Improving the preoperative assessment clinic
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Chapter 3

Patient flow in the preoperative assessment clinic


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Abstract

Background and objective: Previous research has shown that a preoperative assessment clinic enhances hospital cost-efficiency. However, the differences in organization of the patient flow have not been analysed. In this descriptive study, we evaluated the consequences of the organization of the patient flow of a preoperative assessment clinic on its performance, by analysing two Dutch university hospitals, which are organized essentially differently.

Methods: In the final analysis, the study included 880 patients who visited either academic centre. The performance of the two preoperative assessment clinics was evaluated by measuring patient flow time, various procedure times and the total waiting time. Patients’ age, ASA physical status and any preoperative tests requested by the physician were also recorded.

Results: There was a significant difference in patient flow time between the two preoperative assessment clinics. More time was needed for the preoperative assessment when patients’ ASA class was higher. The patient flow time was longer when electrocardiogram and venepuncture were performed at the general outpatient laboratory than when they were performed at the preoperative assessment clinic due to longer waiting times. More tests were requested when they were performed at the preoperative assessment clinic.

Conclusions: This study shows that the organization of patient flow is an important aspect of the logistic processes of the preoperative assessment clinic. It might influence patient flow times as well as the number of preoperative tests requested. Together with other aspects of logistic performance, patient satisfaction and quality of medical assessment, patient flow logistics can be used to assess the quality of a preoperative assessment clinic.
**Introduction**

Establishment of a preoperative assessment clinic (PAC) for outpatients was prompted by medical progress in surgical and perioperative anaesthetic care and by the consequent introduction of ambulatory surgery. In the UK, day surgery rates have risen in the last years; 60–70% of all procedures are performed on an outpatient basis.\(^1\)

If patients are not evaluated at a PAC, where preoperative assessment is performed several weeks or days before surgery, then they are usually assessed by the anaesthetist the evening before, or on the day of surgery. However, previous research has shown that performing the preoperative assessment at the PAC improves the cost-efficiency of the hospital.\(^2\)-\(^7\) Since the PAC has now been implemented in the organizational structure of most major hospitals in The Netherlands\(^8\) and the US and are being advised by the National Health Service (NHS) Modernisation Agency through the National Preoperative assessment Project,\(^9\) the next step is to analyse the logistic processes of a PAC itself. This, in order to acquire insights, which processes could be changed to improve organizational efficiency of a PAC.

Patient flow logistics are an important component of a PAC’s processes. Since previous studies have shown patient satisfaction to strongly correlate with the time spent at the outpatient clinic,\(^10\)-\(^13\) we studied the patient flow at the PACs of two Dutch university hospitals. These hospitals have prearranged their PACs essentially differently

**Methods**

We studied the patient flow at the PACs of two Dutch university hospitals, i.e. Leiden University Medical Centre (LUMC) in Leiden and Academic Medical Centre (AMC) in Amsterdam. At both hospitals, all elective surgical patients are assessed at the PAC. Both hospitals perform ambulatory surgery.
The differences in organizational structure of the two PACs are shown in Table 1. Annually, 3000 more patients are assessed at the AMC than at the LUMC. The PAC of the LUMC is opened 30 min longer per day than the AMC. At the LUMC patients with ASA III or IV are given an appointment of 30 min. Healthy patients and patients with limited co-morbidity (ASA I and II) do not require an appointment and can walk-in. At the AMC all patients are given an appointment time of 15 min.

An important difference is the organization of the patient flow for preoperative testing. At the AMC, all preoperative tests can be performed without an appointment on the same day as the preoperative assessment. In contrast, at the LUMC only electrocardiogram (ECG), venepuncture and chest X-rays can be performed without an appointment; all other tests require an appointment. At the LUMC, ECG and venepuncture are performed by the doctor’s assistants at the PAC, whereas at the AMC, ECG and venepuncture are performed at the general outpatient laboratory.

