Treating patients with opioid intoxications at Oslo Accident and Emergency Outpatient Clinic – A cost-minimization analysis

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Abstract

Background: Patients with acute intoxications of substances of abuse are treated in a different part of the health care chain in Oslo compared with the rest of Norway. In Oslo, most patients with intoxications are treated at a primary care facility (Oslo Accident and Emergency Outpatient Clinic - OAEOC) instead of in a hospital setting, which is the norm most other places. The aim of this paper is to conduct an economic evaluation of the treatment at OAEOC.

Methods: A representative patient with opioid intoxication was constructed based on a cohort of all intoxications registered at OAEOC for 1 year. The expected resources used on this patient at OAEOC was estimated through a combination of data and discussions with experienced clinicians. A patient with the same characteristics was presented to experienced staff at Drammen Hospital who estimated expected resources used in that setting. The expected costs were then calculated both places.

Results: The expected costs of treating a representative patient with opioid intoxication at OAEOC is 1157 NOK, split on personnel costs of 931 NOK and treatment costs of 226 NOK. The expected costs of treating a patient with the same characteristics at Drammen Hospital is 5828 NOK, divided on personnel costs of 1774 NOK, treatment costs of 1744 NOK and costs associated with admission to intensive care unit of 2310 NOK. The point estimate of the difference is 4671 NOK per patient, with a low-difference scenario and high-difference scenario estimated to be 2214 NOK and 7395 NOK respectively.

Conclusion: Treating patients with opioid intoxications at OAEOC is cost-effective compared to treating them in a hospital setting. The results are most likely transferable to intoxications with other substances of abuse. Implementing the routine at OAEOC elsewhere could result in better use of health care resources.

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1 Introduction

One of the main goals of the Coordination Reform implemented in 2012 was to construct a more economically sustainable health care sector, in part by treating more patients at primary rather than specialist care level (1). Identifying the suitable groups of patients to be shifted from specialist care to primary care is controversial and how this should be done is a source of ongoing debate.

The treatment of patients with intoxications of substances of abuse at Oslo Accident and Emergency Outpatient Clinic (OAEOC) is an example of a group of patients treated in a primary care facility who in other parts of Norway are treated at hospitals. The treatment of these patients at OAEOC is based on a local routine that has been developed over a period of many years. Vallersnes et al collected in 2011/2012 data of 2343 patients treated for intoxications at OAEOC and concluded that the routine is safe (2). The costs have never been analysed and this study aims to remedy that. Using in part unpublished data from Vallersnes` dataset, the costs of treating a representative patient with opioid intoxication at OAEOC is compared with the costs of treating a patient with the same characteristics in a hospital, represented by Drammen Hospital in this study.

Patients with opioid intoxications are chosen because they are a common feature at OAEOC (the second most frequent agent after ethanol) and because these patients have a quite predictable clinical presentation.

A key difference between a primary care facility and a hospital is the range of different diagnostic- and treatment options available. The limited diagnostic possibilities at OAEOC force the doctors to trust their clinical judgement to a larger degree than doctors at a hospital, who have more diagnostic tools in their armamentarium. Intoxications with substances of abuse are primarily a clinical diagnosis, though, and a key assumption in this study is that the patient outcomes are equal, despite the different diagnostic and therapeutic possibilities at the two health care facilities. Because the medical outcomes are assumed identical, a cost-minimization analysis is the method of choice.

The patients under scrutiny are those with opioid intoxications who are thoroughly treated at OAEOC, but would have been admitted to hospital if they had presented in Drammen. That means excluding the patients who eventually are admitted to hospital in Oslo and the patients with the mildest intoxications, who are assumed to be taken care of at the casualty clinic in Drammen. A likely clinical pathway for a representative patient is constructed with the help of experienced staff at both OAEOC and Drammen Hospital and expected costs are estimated both places through basic principles of economic evaluation.

To my knowledge, comparisons of neither costs nor outcomes of different regimens of treatments for acute intoxication of substances of abuse have ever been conducted. This study is a small first step in illuminating this field.

The health care sector is a field with scarce economic resources and it is important that the resources put to use are spent as efficient as possible. The hypothesis in this paper is that treating patients with opioid intoxications at OAEOC is cost-effective and that the extra resources being used at hospitals could be put to better use elsewhere.

2 Background

Rising health care costs are a major political issue in all developed countries and a central question in Health Economics. Higher expectations in the population and an ever increasing rate of technological development make prioritizing in the health care sector a difficult and complex problem.

Offering all patients the most modern and expensive treatment is not economically feasible. There is a broad consensus that refusing to offer medical treatment on economic grounds is morally acceptable, even though there is no agreement on where the threshold for refusing treatment is. That some patients are denied treatment because it is rendered too expensive makes it important that the resources actually being used is applied in a cost-effective way.

Cost-containment was one of the main arguments behind the Coordination reform that came in to force in January 2012. A main cost-containing principle in the Health care sector is to treat the patients at the lowest effective level in the health care chain. This also includes acutely sick patients and the municipalities are expected to take care of a gradually larger part of acutely sick patients via General Practitioners, Emergency outpatient clinics and Municipality acute bed units (KAD) (3).

Almost 7 years after implementation of the coordination reform there is still no final consensus on how the distribution of patients between the state (specialist care) and municipalities (primary care) should be (4). One of the main concerns is that some patients with complex needs could end up back and forth between two systems, with neither the state nor the municipalities really being in charge. Another worry is that old and frail patients could be discharged from hospitals too early, without the municipalities being ready to deliver sufficient care.

In spite of issues like these there are few voices who call for a reversal of the reform, and the identification of which groups of patients to be treated at which level of the health care chain is an ongoing process.

Emergency care system

The emergency care system in Norway has two levels; hospitals (specialist care) and primary care emergency services. Patients can in general not present directly at hospitals, they first have to be assessed by ambulance service or in primary care. Primary care emergency services are provided by general practitioners during office hours and local casualty clinics at other times. OAEOC is the main casualty clinic in Oslo, providing services at all hours seven days a week. It is a combined trauma clinic and general practice service, with the latter carrying out 80 000-90 000 consultations each year (5). Most doctors working there are registrars. Oslo`s population has been steadily increasing the last decades and amounts to approximately 673 000 people in 2018 (6).

OAEOC differs from casualty clinics in other Norwegian cities in some ways, most notably that it is open at all hours and the capability to observe patients for some time. Another aspect is the possibility of conducting CT scans (CT of the head is the only available routine for doctors at the general practice service). Beside the radiology-department, the opening hours and the possibility to observe patients for some time, the Department of General Practice at the OAEOC is a quite standard primary care facility with limited diagnostic resources.

Drammen hospital is a general hospital and the largest entity in Vestre Viken Hospital Trust. It serves as a local hospital for 168 000 people and has several regional functions for the area of Vestre Viken of almost 500 000 people (7). Patients brought to the emergency department can in theory receive a full range of specialist care, this also include patients with acute intoxications of substances of abuse.

Acute intoxications

Acute intoxications are a major health problem worldwide. From 2000-2014 the rate of deaths from drug overdoses rose by 137% in the United States, with the rate of deaths related to opioid overdoses increasing by 200% (8). Oslo Accident and Emergency Outpatient Clinic (OAEOC) treat a large and increasing number of patients with acute intoxications of substances of abuse. In 2003 956 patients with intoxications (of all kinds) were treated at OAEOC (9). In 2008 1714 patients were treated for intoxications of substances of abuse and in the year from October 2011 to September 2012 a total of 2343 patients were treated (for intoxications of substances of abuse), the main toxic agents being ethanol (55%), opioids (23%), benzodiazepines (8%) and central stimulants (6%) (10) (2).

The second most frequent toxic agent in Vallersnes` data was opioids, of which 89% were heroin (11). The number of patients with opioid intoxication treated at OAEOC more than doubled from 2003 to 2012, increasing from 207 to 539 patients (9) (2).

Patients with acute opioid intoxication classically present with the triad of depressed levels of consciousness, miotic pupils and decreased respiration. The treatment centres on achieving adequate respiration. If the patient breathes well without support, surveillance can be enough. If the breathing is insufficient, the antidote Naloxone could be provided. Naloxone in sufficient doses reverses an opioid intoxication in 3-5 minutes. Naloxone loses its effect in 20 to 40 minutes and patients should be observed in 2-3 hours after administration since many patients again will get symptoms of opioid intoxication (12).

Routine at OAEOC

The principles of management outlined above are quite simple and do not require advanced medical equipment or involve any invasive procedures. The routine used at OAEOC has been developed locally during the last 30 years. At arrival the patient is triaged by a nurse (using Manchester Triage System (13)) who decides how soon a doctor should examine the patient and whether to initiate the local routine. A designated nurse and doctor are assigned to patients with intoxications around the clock and the nurse will, if the routine is initiated, always perform initial measurements, including blood pressure, pulse, temperature, oxygen saturation, respiration frequency and blood glucose, as well as noting the case history and Glasgow Coma Scale score (GCS). The doctor then examines the patient by at least auscultating the heart and lungs, checking for track marks, sign of injury, examining the pupils and plantar reflex. The GCS is noted. After the initial examination the doctor decides if the patient should be admitted to a hospital, observed at OAEOC or discharged. Patients with suspected GHB (gamma-hydroxybutyric acid)-intoxication are often hospitalized, the same with patients with GCS below 7, psychotic patients and those with hyperthermia. Those who obviously need observation for more than 4 hours should also be admitted to hospital. Patients with head trauma should be examined at the trauma clinic, but are most often returned to OAEOC after examination there.

