

Resource utilisation and costs associated with intravenous patient-controlled analgesia for post-operative pain management

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ABSTRACT

Study objectives: Information regarding intravenous patient-controlled analgesia (IV PCA) resource utilisation, hospital logistics and costs is limited. This multicentre study, conducted in France, Germany and the UK, examined these aspects of IV PCA treatment between March 2004 and April 2005.

Methods: Information about IV PCA-related staff time and resource use were recorded for patients (n = 315) who had undergone elective orthopaedic or abdominal surgery. The nature and severity of IV PCA-related complications (e.g. problems with drugs or pumps) were also recorded. The unit cost of each staff member and resources used for an episode of IV PCA therapy were derived from national and local sources. The sum of staff members and resource costs associated with IV PCA treatment was calculated in order to generate a per-patient cost estimate of an IV PCA episode.

Results: An episode of IV PCA therapy lasted a mean of 1.6 days and had a mean cost of Euros 96.40. Costs were attributed to staff time (78%), pump costs (11%) and consumable costs (11%). The mean time spent on IV PCA-related tasks by all hospital staff in the recovery room was 24.2 minutes (nurses, 20.4 minutes), with 47.1 minutes spent by all staff in the ward (nurses, 39.3 minutes). The most frequently occurring IV PCA-related incidents that required staff attention were patient-related (0.8 incidents per patient) and drug-related (0.7 incidents per patient) problems. The most costly IV PCA incidents were drug-related (Euros 9.10 per incident) and pump-related (Euros 8.70 per incident).

Conclusion: Substantial staff time and costs are associated with IV PCA treatment.

KEYWORDS

Hospital costs and cost analysis, infusion pumps, intravenous drug delivery systems, medical staff, patient-controlled analgesia, time

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INTRODUCTION

Intravenous (IV) patient-controlled analgesia (PCA) is one of the main treatment options used to manage acute post-operative pain [1, 2]. In addition to its ability to provide better pain relief compared with conventional post-operative pain treatment options (intramuscular [IM], subcutaneous [SC] or IV bolus administration), IV PCA is also preferred by patients because it offers them the ability to self-administer small doses of opioids with fewer lapses in pain relief (analgesic gaps) [3-5]. Furthermore, studies have concluded that IV PCA could also be associated with fewer side effects, including a lower risk of pulmonary complications, than IM, SC, or IV bolus administration for post-operative pain relief [1, 2].

Despite these benefits, IV PCA therapy is more resource intensive than conventional routes of analgesic administration; the infusion pump apparatus must be assembled and programmed, and potential IV PCA-related problems may need to be addressed. An IV PCA apparatus typically consists of reusable equipment (infusion pump, power cable, and pole) and consumables (IV line, IV cannula and

an analgesic reservoir that is either pre-filled or filled by staff); these components must be assembled by a qualified staff member before IV PCA can start. In addition, IV PCA treatment requires various staff members (pharmacists, nurses, anaesthetists, biomedical technicians and porters) in its process of analgesic delivery, which includes PCA pump maintenance, storage, transport, set-up, patient monitoring (e.g. dosing adjustments), management of IV PCA-related problems (e.g. line infiltration/clogging, pump malfunction), staff training for set-up and administration, and patient education for IV PCA use.

However, studies of the intense resource utilisation and costs associated with IV PCA use are limited in the US [6-9], and even less information is available in Europe [10], Canada [11] and Asia [12]. Cross-comparison of published data is not feasible because of discrepancies between the methods employed to estimate IV PCA-associated costs. Available evidence is further limited because reported costs and resource utilisation with IV PCA have been underestimated (i.e. estimates have not included all resources associated with IV PCA use) [6, 11, 12]. In order to estimate the cost of an IV PCA episode accurately, multicentre studies are needed that account for costs associated with equipment, consumables, nurse and staff time, and hospital overheads. This multicentre study evaluated the resource utilisation associated with IV PCA for acute pain management following major surgery and estimated the respective mean costs per patient in France, Germany and UK.

METHODS

Study design

This multicentre, prospective, observational study was conducted at 11 centres in France ($n = 4$), Germany ($n = 4$) and the UK ($n = 3$) from March 2004 to April 2005 for patients receiving IV PCA after major surgery.

Patients

Patients were eligible for study enrolment if they met the following inclusion criteria:

1. Received IV PCA for post-operative pain management after one of the following elective operations: total knee replacement, total hip replacement, other orthopaedic surgery (hip, back, knee, and shoulder or intervertebral disk), abdominal hysterectomy or other abdominal surgery (involving a midline incision either above or below the umbilicus).
2. Were the first patient on each morning or afternoon surgical list on Mondays, Tuesdays and Wednesdays

(patients were randomly selected for the study from this patient pool).

3. Provided signed consent on the necessary forms at centres where consent was required.

Patients who were participating in a clinical trial at the time of enrolment were excluded from the study. Appropriate ethical approval was obtained at each site.