In the LUMC and AMC, both anaesthetists and residents perform preoperative assessment. Both clinics have one anaesthetist at the PAC per day, but in the LUMC there are two residents, while in the AMC there is one. The junior resident in the LUMC only assesses walk-in patients (ASA I and II). In the LUMC supporting administrative and clinical tasks are performed by two doctor’s assistants; in the AMC these tasks are performed by two nurses. At the LUMC, ECG and venepuncture are performed by the doctor’s assistants. Except for this, the tasks of the personnel are same at both PACs. Both PACs do a hand-written assessment.

Both PACs have similar guidelines for preoperative testing. All patients over 60 yr of age require a recent ECG and serum creatinine concentration determination. For specific disorders, medication-use and surgical procedures, both centres require the same preoperative tests. In both centres, tests are not ordered routinely; if the necessary tests were performed just prior to the patient’s visit to the PAC, they did not need repeating.

All patients visiting the PAC during a period of 2 weeks at the AMC and 3 weeks at the LUMC in 2005 were included in the study (fewer patients visit the PAC at the LUMC per week). There is little diversity in the number of patients visiting the PAC in the different months of the year, except for the holidays (data not shown). Since
procedure and waiting times can differ if activities are carried out differently, we modelled the routing of a patient at both the PACs in detail. The following times were registered: presentation of the patient at the counter; start and end of the consultation with the doctor, the nurse or the doctor’s assistant; and the time when a patient booked out. These times were used to calculate the different procedure and waiting times. All using the same clock, the personnel in question registered when they started and ended their assessment. This was done on a form attached to the patient’s medical notes. The patient’s age, ASA physical status and any preoperative tests requested by the physician were also registered.

Table 1. Differences between the AMC (Amsterdam) and the LUMC (Leiden).

<table>
<thead>
<tr>
<th>AMC, Amsterdam</th>
<th>LUMC, Leiden</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 nurses</td>
<td>2 doctor’s assistants</td>
</tr>
<tr>
<td>1 resident + 1 anaesthetist</td>
<td>2 residents (1 junior and 1 senior) + 1 anaesthetist</td>
</tr>
<tr>
<td>Monday afternoon 1 anaesthetist, specialised in pediatrics</td>
<td></td>
</tr>
<tr>
<td>No preoperative tests performed at the PAC</td>
<td>ECG and venepuncture performed at the PAC</td>
</tr>
<tr>
<td>Patients mainly on appointment</td>
<td>Patients mainly without an appointment</td>
</tr>
<tr>
<td>Open 5 days a week; 7 h day(^{-1})</td>
<td>Open 5 days a week; 7.5 h day(^{-1})</td>
</tr>
<tr>
<td>Over 10 000 patients per year</td>
<td>Over 7000 patients per year</td>
</tr>
</tbody>
</table>

AMC: Academic Medical Centre; LUMC: Leiden University Medical Centre; PAC: preoperative assessment clinic; ECG: electrocardiogram.

In this study, the primary goal was to investigate the patient flow at the PAC, while differences in quality of assessment were not studied. The patient flow time was defined as the time from presentation at the counter until booking out of the PAC. Possible follow-up work after the patient had been discharged, necessary for completing the preoperative assessment, was not included in the patient flow time. Various procedure times were distinguished, i.e. the procedure time with the physician, the nurse or the doctor’s assistant, and the time needed to complete
ECG and/or venepuncture. At the AMC, patients leave the PAC and go to the general outpatient laboratory for an ECG and/or venepuncture. The procedure time to complete ECG and/or venepuncture at the AMC included the waiting time at the general outpatient laboratory. Only patients who returned to the PAC to discuss the results with the physician and who did not require other preoperative tests than ECG and/or venepuncture, were included in the procedure time to complete ECG and/or venepuncture. The total waiting time was defined as the sum of the waiting time before seeing the clerk, the nurse or the doctor’s assistant and the physician. It did not include the waiting time at the general outpatient laboratory.