Those who are kept at OAEOC are observed by an assigned nurse every 15-30 minutes following a standard procedure of noting the Glasgow Coma Scale score, pupil reaction to

light, respiration frequency and symmetric movement of arms and legs. When necessary, the nurse consult the doctor.

If the patient is respiratory depressed (respiration rate below 10 per minute and/or the oxygen saturation falls below 90%), the doctor should consider administration of Naloxone if opioid intoxication is suspected. If benzodiazepine intoxication is suspected, the antidote Flumazenil could be administered and the patient should be admitted to hospital. It is possible to measure haemoglobin- and CRP-levels, conduct electrocardiogram (ECG), conventional x-ray and CT (computed tomography) scan of the head. Blood gas analysis is not available and generally no laboratory analyses are performed.

Heroin is by far the most usual opioid suspected at OAEOC (89%) and is processed at a rate in the body so that patients should be awake and in progress after at least 4 hours. If a patient does not show any signs of recovery in this time or are deteriorating, differential diagnoses should be considered and the patient should often be admitted to hospital (2). After 4-5 hours the patient is woken up and speak with the doctor before discharge. The doctor and nurse cooperate closely through the whole process and a senior doctor is always available for consult.

Vallersnes et al concluded that the procedure used at OAEOC is safe enough. Of the nearly 2000 discharges from OAEOC, 2 patients died of a new drug overdose the following week. 13 patients (0,7%) was readmitted to OAEOC or a hospital with a diagnosis that was overlooked at the initial observation. 5 were in need of treatment for the same intoxication-episode, two were admitted with psychosis, one had haemorrhagic gastritis, one had a fracture that needed surgery and four had minor injuries (2). Even though these events were unfortunate, none of them were fatal and they do not change the overall conclusion.

In the rest of Norway, outside Oslo and Bergen (who organize the treatment differently), patients with acute intoxications are mainly treated in emergency rooms in hospitals that have more sophisticated diagnostic and treatment possibilities compared to the limited possibilities at OAEOC. 82% of the patients included in Vallersnes` study were brought to OAEOC by either ambulance (61%), police (17%) or addiction outreach services (4%). In Drammen, it is a reasonable assumption that most of these patients had been brought to hospital instead of the local casualty clinic. 18% of the patients either was brought by companions (6%), by

others (4%) or came on their own (8%). Most of these would most likely present at the local casualty clinic in Drammen, where they treat some patients with mild intoxications, but all patients with suspected opioid intoxication in need of observation are admitted to hospital (according to Tommy Bringaker, coordinator at Drammen Casualty Clinic).

Clinical course in Drammen

A likely course of treatment for a patient with suspected opioid intoxications has been outlined together with Andrea Dobloug, specialty registrar at Drammen hospital where she has worked at the emergency department for 5 years.

At arrival, the patient is brought to an emergency room, especially if the consciousness and respiration is depressed. There he is handled by two nurses and two doctors, an intern and a more senior doctor. The patient is first examined clinically by both doctors, oxygen therapy is often initiated immediately and intravenous access is established. Fluid-therapy (Ringer) is initiated if not already done by the ambulance-staff. If opioid intoxication is suspected, many patients are treated with Naloxone (antidote to opioids) with a standard dose of 0,4 mg. Flumazenil (antidote to benzodiazepines) is also available. Further, a standard set of blood tests are taken of almost all patients, the same with arterial blood gas-analysis and ECG. A CT scan of the head is often conducted if the diagnosis after the initial treatment is not entirely certain or if the treatment has not had sufficient effect. Assuming nothing substantial is unveiled on the clinical examination, blood test, ECG, blood gas or CT scan, the next step mostly depends on the respiratory status of the patient. If the patient still is respiratory depressed, or if the patient is better, but the doctor is concerned that he will deteriorate with time, the patient is admitted to an intensive care unit (ICU), the alternative being a general ward, with less possibilities of monitoring the respiration. During daytime and evening, the ICU has one nurse for every patient, in the night there are 4 nurses in charge of a maximum of 6 patients. Possible treatment at the ICU range from mere observation to full-scale intensive treatment, depending on the severity of the clinical condition. Many patients admitted to the ICU in Drammen because of intoxications do not need any more medical treatment, they are admitted to enable continuous surveillance of the respiration. The patients typically stays in the intensive care unit for many hours and are discharged from the ICU without being transferred to another department. In general, they are allowed to stay until the wake up and leave on their own.

The direct medical costs associated with treating patients with intoxications at OAEOC have never been calculated. A literature review has not unveiled any analyses of outcomes or costs of different treatment-regimens for acute intoxications. Pletcher et al (2004) looked at the potential of reducing the burden on American emergency-departments at hospitals by triaging patients with uncomplicated ethanol intoxications to designated "sobering centres". The conclusion was that the effect would be rather small, since 80% of the patients used inpatient services that would not be available at a sobering centre (14). Almost 70% used laboratory services. The results from OAEOC at first glance do not support that conclusion, since only 17% of the patients (with all types of intoxications) were admitted to hospital (2). One could suspect that when all in-patient services are readily accessible, as in the American setting, more services are regarded as necessary.

Analysing costs and effects of different treatment regimens are essential for politicians to make informed judgements. The low socio-economic status of many of the patients may have contributed to the lack of economic evaluations in this field. Research on the medical aspects of treating intoxications should be complemented by economic evaluation, though, since making best use of available resources is important regardless of the diagnosis in question.

3 Methods

This study is a cost-minimization analysis in which the costs of treating patients with acute intoxication of opioids at OAEOC, which is a primary care setting, is compared with the costs of treating the same patients in a specialist care setting.

Model overview

The relevant group of patients is those with opioid intoxication who are treated at OAEOC, but would have been treated at hospital if they had presented in Drammen. The main method used in this paper is to identify characteristics of this group of patients at OAEOC based on Vallersnes` data (2). With the help of these characteristics a representative patient (of this group) is constructed and presented to experienced staff at both OAEOC and Drammen Hospital. Expected costs of treating that patient is estimated both places and then compared.

Constructing a representative patient

Based on the data outlined below, a representative patient is constructed: *He is a 38 year old male brought to OAEOC by ambulance because of a suspected opioid intoxication. The lowest GCS recorded at OAEOC is 12 and he had a respiratory depression with a RF <10, but O2-sauturation>90. He is brought to OAEOC in the morning hours and is observed at OAEOC for 4 hours 45 minutes before being woken up and discharged. The stay is on the dayshift in its entirety.*

The patients in Vallersnes` study was included over one year, from 1 October 2011 to 30 September 2012. Among the patients included in the study, 539 patients were treated at OAEOC for a suspected opioid intoxication. This constituted 23% of the 2343 patients included in total.

102 of the 539 patients (19%) were admitted to hospital, and therefore not relevant to this analysis. Of the 437 remaining patients, 78 never had a lower GCS score than 15. In this analysis, these patients are assumed to be treated at the casualty clinic in Drammen, not being admitted to the hospital. Consequently, the relevant group of patients consists of 359 patients with suspected opioid intoxication who at some point at OAEOC had GCS lower than 15 and were discharged from OAEOC.

To construct a representative patient from this subgroup of the patient cohort, key characteristics of the subgroup were derived from raw data from Vallersnes` data set. The characteristics are all based on unpublished data from this set (if not stated otherwise).

The median patient of the relevant subgroup had a lowest GCS of 12 and the proportion of patients with respiratory depression was 35,7%.

The median observation time of all patients eventually discharged from OAEOC was 4 hours 15 minutes. Patients with opioid-intoxications are in general assumed to resemble patients with other kinds of intoxications quite well in terms of length of stay. Since patients with GCS 15 is excluded, the median length of stay in the relevant subgroup is estimated to be somewhat longer, and set to 4 hours 45 minutes in this analysis. 78,3% of the patients were male and the median age of patients in the subgroup was 38 years old. 61% of the total 2343 patients were brought to OAEOC by ambulance.

The representative patient is deemed to have respiratory depression even though only 35,7% of the relevant patient group satisfied the criteria for that while treated at OAEOC. The reason for that is that 28,1% at some point was treated with Naloxone, most of them by ambulance-personnel before arrival at OAEOC. It is assumed that many of those patients at some point satisfied the criteria of respiratory depression even though they did not at OAEOC. Presence of respiration depression earlier in the clinical course is especially important in Drammen, where it is essential when the treatment pathway is decided. The relevant proportion is therefore higher than 35,7% and assumed to be high enough to be included as a characteristic of the representative patient in this study.

