 5 are nurses with a vocational education resp. college education.

The lower quality education levels generate care assistant function groups whereas the higher levels have a core business in coordination and planning of care (Merode G van (2001)). Hereby should be taken into account that the patient has contact with several caregivers and that the lower quality levels are less able to provide care of high quality such as signal potential problem and complications. Positive effects are that lower quality levels are able to provide high quality less complex care activities, so higher quality levels focus on complex care (Jansen P(1994)) (Jansen P(1997)) (Ven W van de(2002)) (Visser M(2002)).

The positive effect of differentiated care on quality of care could possibly be due to improvement projects from the higher quality levels combined with the valuable assistance of nurse assistants (Ven W van de(2002)).

Nurse assistant will assist nurses. They will act on patient calls and assist with patient care. A nurse and nurse assistant will interact as a duo team where they are complementary in roles and responsibilities (Kenney C(2011)).

Roles and responsibilities of nurse and nurse assistants are pointed out in Table XIV.

Table XIV – Roles and responsibilities

	Nurses	Nurse assistants
Patient basic care (feed, showering, toilet, mobilization)		X
Wound care	X	
Administration	X	
Nurse student	X	
Nurse assistant student		X
Consulting other disciplines	X	
Coordination and continuity of care	X	
Quality of care	X	
Medication	X	
Meetings	X	
Phone		X
Patient calls		X
Cleaning		X
Searching for supplies		X
Logistics		X

*Changing culture*

Implementing geographic cells improves the coordination between nurses and nurse assistants and reduces patients' calls. Nurses are assigned to patients along a lengthy hallway and spend a good deal of time walking to and from rooms or in search of supplies. A nurse could never be in close proximity to all patients at once. By creating geographic cells, the physical position changes so nurses are only a few steps away from each room. It placed nurses in central to a cluster of rooms for which they are responsible. They are able to take any cluster of five patients, because they saved so much time in walking that the acuity differences among patients did not matter. Geographic cells also improved coordination between nurses and nurse assistants.

With better coordination, staff members were readily available for patients, resulting in a market decline in call lights (Kenney C(2011)).

Also, nursing processes need to change from a reactive culture to a pro-active to reduce patient calls. Instead of waiting patients to call the nurse with specific needs, nurses should do rounds every hour to anticipate on patient needs. In that case, nurses are less likely to be interrupted in the midst of caring for a patient. These sorts of changes are particularly difficult because they often contradict cultural traditions in nursing. To overcome these cultural differences, creating a choreography for rounds in use of training could facilitate these difficulties. It is a series of steps starting introducing the nurse to the patient. Second step would be to ask the patient if he/she is comfortable. Instead of asking how are you? Because the term comfortable elicits a lot of remarks from the patient, from the temperature in the room to their bed in uncomfortable. The next step is making sure the patients do not need to go to the bathroom. If you are a patient and you are alert, oriented, able to get up, you know when you have to go to the bathroom. It is a reminder to make sure you go to the bathroom and don't wait until the last minute so that you will have to rush and possibly trip. For a patient who is alert and oriented but does not know when they have to go, we remind them and help them, before it is too late. Part of the checklist also includes making sure that everything a patient might need – personal items, telephone, tissues, water – is easily in reach. This is important for the patients' comfort and convenience but also for their safety, as many falls occur when patients struggle to reach for something outside their grasp. The checklist also requires that nurses make sure the bed setting is correct and that if there is a bed alarm (for patients who are not supposed to get up on their own) that it is working properly. Nurses then give patient an opportunity to ask for other help they might need before they go to check on the other patients. Important is to communicate to the patient when the nurse will come back to check on them (Kenney C(2011)).

Nurses spend a great amount of time searching for supplies. By identifying the seven most common used supplies and allocate these into plastic containers for every cluster of rooms, nurses do not have to leave the patient to find these supplies (Kenney C(2011)).



Nurses routinely break away from their patients to complete their documentation. By the use of workstations on wheel (WoWs), nurses can spend their time with the patient during their documentation and do their assessment about the patient care plans and pain in-room (Kenney C(2011)).