We hypothesized that a patient’s ASA physical status might influence the physician’s procedure time. Therefore, we differentiated the procedure time for the physician per ASA class. As a patient’s waiting time is dependent on the procedure time of the preceding patients, we did not differentiate the waiting time per ASA class.

Since the organization of preoperative testing was completely different in both university hospitals and performing preoperative tests could influence the patient flow time, we also analysed the number of patients who required preoperative tests and the type of tests performed in each hospital.

Statistical analysis

SPSS 12.0.1 (SPSS Inc., Chicago, IL, USA) for Windows was used for statistical analysis. Because the data were skewed, values are given as median (25th–75th percentile). The U-test was performed to analyse differences between the AMC and LUMC. \( P < 0.05 \) was considered to represent a statistically significant difference.

Results

At the AMC, 430 patients were included; 13 data forms were not returned (\( n = 417 \) included in the final analysis). At the LUMC, 467 patients were included; four forms were not returned (\( n = 463 \) included in the final analysis). Patients’ age and ASA physical status were comparable in both groups (Table 2).
Table 2. Age and ASA physical status.

<table>
<thead>
<tr>
<th>AGE-CATEGORY</th>
<th>0 - 10</th>
<th>11 - 20</th>
<th>21 - 30</th>
<th>31 - 40</th>
<th>41 - 50</th>
<th>51 - 60</th>
<th>61 - 70</th>
<th>71 - 80</th>
<th>81 - 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMC (n = 417)</td>
<td>n</td>
<td>76</td>
<td>30</td>
<td>30</td>
<td>51</td>
<td>72</td>
<td>56</td>
<td>51</td>
<td>38</td>
</tr>
<tr>
<td>LUMC (n = 463)</td>
<td>n</td>
<td>68</td>
<td>38</td>
<td>33</td>
<td>57</td>
<td>69</td>
<td>70</td>
<td>62</td>
<td>51</td>
</tr>
</tbody>
</table>

Number of patients in various age categories, number of patients per ASA class and the procedure time for the physician per ASA class. The age of two patients from the AMC was not documented. The ASA physical status of four patients from the LUMC was not documented. ASA: American Society Anesthesiologists; AMC: Academic Medical Centre; LUMC: Leiden University Medical Centre.
Figure 1 shows the patient flow at both PACs. Total patient flow times (i.e. the total time spent at the PAC) are presented in Figure 2. Total patient flow time of all patients visiting the PAC was significantly shorter at the LUMC; 49 min (33–69 min) vs. 65 min (41–92 min) at the AMC ($P < 0.001$) (Fig. 2). The difference mainly resulted from the increased patient flow time when venepuncture and/or ECG (the most frequently requested preoperative tests) had to be performed. For patients requiring venepuncture and/or ECG, the patient flow time was 63 min (48–83 min) at the LUMC vs. 119 min (91–136 min) at the AMC ($P < 0.001$). For patients who did not require any preoperative tests, the patient flow time was 37 min (26–55 min) at the LUMC vs. 53 min (36–78 min) at the AMC ($P < 0.001$). The time to complete venepuncture and/or ECG was 6 min (4–8 min) at the LUMC vs. 40 min (27–54 min) at the AMC ($P < 0.001$) (Fig. 3). The total waiting time was 24 min (14–41 min) at the LUMC vs. 32 min (18–52 min) at the AMC ($P < 0.001$) (Fig. 2). The procedure times were as follows: 5 min (2–8 min) for the doctor’s assistant (LUMC) vs. 8 min (5–11 min) for the nurse (AMC) ($P < 0.001$); 15 min (10–20 min) for the physician at the LUMC vs. 12 min (9–16 min) at the AMC ($P < 0.001$); and 4 min (2–
Figure 2 Comparison of the total patient flow time and the total waiting time in the AMC, Amsterdam and the LUMC, Leiden. The boxes extend from the 25th to the 75th percentile. The error bars extend down to the 10th percentile and up to the 90th percentile. The lines at the middle of the boxes are the medians. AMC: Academic Medical Centre; LUMC: Leiden University Medical Centre.