Estimating expected resources used at OAEOC

The observation routine at OAEOC is described in detail in the background-section. The doctor and nurse assigned to these patients are said to be in charge of the observation room. The expected resources used on the representative patient can be divided into personnel resources (the amount of time used by staff at OAEOC) and other (treatment) resources. The time used by doctors and nurses is estimated with the help of senior doctor Odd-Martin Vallersnes and chief nurse Monika Nordmo. The treatment resources are estimated based on data from Vallersnes et al (2) and modified through discussions with dr. Vallersnes.

The expected time spent by the different doctors and nurses involved are summarized in the third column of table 1.

In the routine at OAEOC, glucose is measured on all patients upon arrival. Some patients resist the test, the probability is therefore set at 0.98.

Naloxone was administered to 10% of the relevant 359 patients at OAEOC (unpublished data from Vallersnes` dataset).

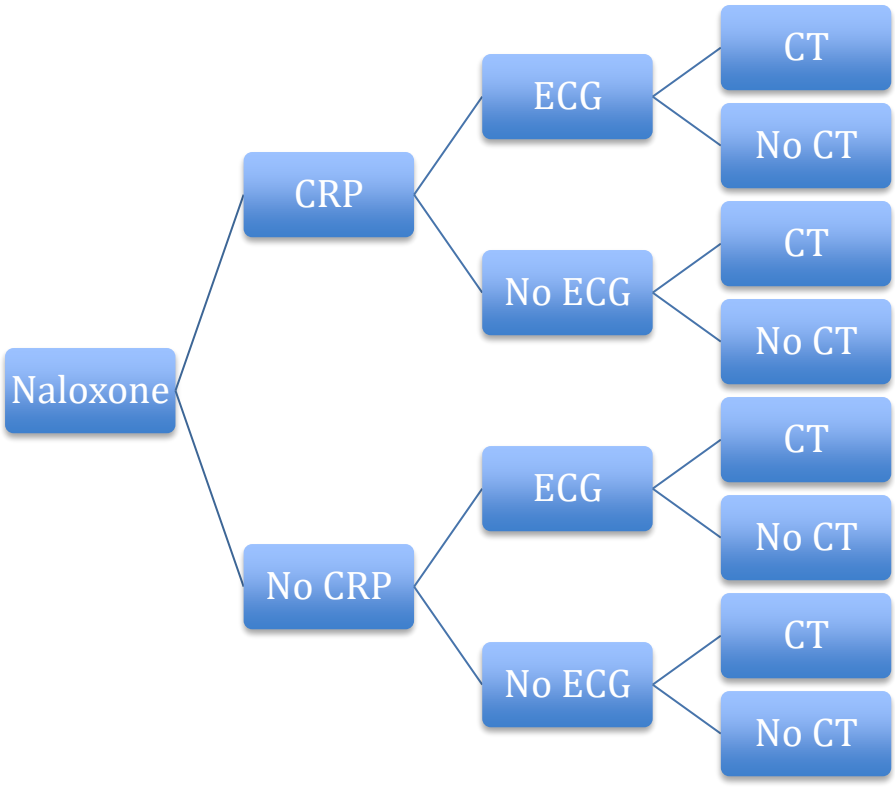
There are no exact numbers for CRP-tests performed in the data, but 3% (of the whole population of 2343 patients) had an infection, which is used as a proxy base-line for the probability of the test being carried out. It is known from clinical experience that CRP is measured on more patients than only those diagnosed with an infection, though, and the probability is set to 10%.

1% of the total population had chest pains, which work as a proxy base-line for the number of ECGs being performed. Not all patients with chest pains are examined with ECG, but there are other indications for the tests being performed besides pains (for example irregular heart rhythm). The correct number is therefore believed to be somewhat higher and is set to 3%.

A CT scan of the head was performed in 6% of the 2343 patients.

Figure 1 displays half of a decision tree illustrating the decisions made by the doctor at OAEOC. The full decision tree is displayed as attachment 1.

Figure 1 – Decision tree OAEOC



Displaying half the decision tree at OAEOC. The other half starts with "No Naloxone" and is identical after that.

The estimates of the probability of CRP, ECG and CT being performed are based on data of the total population of 2343 patients. Concerning the likelihood of these tests being carried out, there is no obvious reason why the representative patient should defer from the rest of the population in any substantial way. The numbers are therefore rendered relevant to our analysis.

The routine at OAEOC is more or less unchanged from 2011/2012 with the same diagnostic possibilities available today. Further, nothing in the clinical experience suggest that the types of opioids used today are essentially different from 7 years ago.

Estimating costs at OAEOC

The Norwegian Directorate of Health issued in 2012 a guide to conducting economic evaluations in the health care sector. The basic principle is that resources should be valued according to their best alternative use, the opportunity cost (15).

- Personnel costs should be measured based on the average pay of the personnel involved, including taxes, payroll tax and other social costs.
- For services provided by hospitals, the guide recommend a unit cost estimated as if the financing was based on 100% reimbursements from The Norwegian Health Economics Administration (Helfo).
- The unit cost of services provided by doctors and other specialists can be estimated by multiplying the honorarium received for the service from Helfo (List of reimbursed codes (16)) by two. The sum is multiplied by two to count in other forms of financing.
- Similarly, the unit cost of outpatient radiological and laboratory-services are found by including the reimbursed sum from Helfo plus the fee payed by patients multiplied by two.

The average hourly wage for a nurse at OAEOC is 253,50 NOK without any additions (evening/night/weekend). Both nurses in our analysis are assumed to have this wage. The hourly wage of the doctor in charge of the observation room is assumed to be 360 NOK and for the senior doctor 410 NOK.

The personnel costs per hour are found by multiplying the hourly wage with 1,3 to count in payroll taxes and other social costs (17).

The personnel resources used at OAEOC are summarized in table 1;

Table 1 – Personnel resources at OAEOC

Personnel	Personnel costs/hour (NOK)	Time spent (Minutes)	Sources
Nurse obs.room	330 (299-358)	90 (75-105)	P.H/M.N
Nurse triage	330 (299-358)	6 (3-12)	P.H/M.N
Doctor obs.room	468 (429-507)	45 (30-60)	M.N/O.M.V/J.Ø
Senior doctor	533 (507-559)	6 (3-12)	M.N/O.M.V/J.Ø

NOK=Norwegian kroner. Obs.room=Observation room

P.H= Pål Hansen, chief nurse at OAEOC

M.N=Monika Nordmo, nurse at OAEOC

O.M.V=Odd Martin Vallersnes, senior doctor at OAEOC

J.Ø=Jon Ørstavik, Director OAEOC

The treatments given are defined as an outpatient radiological and laboratory services and the unit cost is thus found by summarizing the sum reimbursed by Helfo and the fee paid by patients. This sum is multiplied by two to count in other forms of financing, namely the grants from Oslo municipality.

The tariffs received from Helfo for the laboratory tests are found in "List of reimbursed codes" ("Normaltariffen") (16). The tariff 701A is activated whenever the laboratory is used, but can only be used once per patient regardless of how many tests are performed. In this analysis, the 701A-tariff is combined with the tariff for glucose-measurement, 708A.

The tariff for CT-scan of the head is 165 NOK refunded from Helfo and 250 NOK from the patients, in total 415 NOK (18) (19).

The price for Naloxone is derived from Felleskatalogen 10.10.18 and is 568 NOK per 10 x 04 mg (20).

Tests probabilities, prices, tariffs and unit costs are summarized in table 2.

Table 2 – Tests, probabilities, prices, tariffs and costs at OAEOC

Test/treatment	Probability	Price (NOK)	Tariffs	Unit cost (NOK)
Glucose	0.98 (0.96-1.0)	76	701A + 708A	152
CRP	0.1 (0.05-0.2)	42	705K	84
ECG	0.03 (0.01-0.05)	213	10b + 707	426
CT	0.06 (0.04-0.08)	415	Helfo	830
Naloxone	0.10 (0.05-0.15)	57	Felleskatalogen	57

NOK=Norwegian kroner

Uncertainties

Reimbursements from Helfo and prices on medicines are counted as certain, all other parameters are stated with attached uncertainties. The uncertainties of the parameters (for both Drammen Hospital and OAEOC) are stated in brackets next to the estimates. They were found through discussions with clinicians at both institutions and the interpretation should be that the correct estimate with a high degree of confidence could be said to be between the cut-offs.

Sensitivity analyses are carried out to assess the possible impact on the results. It is conducted one-way analyses where parameters are varied one at a time to find the impact. The results from the sensitivity analyses are presented in a tornado-diagrams as described in Drummond et al (21), page 58.

Estimating the expected resources used at Drammen Hospital

A road-map to how patients with suspected intoxications of substances of abuse are handled at Drammen Hospital is outlined in the background-section. More specifically for this analysis, the representative patient was presented to specialty registrar Andrea Dobloug at Drammen Hospital who together with colleagues estimated expected resources used on this hypothetical patient.

Upon arrival at the hospital the patient is brought to an emergency room and taken care of by two nurses and two doctors, an intern (LIS 1) and a more senior doctor.

There are 3 levels of senior doctors, LIS A-C, where LIS C is the most experienced and highest paid. On average the senior doctor is assumed to be LIS B. The time spent by the LIS B (or the other staff) is not including time later spent at the intensive care unit.