Study protocol

A bottom-up costing approach (built up from basic details) was used to calculate the mean cost of IV PCA using four data collection tools: a site-level case record form, a patient-level recovery room case record form, a patient-level ward case record form and a site-level staff exit interview.

Site-level case record form

A site-level case record form was completed by the audit coordinator at each centre and provided the following information:

1. Hospital information, including the hospital type (teaching or non-teaching, public, private or non-profit), the number of IV PCA episodes, the salaries of hospital staff involved in administering IV PCA, the costs of IV PCA-related consumables, and whether or not an acute pain service (APS) existed at the hospital.
2. PCA equipment-related information, including the types of PCA pumps used, the method of acquisition of PCA pumps (owned or leased), pump acquisition costs, pump inventory, the maintenance routines for pumps, routines for pump collection, dismantling, and cleaning, the percent utilisation (proportion of pumps being used by a patient in the hospital at a given time), and mean life span of PCA pumps.
3. Pharmacist time (if applicable), including the time required to prepare syringes, either pre-filled or filled by staff.

Patient-level recovery room case record form

The recovery room case record form was completed in the recovery room or post-anaesthesia care unit by all members of the hospital staff who were involved in the set-up of IV PCA. Information recorded on this case record form included patient demographics, the type of surgery performed, the date and time of IV PCA set-up and the resources used to complete IV PCA set-up (equipment and consumables, analgesic prescriptions, and staff time for set-up, patient monitoring and instruction). The provided list of tasks associated with IV PCA set-up included routine observation, analgesic-related tasks (e.g. stabilisation of the patient with bolus doses of analgesic), patient-related tasks (e.g. patient instruction on the use of

IV PCA), and equipment-related tasks (e.g. retrieval of the pump from storage or infusion pump programming).

Patient-level ward case record form

The ward case record form was completed following each contact with a patient on the post-operative ward by all members of the hospital staff involved in the ongoing monitoring of a patient and/or IV PCA apparatus. Information concerning all IV PCA or analgesic-related staff contacts with patients, including the duration and purpose of the contact, was recorded, along with the type of staff involved. Depending on the site, staff members included anaesthetists, surgeons, nurses, pharmacists and technicians. Reasons for patient-staff contacts included routine observation, analgesic-related problems (e.g. dosing adjustment or request for additional on-demand analgesia), patient-related problems (e.g. re-educating the patient or addressing a request for help pushing the dosing button), IV line-related problems (e.g. line infiltrated, clogged, kinked or disconnected), or PCA equipment-related problems (e.g. pump malfunction or new battery required). Each patient was asked to provide a pain intensity score for the worst pain they had experienced during the first 24 hours following his or her transfer from the recovery room. This pain score was recorded using the standard pain measurement scale used during routine observations at each centre. Only one pain intensity score was collected in order to minimise the burden of the study on staff and patients. Pain scores were translated into a score of mild, moderate or severe as previously described in the literature [13].

Exit interview

After the completion of the study, exit interviews were conducted with at least one staff member per site at nine of the 11 centres to gather information on tasks not included on the original case record form. The interviews were not conducted at two of the centres in the UK because of low throughput of study subjects. Data obtained from the exit interview included the following:

1. The typical frequency of routine observations during a 24-hour course of IV PCA therapy and possible explanations for any discrepancies between the number of patient-staff contacts recorded in the study and the number of contacts typically required during an episode of IV PCA.
2. IV PCA-related tasks that would not be required for a post-operative patient receiving pain management through a route other than IV PCA (e.g. discontinuation of IV PCA), the type of staff who performed these tasks, and the estimated staff time required to perform these tasks for a typical patient.

3. The estimated time spent on direct staff-patient contact (e.g. assisting with patient movement) versus indirect staff-patient contact (e.g. preparing medicines and devices, recording patient activities), and non-contact, non-clinical (e.g. rest breaks, staff time per shift).

Cost estimates

Cost estimates for an episode of IV PCA incorporated staff costs, consumable costs and equipment costs. Costs per minute of staff time were estimated using salaries reported on site-level case record forms and the assumption that staff worked 20 eight-hour days per month; estimates of staff unit costs included the following: hospital overheads, staff training and certification costs, and costs associated with time spent performing non-patient-contact tasks (e.g. administrative work) versus patient-contact tasks (e.g. tasks recorded on patient case record forms). Costs of consumables were determined using per-syringe costs of analgesia provided by hospital pharmacies, country-specific mean unit syringe costs and per-syringe add-on costs. Equipment costs included the daily cost of a PCA pump based on the cost of the equipment alone (i.e. purchase price), its estimated utilisation rate and anticipated lifetime (a mean of 10 years was assumed), daily per-pump add-on costs and the daily cost of IV giving sets. For total costs, a unit cost was estimated for each type of resource that was recorded on the patient case record forms, including daily cost of PCA pumps, analgesic cost per syringe and staff costs per minute.