Figure 3 The patient flow time without preoperative tests, the patient flow time with ECG and/or venepuncture and the time to complete ECG and/or venepuncture in the AMC, Amsterdam and the LUMC, Leiden. The boxes extend from the 25th to the 75th percentile. The error bars extend down to the 10th percentile and up to the 90th percentile. The lines at the middle of the boxes are the medians. AMC: Academic Medical Centre; LUMC: Leiden University Medical Centre; ECG: electrocardiogram.
5 min) for the second consultation with the physician at the AMC (at the LUMC the physician is only consulted once). The procedure time for the physician per ASA class is shown in Table 2. More time was needed for the preoperative assessment when patients’ ASA class was higher. Missing data were <8%.

At the LUMC, 46% of all patients had preoperative tests compared to 25% at the AMC ($P < 0.001$) (Table 3). At the LUMC, 98% of the preoperative tests were either venepunctures or ECGs, in comparison to 90% in the AMC. At the LUMC, 2% of the preoperative tests consisted of echocardiography, pulmonary function tests and chest X-rays; this was 10% at the AMC (Table 3).

<table>
<thead>
<tr>
<th>Table 3. Number of preoperative tests performed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients with preoperative tests</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Distribution of preoperative tests</td>
</tr>
<tr>
<td>Total number of preoperative tests</td>
</tr>
<tr>
<td>Total number of electrocardiograms</td>
</tr>
<tr>
<td>Total number of venepunctures</td>
</tr>
<tr>
<td>Total number of echocardiograms</td>
</tr>
<tr>
<td>Total number of pulmonary function tests</td>
</tr>
<tr>
<td>Total number of chest X-rays</td>
</tr>
</tbody>
</table>

AMC: Academic Medical Centre, LUMC: Leiden University Medical Centre.

**Discussion**

In The Netherlands and other Western countries, the demands for healthcare services are growing. Concurrently, stakeholders of the healthcare system (governments, healthcare insurance companies and patients) are increasingly demanding transparent outcome measures and tools to compare similar healthcare services in different hospitals in respect of quality and cost-efficiency.\textsuperscript{14-16} The PAC is a rather new healthcare service and has shown to increase hospital cost-efficiency.\textsuperscript{2-7} Although some organizational aspects of the PAC have been
investigated such as preoperative laboratory testing,\textsuperscript{4} patient satisfaction,\textsuperscript{12,13} and staffing\textsuperscript{17,18} and scheduling of the PAC,\textsuperscript{12} studies on improving logistical processes at a PAC have not been published. The logistical performance of a PAC can be regarded as one of the keystones of its quality, together with the quality of medical assessment and patient satisfaction. We focused on the patient flow, as part of the logistic performance of the PAC, comparing two Dutch university hospitals, which have organized the patient flow essentially differently. Possible differences in quality of preoperative care or work practice were not analysed.

Patient flow time is frequently used as an objective instrument to compare healthcare services. However, the following limitations and difficulties in interpretation should be considered when comparing hospital facilities based on patient flow time, as we encountered during our analysis. Firstly, although we analysed two similar hospitals, i.e. university hospitals with comparable tasks in the Dutch healthcare system and comparable patient demographics, the number of patients visiting the PAC of each hospital annually is significantly different (LUMC 7000 vs. AMC 10 000). In addition, the PAC of the LUMC is staffed by more physicians than the AMC and is opened for 30 min longer in a day (Table 1). Hence, these factors might considerably influence the patient flow time, which indeed is shorter at the LUMC (Figs 2 and 3). One could also state that the AMC, despite longer patient flow time, is more efficient because it employs fewer staff, is open for fewer hours, but sees more patients than the LUMC.