The expected time spent by the different doctors and nurses involved are summarized in table 3.

A standard set of blood tests are taken from all patients brought to the emergency room at Drammen Hospital, the representative patient being a certain candidate. Sometimes it can be technically difficult to draw blood from patients (explaining probability of 0.99 instead of 1.0). Blood gas will be performed on our patient (some will encounter technical difficulties) and ECG is performed on almost all patients with suspected intoxication.

Our patient would most likely be treated with Naloxone, with a combined diagnostic and therapeutic intention. Limited effect of Naloxone and/or uncertainty of the diagnosis could lead to Flumazenil being administered.

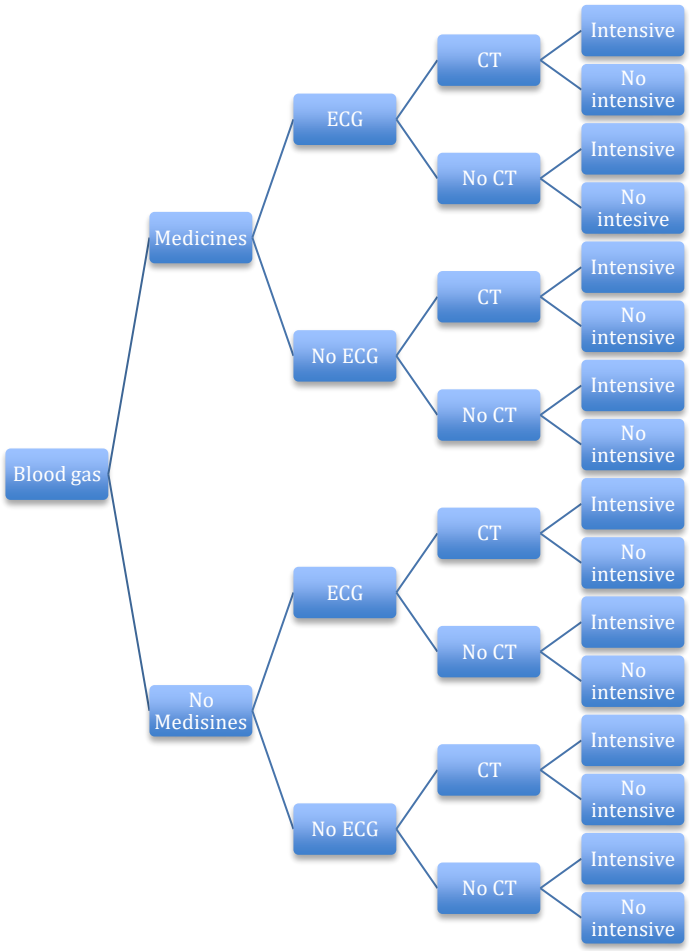
It is rendered likely that our patient is still somnolent and/or has a depressed breathing after the initial treatment. If the diagnosis (of opioid intoxication) is still not absolute certain, a CT scan of the head could be carried out.

After the initial examinations, tests and subsequent CT scan, the patient has been at the hospital for an estimated time of 90 minutes. There is a chance that he has recovered well and is able to leave the hospital after this, but most likely he is still somnolent with or without a depressed breathing and in need of further observation. In that case he will most likely be admitted to the intensive care unit.

The patient is assumed to stay in the intensive care unit for 8 hours, where he does not receive any specific treatment. He eventually wakes up and leaves the hospital without further investigations. He arrives at the hospital in the morning and is discharged 9,5 hours later.

Figure 2 displays a part of a decision tree illustrating the clinical pathway at Drammen Hospital. The complete decision tree with probabilities is displayed as attachment 2.

Figure 2 – Decision tree Drammen Hospital



Displaying half the decision tree at Drammen Hospital. The other half starts with No blood gas and is identical after that.

Expected costs in Drammen

The principles of valuing resources in the health care sector are outlined above. A nurse with a seniority of 8 years (assumed to be representative in Drammen) at the emergency unit has an average wage of 234.50 NOK/hour. Both the nurses in this analysis are assumed to have that wage.

The LIS 1 and LIS B have their wage set in the main deal between Vestre Viken Hospital Trust and The Norwegian Medical Association. LIS 1 has a yearly wage (without additions)

of 507 200 NOK and LIS B 628 500 NOK (22). In Drammen doctors work 38 hours/week, which amounts to approximately 1717 hours/year. Hourly wage is 295.30 NOK/hour and 365.92 NOK/hour for LIS 1 and LIS B respectively.

The personnel costs per hour are found by multiplying the hourly wage with 1,3 to count in payroll taxes and other social costs (17).

The personnel resources in Drammen are summarized in table 3;

Table 3 – Personnel resources at Drammen Hospital

Personnel	Personnel costs/hour (NOK)	Time spent Minutes	Sources
Nurse 1	305 (286-325)	90 (75-105)	T.B/A.D
Nurse 2	305 (286-325)	90 (75-105)	T.B/A.D
LIS 1	384 (358-410)	60 (45-75)	(22)/T.B/A.D
LIS B	476 (449-501)	60 (45-75)	(22)/T.B/A.D

NOK=Norwegian kroner.

A.D=Andrea Dobloug: Senior registrar Drammen Hospital

T.B=Tommy Båtstrand: Nurse at the emergency department at Drammen Hospital

If a patient stay at the hospital is less than 5 hours it is defined as outpatient (23). The representative patient stays for longer than that, but it is chosen to define it as outpatient anyway. The reason is that Helfo reimburses outpatient treatment differently than longer stays at the hospital, reimbursing the costs of each service being provided, instead of a fixed, general sum depending mostly on the registered diagnosis and invasive procedures. This make it easier to isolate the direct medical costs of the expected treatment.

The sums reimbursed from Helfo for the relevant blood tests, blood gas and CT are derived from the department of laboratory medicine at Drammen Hospital. The tests included in the

set of blood tests and blood gas are attached in attachment 3. Finding the reimbursed sum for ECG at a hospital did not succeed, so it was chosen to use the same sum as in the analysis at OAEOC. The prices for Naloxone and Ringer are derived from Felleskatalogen.

The cost of treating the most uncomplicated patients at an intensive care unit is a complex issue and efforts to find estimates of this in the literature has not succeeded. After discussions with chief nurse at the ICU in Drammen, it was chosen to use an estimate of 10 000 NOK per day for the representative patient. That estimate will include a broader set of costs (both direct and indirect) than the direct costs calculated at OAEOC and the emergency department in Drammen. The patient is expected to stay at the ICU for 8 hours.

The senior doctor will most likely use time treating the patient at the ICU. That time is not included in the personnel costs, but in the total cost of intensive care treatment. Likewise, the personnel costs of a bioengineer performing the blood-samples and staff conducting the CT scan (radiograph and radiologist) is included in the unit costs of the blood samples and CT scan respectively.

The tests, probabilities, prices and unit costs are summarized in the table 4 while parameters concerning the intensive care unit are summarized in table 4;

Table 4 – Test, probabilities, prices and unit costs at Drammen

Test/treatment	Probability	Price (NOK)	Unit cost (NOK)	Sources
Blood tests	0.99 (0.98-1.0)	321	643	A.D/(24)
Blood gas	0.9 (0.8-1.0)	144	288	A.D/(24)
Ringer	0.5 (0.4-0.6)	24	49	A.D/Felleskatalogen
ECG	0.65 (0.5-0.8)	213	426	A.D/(16)
CT	0.4 (0.3-0.55)	415	830	A.D/(18)/(19)
Naloxone	0.8 (0.7-0.9)	57	57	A.D/Felleskatalogen
Flumazenil	0.5 (0.4-0.6)	148	148	A.D/Felleskatalogen

NOK=Norwegian kroner.

A.D=Andrea Dobloug, Senior registrar Drammen Hospital

Table 5 – Probability, price and length of stay at Intensive care unit

	Probability	Price (NOK)	Length of stay (LOS)	Sources
Intensive care unit	0.7 (0.6-0.8)	10000 (8000-12000)	0.33 (0.25-0.42)	A.D/B.H.H

NOK=Norwegian kroner

Probability=Probability of ICU-admission for the representative patient

Price=Estimated price for 24 hours stay for the representative patient

LOS=Part of 24 hours. 0,33=8 hours, 0,25=6 hours, 0,42=10 hours.

A.D=Andrea Dobloug, Senior registrar Drammen Hospital

B.H.H=Bente Helene Heide, chief nurse, ICU Drammen

A fundamental discussion in Health Economics is how to value resources who would otherwise sit idle. At OAEOC there is a room with two beds designated to patients with acute intoxications which are not used when none such patients are present. Much the same could be said about an emergency room in Drammen, which is not in use for much of the time to be available when acutely sick patients arrive. The staff both places work with other patients and have an easily definable opportunity cost. One could argue that the opportunity cost of using the bed at the designated rooms at OAEOC and the emergency department in Drammen is

zero and there are not included any such costs in this analysis. Whether this type of cost is included in the cost at the intensive care unit is unclear.