Table XV – Implementation management

Subject	Responsibility	Deadline
Personal time	A. Coenraadts (champion)	April 2016
Meetings	A. Coenraadts	April 2016
Idle time	M. Mens (board member division)	June 2016
Disturbances	A. Coenraadts	June 2016
Differentiated practice	M. Mens	December 2016
Changing culture	A. Coenraadts	June 2016

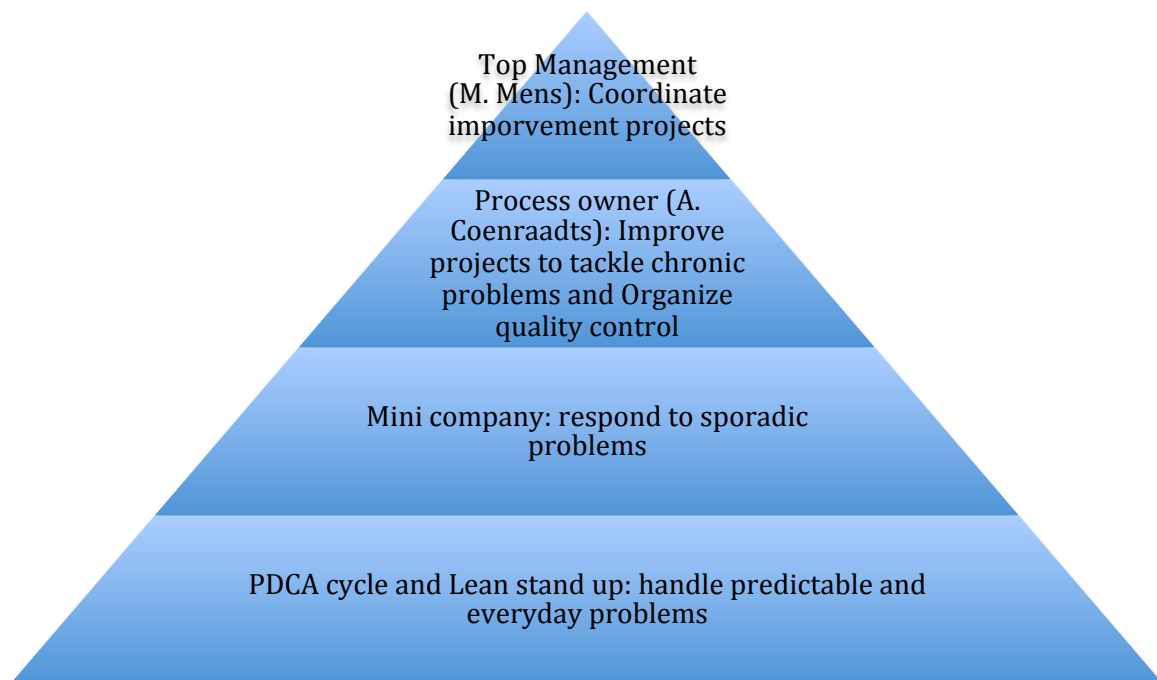
## **E. Control**

In order to connect the improvement measures to the line management several actions will be taken to hand over the project.

### *Control pyramid*

Responsibilities for process control will be incorporated into this template. Four layers of control are described with their own responsibilities: Top management, supervisors/project owners, shopfloor/employees, and automatic process control (Mast J de(2012)).

Table XVI: Control pyramid



Mini company

The mini company is a template for matters that line management should organize. A team of representatives will coordinate the progress of the outcome.

In order to do so, one of the representatives should be responsible for organizing and maintaining relevant documentation such as SOP and performance indicators. Another representative should be responsible for providing feedback to the team on performance (Mast J de(2012)).

Process control

In order to be in control, a control point should be planned on a regular basis to compare the current performance with the planned performance.

A control plan defines the process control for a certain process. It specifies what to be measures, where in the process and with what tool, how often and when. The standard are to be set with the top management to set the reference framework (Mast J de(2012)).

The AMC hospital is using the Joint Commission International system for quality and process control. Demings PDCA (plan–do–check–act or plan–do–check–adjust) system is used as an iterative four-step management method for the control and continuous improvement of processes and products.