The total patient flow time of the PAC at the AMC is slightly distorted. The procedure time to complete ECG and/or venepuncture was included in the total procedure time at the PAC, but these tests were performed at the general outpatient laboratory and not at the PAC. However, these tests were performed at the PAC of the LUMC; therefore, we decided to include the total procedure times for these tests in the total patient flow time of both PACs. At the LUMC, the waiting time before having ECG and/or venepuncture performed is listed as waiting time III. The procedure time to complete ECG and/or venepuncture in the AMC includes the waiting time at the general outpatient laboratory. Therefore, in reality the total patient waiting time at the AMC is longer.
The difference in the total waiting time contributes to the difference in the patient flow time between the LUMC and AMC. Waiting times at the LUMC are shorter, even though patients are mainly seen without an appointment, which is contrary to what one would expect. With an appointment system, waiting time occurs when the time reserved for an appointment is less than the real procedure time. Alternatively, if the time reserved for an appointment is greater than the procedure time, idle time will occur. The idle time is the time when the physician is not consulting, because no patients are waiting to be seen. There are two possibilities to reduce the mean waiting time. (1) Increasing the reserved appointment time. However, if there is a large variability in procedure times, as is the case with preoperative assessment, an increase in the reserved appointment time will be accompanied by an increase in idle time. This is not efficient as there is a loss of capacity. (2) Reducing the variability in the procedure times.

We found that preoperative assessment of patients with a higher ASA class requires more time. Making the reserved appointment time dependent on a patient’s ASA physical status reduces the variability in the procedure times, thus reducing the waiting time without increasing the idle time, making more efficient planning possible. At the LUMC, differences in procedure times caused by the difference in co-morbidity are taken into account. Patients do not need an appointment if they have no or limited co-morbidity (ASA I and II). All other patients get an appointment of 30 min. Fifty percent of the ASA IV patients are assessed by the physician within 29 min (Table 3). Relative overcapacity enables walk-in for patients with ASA I or II. At the AMC, all patients are given an appointment of 15 min. Differences in procedure time because of difference in co-morbidity are thus not considered; the result is great variance in procedure times. As Table 3 shows, the procedure time for the physician is over 15 min for >50% of patients with ASA III and IV; a reserved appointment time of 15 min is insufficient for these patients. Several other issues might be important for the performance of patient flow logistic but are not reflected in the patient flow times. At the AMC, all preoperative tests are performed on the same day as the preoperative assessment. At the LUMC, patients have to make an appointment for all tests other than ECG and venepuncture. We did not ask the patients whether they preferred all tests being
performed the day of the preoperative assessment, with possible longer patient flow times, or whether they favoured a new appointment for preoperative testing. Follow-up work necessary for completing the preoperative assessment, after the patient has been discharged, was also not taken into account. Difference in the skill and experience of the physicians, in particular the residents, can also influence the patient flow. This can influence not only the procedure times for the physician but also the amount of preoperative tests that are requested. Co-morbidity, medication-use, the surgical procedure the patient is to undergo and the tests performed prior to the patient visiting the PAC could influence the patient flow times. We did not include these variables in our study.

The organization of preoperative testing might have an impact on the amount of tests performed. Patients were tested significantly more often at the LUMC than at the AMC, though demographics were comparable in both groups (Table 2) and both centres have similar guidelines for preoperative testing. At the LUMC, the tests performed at the PAC, namely ECG and venepuncture, are the most frequently requested tests (Table 3). Possibly, the immediate availability of testing facilities lowers the threshold and increases the probability of testing. In contrast, the preoperative tests that require an appointment at the LUMC, namely echocardiography and pulmonary function tests, are requested less often at the LUMC than at the AMC, where no appointment is necessary for these tests. It is possible that the need for an appointment for a test raises the threshold for testing. However, the type and number of co-morbidities of each patient, the surgical procedure the patient is to undergo and the tests performed prior to the patient visiting the PAC were not registered and may account for the difference in the amount of tests requested.

In conclusion, this study shows that the organization of patient flow is an important aspect of the logistic processes of the PAC. It might influence patient flow times as well as the number of preoperative tests requested. Together with other aspects of logistic performance, patient satisfaction and quality of medical assessment, patient flow logistics can be used to assess the quality of a PAC.
Acknowledgements

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References