4 Results

Calculation of expected costs:

Expected treatment costs are calculated by multiplying the unit cost with the probability of the tests/treatment being carried out. Expected personnel costs are calculated by multiplying personnel costs/hour with expected time spent. Expected costs of intensive care treatment are calculated by multiplying probability of ICU-admission with the estimates for price and length of stay.

Point estimates of expected costs

The main results from OAEOC and Drammen are presented in the first column of table 6 and 7 respectively. The point estimate of the expected costs of treating a representative patient with opioid intoxication at OAEOC is 1157 NOK, a sum split between personnel costs of 931 NOK and treatment costs of 226 NOK.

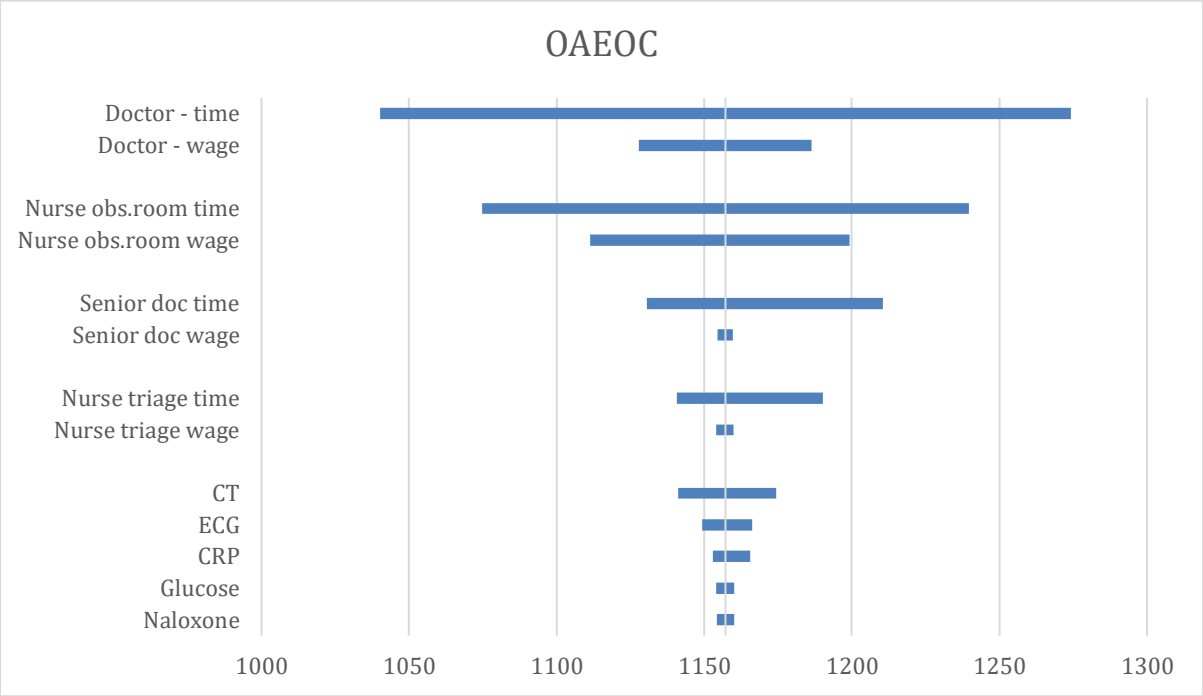
The doctor and nurse assigned to the observation room is contributing most to the expected personnel costs, while glucose and CT are most important among the expected treatment costs.

The point estimate of the expected costs of treating a representative patient with opioid-intoxication at Drammen Hospital is 5828 NOK. The personnel costs are 1774 NOK, treatment costs 1744 NOK and cost of intensive care unit of 2310 NOK.

Expected costs associated with ICU-treatment is most important. All the involved health personnel are contributing quite evenly to the expected personnel costs. Blood tests is the single procedure contributing most to the expected treatment cost, followed by ECG, CT and blood gas.

Sensitivity analysis OAEOC

Figure 3 – Sensitivity analysis OAEOC



Expected costs showing highest and lowest values of the parameter in question.

Horizontal axis: Expected cost in Norwegian kroner.

The tornado diagram in figure 3 illustrates a one-way sensitivity analysis of the different parameters at OAEOC. The uncertainties concerning resources used by the nurse and doctor in charge of the observation room are most important, with time spent being more important than the wage.

Uncertainties concerning costs of the different tests and treatments are of less importance than the personnel costs.

The second and third column in table 5 display the lowest and highest achievable value of the different parameters at OAEOC given the assumed uncertainties. The total cost in the low value-column is the expected cost when all parameters take their lowest possible values and is 819 NOK. Conversely, if all parameters take their highest possible value the total cost in this analysis is 1582 NOK.

Table 6 – Expected cost OAEOC

Costs	Expected cost (NOK)	Low value	High value
Personnel costs:			
Nurse triage	33	15	72
Nurse obs.room	494	374	626
Doctor obs.room	351	215	507
Senior doctor	53	25	112
Sum	931	629	1317
Treatment costs:			
Glucose	149	146	152
Naloxone	6	3	9
CRP	8	4	17
ECG	13	4	21
CT	50	33	66
Sum	226	190	265
Total costs	1157	819	1582

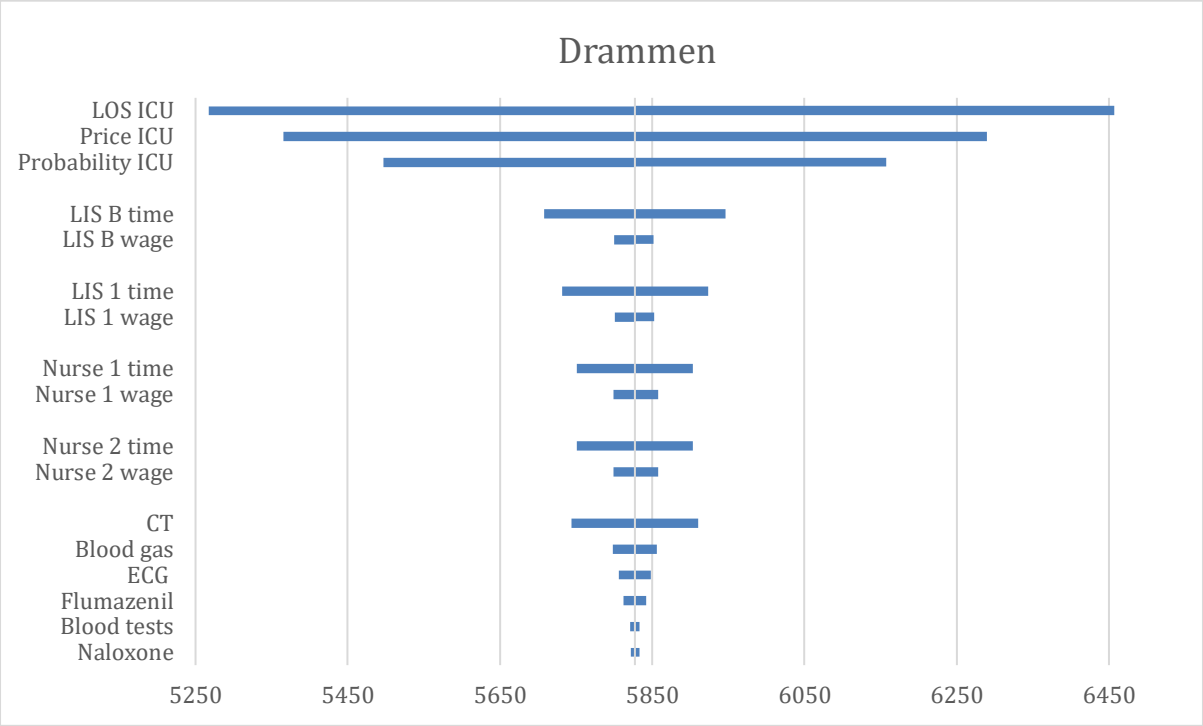
NOK=Norwegian kroner

Obs.room=Observation room

Low/high value= Lowest/highest achievable value given the assumptions

Sensitivity analysis Drammen

Figure 4 – Sensitivity analysis Drammen



Expected costs showing highest and lowest values of the parameter in question.

Horizontal axis: Expected cost in Norwegian kroner.

LOS ICU=Length of stay at intensive care unit

Price ICU=Price for 24 hour stay at intensive care unit

Probability ICU=Probability of ICU-admission

The tornado-diagram in figure 4 illustrates a one-way sensitivity analysis of the parameters at Drammen Hospital. The uncertainty concerning costs associated with the intensive care unit are the most important aspects affecting expected costs. Uncertainty concerning length of stay is most significant, followed by the price of ICU-treatment and probability of admission. Besides expected ICU-costs, personnel costs are in general more uncertain than treatment costs, especially estimates about time used by doctors and nurses. Estimates of probability of conducting CT is also of importance.

The second and third column in table 6 display the lowest and highest possible value of the parameter given assumptions about the uncertainties. The total cost in the two columns is

4101 NOK and 8214 NOK and is the expected cost when all parameters take their lowest and highest possible values respectively.