Table XVII: Control Plan

**Control plan for project Nursing process**

CONTROL PLAN							
<u>Process: Efficiency and Efficacy of nursing process</u>						Version: 1	
<u>Process owner: A. Coenraads and M. Mens</u>							
Measurement	Who	How	Where	When	Reporting	Norm / spec.	Which OCAP
Personal Time	Black belt	Time sheet	Unit F7Z	During day and evening shift	Daily on Lean board	45 min/shift	PDCA during daily lean stand ups
Meeting	Black belt	Time sheet	Unit F7Z	During day and evening shift	Daily on Lean board	45 min/shift	PDCA during daily lean stand ups
Idle time	Black belt	Ratio nurse/patient	Unit F7Z	At the beginning/ end of each shift	Report to A. Coenraads daily	0	PDCA
Disturbances by colleague	Black belt	Time sheet	Unit F7Z	During day and evening shift	Daily on Lean board	0	PDCA during daily lean stand ups
Disturbances by patient	Black belt	Time sheet	Unit F7Z	During day and evening shift	Daily on Lean board	0	PDCA during daily lean stand ups
Searching for supplies	Black belt	Time sheet	Unit F7Z	During day and evening shift	Daily on Lean board	0	PDCA during daily lean stand ups

### Managing changes

The implementation of the change should be managed on three dimensions (Mast J de(2012)):

- Technical: the changes themselves.
- Organizational: planning and implementation
- Political: resistance, conflict interests

The discharge form will be signed after the assessment of the company project.

Table XVIII: Discharge form

<b>Project discharge form</b>	
<b>Project title:</b> Efficiency and efficacy of the nursing process	
<b>Blackbelt or greenbelt</b> Astrid Bijl	<b>Date</b> Januari 31st 2016
<b>Process or product to be improved:</b> Nursing care process	
<b>Benefits (realised)</b> none	
<b>Benefits (to be realised)</b> Personal time: - 0.78 FTE Meeting: -1.06 FTE Disturbances: -89% reduction in frequency = 16 till 2/shift Changing culture and Differentiated practice: -3.18 FTE + 7654 euro annual Idle time: -0,6 FTE Total cost reduction: 14.9% = 307.676,17 euro on a yearly basis	<b>When? Who is accountable?</b> April 2016 A. Coenraadts April 2016, A. Coenraadts June 2016, A. Coenraadts June 2016, A. Coenraadts December 2016, M. Mens June 2016, M. Mens December 2016, M. Mens and A. Coenraadts
<b>Approvals</b> The persons below state that: 1. The attached review documentation ("review template") gives a fair representation of the project. 2. That the benefits claimed above are realistic. 3. And therefore, that the blackbelt / greenbelt is discharged from this project.	
<b>Project champion</b> A. Coenraadts	
<b>Controller</b> M. Oldenburg	

#### **IV. Results – what will you learn when you structure/analyze the case using the framework chosen**

According to the Pareto analysis we could have chosen for the major time consumer as administration. As we were changing our electronic patient administration system, we considered this to be out of scope. This also means that the data contained during the measurement period might not be applicable to the situation at this time.

In data analysis we did not investigate the different influences of day and evening shift on the CTQ, this would have given more precise information. Though the relevance of this information on the improvement actions would be small and therefore we did not consider this as relevant information.

During analysis on the disturbing factors we distinguished several categories. It would have been more helpful with regard to the improvement actions if we had more information within these categories. In example the disturbance of colleagues on the nurses, within this disturbance we can separate the next categories:

- Nurse
- Nurse assistant
- Physician
- Secretary
- Student
- Dietitian
- Physiotherapist
- Et cetera

And next to these categories we could separate private from professional disturbances. With more information about the disturbance, we would have been able to focus the improvement actions on these disturbances with their own causes.

## **V. Conclusions/Recommendations – what is the relevance of the research question and analysis, how does it help your organizations and/or others**

The AMC is under pressure to provide affordable and good care to be player in the field for sustainable healthcare in the future. The prospective collaboration/merger with another big player in the field, VU Medical Center, provides opportunities to change obsolete care giving.

One of the processes within the hospitals is nursing care. Unit F7Z gives a good reflection of the nursing process within these two academic hospitals. The research template, designed for this company, could easily be used to audit the other nursing wards. When we extrapolate the potential saving within the nursing processes for these hospitals, the amount is almost 15% of the total personnel costs in het nursing wards.

This potential saving could also be translated to increase the performance, in example number of admission, with the same resources. In relation to the collaboration/merger with the VU Medical Centre, this could result in handling large patient flows from each other's specialized areas.

The safety improves by reducing disturbances with 89%. Better use is made from the highest educated nurses, which also improves work pleasure. Nurses are doing what they are best at, especially on their core competences as coordination, continuity and quality of care.

The quality and safety will also improve due to professionals are spending more time with the patient.

The entrepreneurship by changing the status quo using this method gives a disruptive change en therefore strengthen the market position.

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