Table 7 – Expected costs Drammen

Costs	Expected cost (NOK)	Low value	High value
Personnel costs:			
Nurse 1	457	358	569
Nurse 2	457	358	569
LIS 1	384	268	512
LIS B	476	336	626
Sum	1774	1320	2276
Treatment costs:			
Blood tests	637	630	643
Blood gas	260	231	288
Ringer	12	10	15
Naloxone	46	40	51
Flumazenil	74	59	89
ECG	383	362	405
CT	332	249	415
Sum	1744	1581	1906
Intensive care unit	2310	1200	4032
Total costs	5828	4101	8214

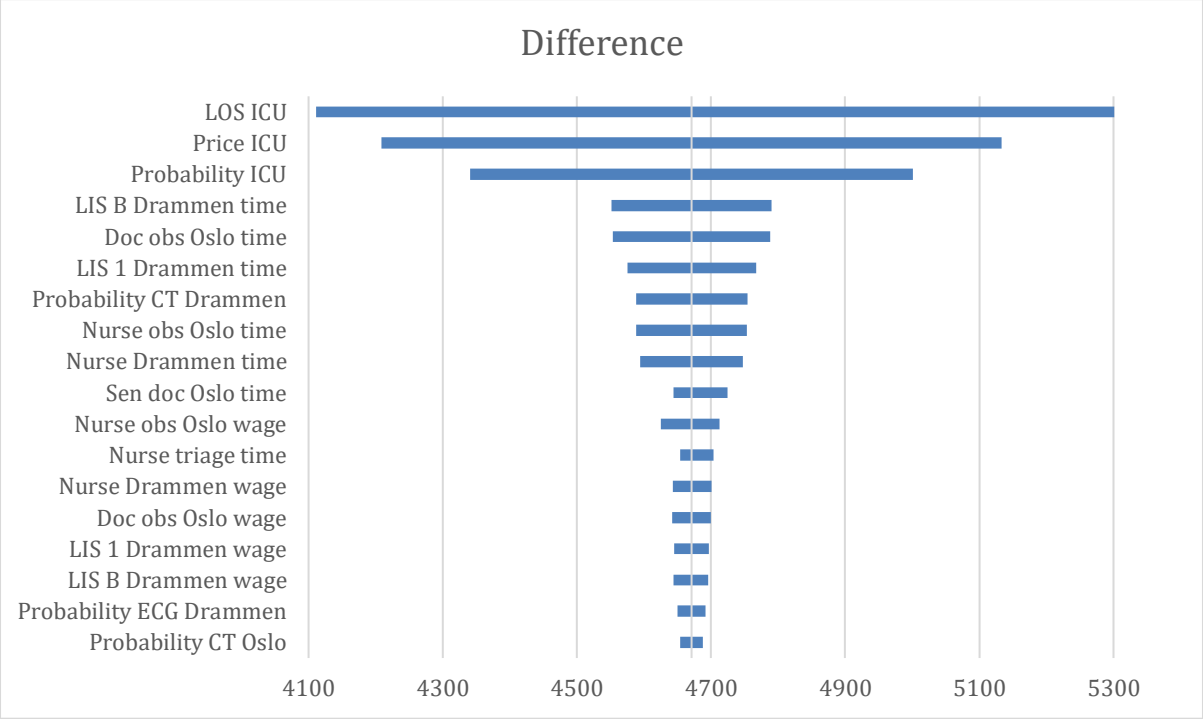
NOK=Norwegian kroner

Difference

The point estimate of the difference between Drammen Hospital and OAEOC is 4671 NOK, split on 2310 NOK on ICU-costs, 843 NOK on personnel costs and 1518 NOK on treatment costs. The highest possible difference is 7395 NOK while the lowest possible difference is 2214 NOK.

The tornado-diagram in figure 5 is a one-way sensitivity analysis of the different parameters on the difference in expected costs. Parameters with minor importance are left out.

Figure 5 – Sensitivity analysis difference



Horizontal axis displays difference in expected costs.

Nurse/doc obs Oslo = Nurse/doc in charge of observation room at OAEOC

LOS ICU=Length of stay at intensive care unit

Price ICU=Price for 24 hour stay at intensive care unit

Probability ICU=Probability of ICU-admission

The most important parameters affecting the difference are associated with the intensive care unit. Uncertainty about length of stay is most important, followed by price and probability of admission. Next is time spent by the LIS B doctor at Drammen Hospital, followed by time spent by the doctor in charge of the observation room at OAEOC. Uncertainty concerning

probability of CT in Drammen is the most significant treatment cost. In general, personnel costs are less certain than treatment costs and uncertainties concerning time spent are more important than wage.

The treatment costs included in the analysis are those deemed relevant for the expected costs. Some patients at OAEOC receive treatments as Paracetamol, Ringer, urine tests and numerous other small services. These services are either so cheap or rare that they do not affect the results in a significant way. The expected cost of Paracetamol for at OAEOC is for example 0,0408 NOK and for Ringer 0,4892 NOK. The same reasoning applies to Drammen. All thinkable costs have not been calculated, but having discussed the likely scenarios with experienced clinicians at both Drammen Hospital and OAEOC numerous times, it seems unlikely that any important costs have been excluded at any of the facilities.

5 Discussion

This study is a cost-minimization study comparing the costs of two different treatment regimens of patients with suspected opioid intoxication. The perspective is from Oslo Accident and Emergency Outpatient Clinic (OAEOC), comparing costs of treating these patients in that primary care facility to treating them at specialist care level, with Drammen Hospital being chosen as a representative institution.

The main finding in this study is that treating a representative patient with opioid intoxication at OAEOC is cost-effective, compared to treatment in a hospital setting at Drammen Hospital. The point estimate of the difference of expected costs is 4671 NOK per patient, making the expected treatment in Drammen 5 times more expensive than at OAEOC, without any obvious gains in patient health.

Personnel costs are dominating the expected costs at OAEOC, while costs associated to admission to the intensive care unit is most important in Drammen. Besides the intensive care unit, expected costs at Drammen Hospital are quite evenly divided between personnel costs and treatment costs as blood tests, blood gas, ECG and CT.

Sensitivity analyses reveal that uncertainty about time spent by the health personnel involved are most significant at OAEOC. Uncertainty about both probability of admission to the intensive care unit and the price and length of that stay are important in Drammen, as are uncertainties about time spent by the different health personnel involved. The only significant uncertainty among the treatment costs is about the probability of CT scan being performed.

The same uncertainties are reflected in the one-way sensitivity analysis of the difference in costs, which is most sensitive to assumptions regarding intensive care costs and time spent by doctors and nurses at both facilities. No uncertainties do challenge the main results, though, making the findings in the study robust.

A strength of the study is the utilization of real-world data from OAEOC with key characteristics of the entire population (of 2343 patients) in Vallersnes` study as well as unpublished data concerning subgroups of that population. The representative patient is

constructed based on these data with the aim of finding the representative patient from the group of interest (those treated at OAEOC who would be treated at hospital in Drammen), not just the average patient with opioid-intoxication treated at OAEOC.

The probabilities of the different tests and treatments being carried out at OAEOC are also based on real world data of the entire population. The validity of the data on the representative patient has been evaluated by dr. Vallersnes, nurse Monika Nordmo and the author of this study, who all are experienced clinicians at OAEOC. The resulting probabilities of tests being performed are "the clinicians best guess" and should be relatively uncontroversial. "Clinicians best guess" is the *only* source for the estimation of time spent by the doctors and nurses involved, and is therefore more uncertain. Since personnel costs are the most important contributor to total expected costs at OAEOC, this uncertainty is important. There has been put great emphasis on estimating these as balanced as possible, though, and there is consensus in the college that the estimated numbers are as close to the actual numbers we get without measuring manually.

Estimates of resources used at Drammen Hospital is entirely based on "clinicians best guess". The author of the article has worked through the scenario with dr. Andrea Dobloug numerous times and worked out an expected clinical pathway with corresponding probabilities of different procedures being performed, including time spent by involved health personnel. The resulting model was presented to a group of other doctors and nurses at the emergency department in Drammen who made their own predictions of treatment pathway and probabilities. These opinions were incorporated in the final model. Clinicians best guess can never be a perfect substitution for real world data, but the group of clinicians working with dr. Dobloug was very much in line about both expected treatment and expected time spent by the involved doctors and nurses, making it likely that the estimates in this study are reliable.

All relevant parameters are subject to sensitivity analyses and both the actual analysis and sensitivity analyses are conducted in line with methods for economic evaluations based on Drummond et al (21). One-way sensitivity analyses are chosen, as well as estimation of expected total costs in the extreme scenarios where all parameters are set to their lowest and highest values at both institutions. Since the difference was substantial (2214 NOK) also in the lowest possible estimate of the difference (lowest possible estimate Drammen – highest

possible estimate OAEOC), it did not seem necessary to conduct a probabilistic sensitivity analysis.

Valuing resources was done using the guide published by the Directorate of Health in 2012. The treatment at both OAEOC and Drammen Hospital were defined as outpatient. The reason for this is explained above and enables a more detailed analysis. The guide warns that estimates made using the method in the guidelines in general must be expected to differ from the correct estimates in specific settings. It is not done any measures to reveal to which extent the estimates in analysis are affected by this.

A key assumption in this paper is that the outcomes of the treatment-regimens are equal, effectively saying that all the extra resources used per patient in a hospital-setting do not produce any positive health effects at all. This is based on Vallersnes et al who assessed the outcomes of the patients treated at OAEOC (2) and the fact that the patients do not receive any sophisticated treatment directed at the intoxication at the hospital that is not available at OAEOC. Many of them leave the hospital shortly after they are physically able to do so without any follow-up being arranged.

This assumption is debatable. Firstly, 19% of the patients brought to OAEOC with suspected opioid intoxication were later admitted to hospital. Relevant factors most strongly related to hospital-admissions for this group include respiratory depression, suicide attempts, hallucinations and a GCS score lower than 7 (2). The median observation time at OAEOC for hospitalized patients was 1 hour 50 minutes (for the entire population of 2343 patients), and it is reasonable to think that some of these patients had profited by being brought directly to hospital without the intermediate stop at OAEOC.

Secondly, many of the patients treated for acute intoxications belong to a population-group with high risk of developing many kinds of diseases. By performing blood tests, blood gas, ECG and CT at the hospital, conditions that otherwise could have gone without being recognized for some time, can be diagnosed and possibly treated. Blood-tests could for example reveal kidney failure in need of treatment or diagnose hepatitis and anemia. Early recognition of diseases could lead to some long-term health-benefits that are not reckoned with in Vallersnes` study (2).

Further, at Drammen hospital, as is the case of most hospitals in Norway, a psychiatric ward is part of the hospital and patients at somatic departments can be easily assessed by psychiatrists and psychologists while admitted. Those discharged from OAEOC, but in need of psychiatric follow-up are referred to outpatient psychiatric treatment. Many of these patients could be suspected of having a low follow-up rate at their general practitioner or psychiatric outpatient clinics. The direct contact made at the hospital could facilitate a higher rate of successful referrals for the patients in need of that. Countering that argument are results published by Vallersnes et al in 2016, where the proportion of cases in which the patients referred from OAEOC attended the follow-up within 3 months were registered. 85% of the patients referred to specialist health services attended, indicating that offering specialist treatment to these patients were worthwhile (25).

Even though the aspects commented above complicate things somewhat, neither of them challenge the assumption of equal outcomes in a fundamental way.

The main aim in this study is to compare the direct medical costs of treating the patients. The decision was therefore made to measure the time directly used on the patients by the health personnel involved, valued by average hourly wage and social costs. Exceptions from this being the bioengineer (Drammen), radiologist, radiograph and personnel at the intensive care unit (Drammen), of which costs are included in the respective treatment costs. Adopting two ways of estimating personnel costs in the same analysis is not desirable, but the direct costs dominates the others (except intensive care unit) to such a degree that it does not significantly influence the results.

Another important element for discussion is the omission of capital costs, overhead costs and per diem costs (26). Capital costs such as buildings and land are encountered at a specific point in time and the opportunity costs are spread over time. Overhead costs are costs shared by more than one department or entity, for example ICT- and caretaker-services. Even though these types of costs belong in a complete economic evaluation, the group of patients under scrutiny here is sufficiently small for variable costs to be overwhelmingly more important. The capital- and overhead are therefore omitted for simplicity.

Omission of the per diem costs at OAEOC is somewhat more problematic. The per diem cost is described as the hotel aspect of staying in health institution, excluding the direct medical

costs of drugs and special consumable items. The hotel cost of treatment at the emergency department in Drammen should be negligible and is safely omitted. It seems safe to consider per diem costs as small at OAEOC as well, even though the patient stays for more than 4 hours and sometimes are served some food and given new clothes.

The per diem costs are included in the estimates from the intensive care unit, though. Of the three different units in question (OAEOC, emergency department in Drammen and intensive care unit in Drammen), the hotel costs are arguably most relevant at the intensive care unit, but the inclusion of one type of costs in the analysis in Drammen and not in Oslo is anyway a source of overstating the relative costs in Drammen, even though the omitted costs at OAEOC would be expected to be small.

Another methodological problem is the risk of counting costs more than once. One example is the senior doctor in Drammen who is expected to spend some time on the patient after admission to the intensive care unit, costs which are included in the estimates for the ICU. Another example is the tariffs for the different tests performed. It could be argued that these tariffs include time spent by the doctor interpreting the results. The most obvious example is tariff 707 received for ECG, where the payment is specified to include "conducting and interpreting". The time used interpreting the ECG is done by a doctor and could therefore be counted two times in the analysis. If so, costs at Drammen is overstated compared to OAEOC, because ECG is of relative larger importance there. Subtracting the time used interpreting the ECG from the time spent in general would not count to many minutes though, so any impact on the total costs would be small.

All in all, the treatment of patients with acute opioid intoxications at OAEOC does seem to be cost-effective. There is no single aspect explaining the difference in treatment regimens. As indicated above, all the different diagnostic- and treatment-possibilities at the hospital does enable a culture where these are being used. The main concern for the doctor treating a patient with depressed consciousness is to overlook other reasons for the clinical condition (as intracerebral haemorrhage, hypoglycaemia, sepsis etcetera) and many of the tests performed are largely conducted to be absolutely sure of not making that mistake.

One of the reasons the routine at OAEOC works well is the large volume of patients treated for acute intoxications each year, with ethanol- and opioid intoxications constituting almost

80%. Opioid intoxications being a frequent event, the doctors and nurses involved at OAEOC could be more comfortable in trusting their judgement of the clinical condition than staff at Drammen Hospital, where patients with opioid-poisoning are a rarer event.

Another way of looking at it is that a large majority of patients brought to the general practice service at OAEOC with depressed consciousness do suffer from acute intoxications, while patients with depressed consciousness brought to the emergency department at Drammen Hospital is a much more varied group. This heterogeneity may necessitate a broader approach to diagnostics.

Since treatment at OAEOC is cost-effective compared to treatment at specialist care level it is safe to state that money is saved by treating patients with acute intoxications at primary care level in Oslo. Estimating the amount is unfortunately not as simple as multiplying 359 patients with 4671 NOK (=1 676 889 NOK). As discussed above, one of the aspects enabling an efficient treatment of patients with intoxications is the sheer volume treated at OAEOC. If those patients had been treated at hospitals in Oslo, other routines than the one described from Drammen would likely have been developed.

This study has compared costs of treating patients with opioid intoxications. At OAEOC, patients with intoxications of all kinds of agents are treated following the same routine and it is likely that one would find similar results if comparing costs of treating ethanol- and benzodiazepine-intoxications as for opioids. Ethanol is the most frequent toxic agent in Oslo and the patients are rarely hospitalized. Respiratory depression is not a common feature among these patients and few of them would be suspected to be admitted to the intensive care unit in Drammen. Most of the other treatments described in this study would be expected to be applied to ethanol-intoxications in Drammen, though, making the results in this study relevant for this patient-group as well. Much the same could be said about benzodiazepines.

Since this study indicates that resources are spent in a more cost-effective way at OAEOC than at Drammen Hospital, it could be tempting to suggest that the latter adopted the routine used at OAEOC, at least for opioid intoxications, but possibly for other kinds of intoxications as well. Further, the treatment at Drammen Hospital described in this study is most likely representative for how these patients are treated at most hospitals nationwide, making the routine at OAEOC relevant on a more general level.

Simply adopting the routine from OAEOC at hospitals is most likely not the best option, though. Doctors working in emergency departments treat patients with a wide variety of conditions every day and work in a culture where many tests are automatically performed when patients are presented, as described from Drammen Hospital in this study. Patients with intoxications constitute a small share of the total, and it could be difficult to make doctors change their mode of conduct for only one group of patients. Reducing the utilization of the ICU could be achievable by finding ways to monitor the respiration sufficiently without admitting them to a ICU. An example could be a form of intermediate units with higher nurse-patient ratios than at the general wards, but without the other costly aspects of ICU-treatment.

Another, and perhaps better, option would be to adopt the organization in Oslo and treat the patients on a primary care level. Using the routine from Oslo is in theory possible almost anywhere since it does not require any equipment or type of personnel outside what is found in any casualty clinic around the country. A problem is that smaller clinics neither would have enough manpower nor enough relevant patients to enjoy the positive aspects of the routine. In bigger cities like Trondheim, Stavanger, Kristiansand and Drammen (Bergen already has its own routine), the population should be sufficiently large for casualty clinics to implement the routine successfully. Investments in the clinics would most likely be necessary and decisions to adopt this routine should be based on more throughout economic evaluations.

Cities of comparable size to Oslo outside Norway would be even better candidates for adopting the cost-effective routine from OAEOC. Health care systems in cities like Gothenburg, Stockholm and Copenhagen do all face patient-groups with opioid-related issues, including an inevitable amount of intoxications. They could do worse than look to Norway when organizing their treatment.

Finally, that the treatment at OAEOC is cost-effective does not necessarily mean that the money possibly saved should be used on other groups of patients. Taking care of patients with opioid addiction is much more complex than merely handling the occasional intoxications, but treating the intoxications as efficient as possible could make additional funds available for other kinds of measures as rehabilitation and psychiatric interventions.

6 Conclusion

Treating a representative patient with opioid intoxication at Oslo Accident and Emergency Outpatient Clinic is cost-effective compared to treating a patient with similar characteristics in a hospital setting. The findings in the analysis are robust and support the assumptions underpinning the Coordination reform, that some groups of patients are more efficiently treated at the level of primary care.

Elements of the routine at OAEOC could be implemented both at hospitals and casualty clinics of a certain size both in Norway and abroad, and the health resources saved could be put to better use elsewhere, for example by investing in other types of treatments for patients with opioid-related problems.

Further research is needed to establish the results found in this analysis. The collection of real-life data from Drammen Hospital (or a comparable facility), both concerning time spent by involved personnel and probabilities of test and treatments being carried out would strengthen the reliability of the results. As would manually measuring personnel resources used at OAEOC. Efforts to better compare the outcomes of the different treatment regimens, enabling a full-scale cost-effectiveness analysis, would also be a valuable contribution to the subject.

Finally, more cost-effectiveness analyses comparing treatments in primary and specialist care concerning other types of patients should be conducted as well, to further strengthen the knowledge base of our health care system.

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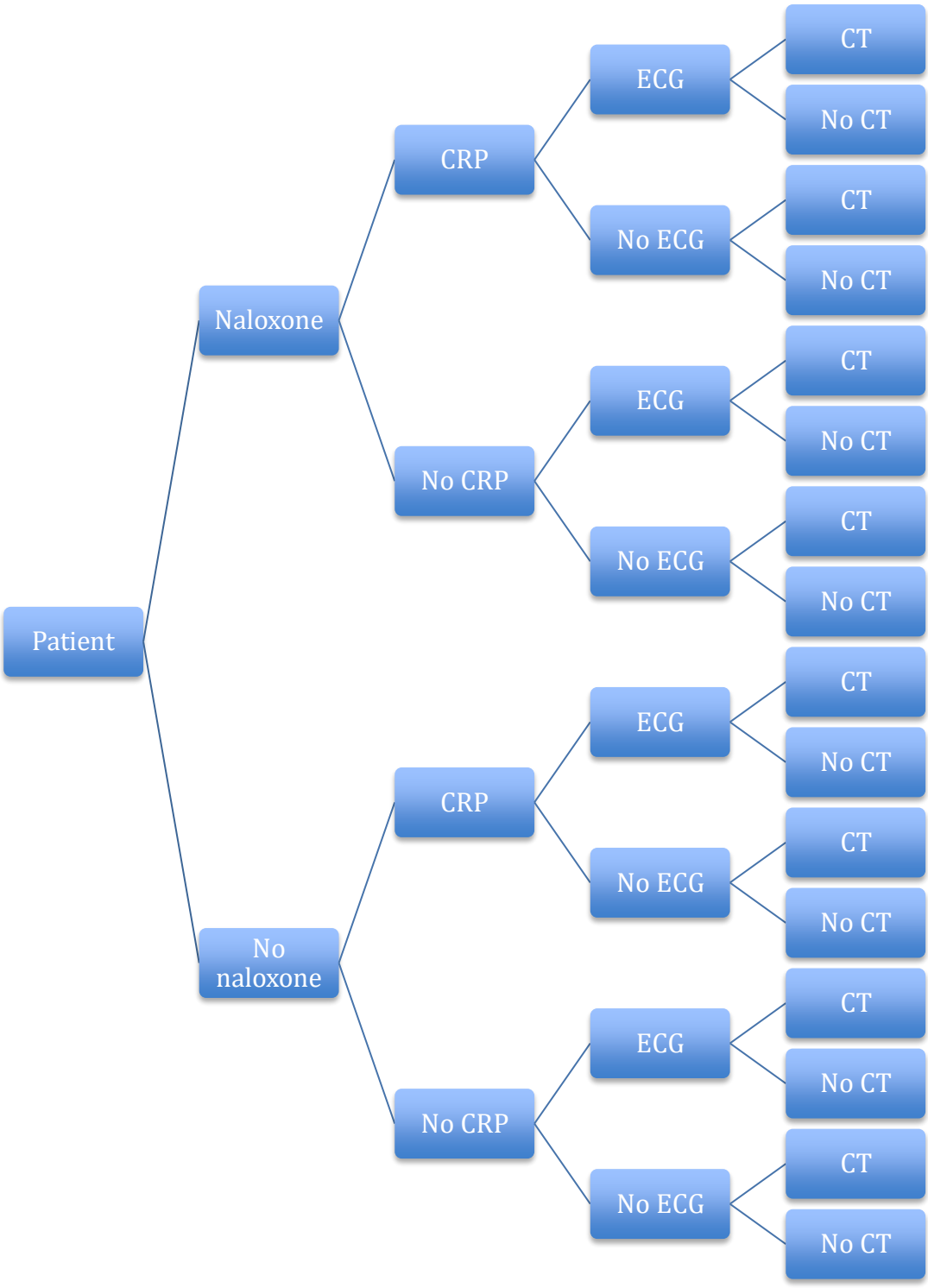
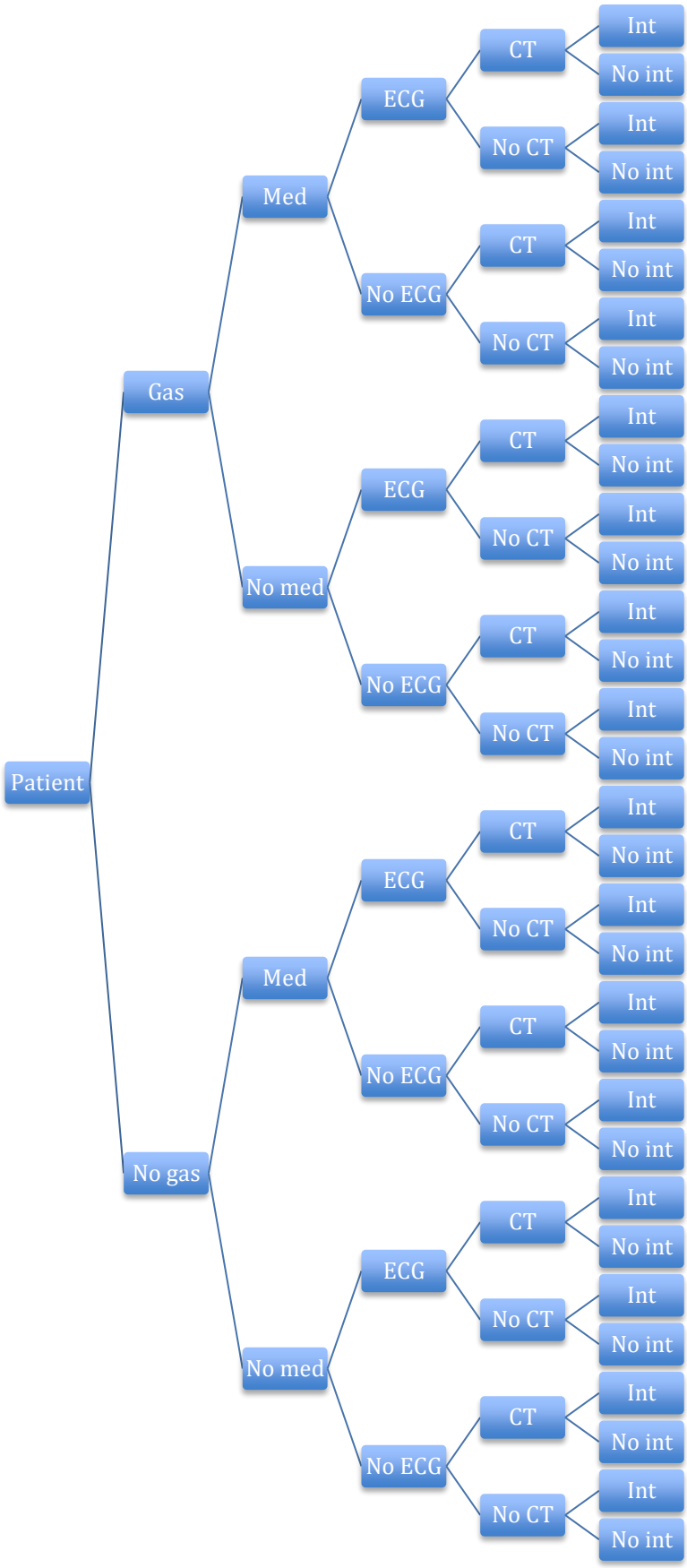
Attachments

Attachment 1: Decision-tree OAEOC



Attachment 2:



Attachment 3:

Blood tests Drammen:

B-SR

B-Hct

B-Erythrocytes

B-MCV

B-MCH

B-Leukocytes

B-Neutrophile Granulocytes

B-Lymphocytes

B-Monocytes

B-Eosinophilic Granulocytes

B-Platelets

S-Sodium

S-Potassium

S-Calsium

S-Creatinine

S-Cystatin C

S-ALAT

S-ALP

S-Bilirubin

S-Glucose

S-Albumin

Blood gas:

pH

pCO2

cBase(Ecf)c

cHCO3(P)c

pO2

Lactate

Ionized Calsium