National estimates of staff unit costs were available for France and were based on the total staff costs in public hospitals, including costs of staff education and on-costs (costs that an employer must pay in addition to salary for an employee) [14]. An additional 25% charge, based on previous estimates from national data, was applied to these national estimates to account for hospital and ward overhead costs [15]. The percentage of time spent by nurses in France on non-patient-contact activities was estimated during exit interviews. Because no data were available to determine the proportion of doctor time spent on non-patient-contact activities in France, the mean of German (33%) and UK (31%) estimates was used to calculate the unit cost per minute of patient contact time for a doctor.

National estimates of staff unit costs were also available for the UK and were used to determine staff on-costs, qualifications costs, and hospital and ward overhead costs [16]. National estimates were also used to determine staffing unit costs in the UK [17-19].

Because national costs were not available for staff unit costs for Germany, the mean of local estimates at each centre was used. To account for employer on-costs, 22% (based on hospital tariff data) was added to the estimated staff costs for German centres. Based on a German Hospital Society (2001) estimate of hospital costs that are related to non-staffing costs, a 33% overhead charge was applied to salary costs to account for ward and hospital overhead costs [20]. An estimate that suggested doctors and nurses spend 33% and 47% of their time, respectively, on non-patient-contact activities was used to calculate staff unit costs [21].

Statistical analyses

The amount of each resource used per patient was multiplied by the respective unit cost to obtain the total cost of each resource per patient. For each patient, total costs of resources were added together to obtain the total cost of an episode of IV PCA (per-patient cost). For each patient, the per-patient cost was divided by the number of days the patient received IV PCA therapy, in order to obtain the mean daily cost of IV PCA (per-day cost per patient). The mean and distribution of total per-patient costs and the per-day costs per patient were analysed. Variability in mean per-patient costs and resource utilisation was analysed by geographic region. The potential association of patient-related factors, such as age, gender and surgical procedure, with the cost of an episode of IV PCA was evaluated using regression analysis where the centre was included as either a fixed effect or random effect in the models.

RESULTS

The majority of participating sites were teaching and/or public hospitals (see Table 1). An APS was in place at 82% of the hospitals; only 18% of the hospitals had an APS that managed all routine post-operative cases. Pain management protocols were in place at 82% of the sites; however, only 36% of sites had a protocol that covered pain management using IV PCA. All of the sites purchased their PCA pumps, with the exception of one German site, which used both purchased and leased PCA pumps. The sites had an average inventory of 37 pumps with a mean utilisation rate of 85% (range, 34–100%); between-country differences were not evident.

Patients (n = 315) were enrolled following total knee replacement (n = 58), total hip replacement (n = 105), other orthopaedic (n = 13), abdominal hysterectomy (n = 58) or other abdominal (n = 81) surgical procedures. The average duration of IV PCA was 1.6 days per patient (mean site range, 0.8–3.0 days). Severe pain was reported by 11% of patients, 49% reported moderate pain and 33% reported mild pain in the first 24 hours following transfer from the recovery department; 7% of patients had no recorded pain score during this period. Considerable variation in reported pain scores was observed between centres; for example, at seven of the 11 centres, no more than 7% of patients reported severe pain, whereas 23–29% of patients reported severe pain at the remaining four centres. Morphine was administered via IV PCA for post-operative pain management at 100% of the sites in France and the UK; in Germany, piritramide, which has a relative potency to morphine of 0.75 [22], was administered at 98.6% of the sites, and morphine (1.4%) was administered at the remainder.

Resources used in the recovery room

All patients (100%) in the recovery room had contact with at least one staff member (nurse, anaesthetist, surgeon, pharmacist or technician); however, patients could have had multiple contacts with different staff members. The mean number of contacts with a staff member was 6.3 (mean site range, 2.0–9.2 contacts) per patient and the mean duration of staff time spent with each patient was 24.2 minutes (mean site range, 12.2–39.1 minutes;

Table 1: Site characteristics

Characteristic	Country			
	France (n = 4)	Germany (n = 4)	United Kingdom (n = 3)	Total (n = 11)
Teaching status (%)				
Teaching	50	100	67	73
Non-teaching	50	0	33	27
Ownership (%)				
Public	50	75	100	73
Private	50	0	0	18
Non-profit	0	25	0	9
Acute pain service provision (%)	50	100	100	82
All post-operative cases managed by the acute pain service (%)	25	0	33	18
Pain management protocol in place (%)	75	75	100	82
Pain management protocol in place that covered IV PCA (%)	50	25	33	36

see Table 2). The mean number of nurse contacts per patient was 5.2 (mean site range, 2.0–8.8 contacts) and the mean duration of nurse time spent with each patient was 20.4 minutes (mean site range, 10.5–34.5 minutes). The mean cost per patient for reported staff time in the recovery room was Euros 26.50 (mean site range, Euros 14.0–Euros 39.0); the mean cost per patient for reported nursing time in the recovery room was Euros 22.30 (mean site range, Euros 11.20–Euros 37.0). Activities that required the most time by the hospital staff in the recovery room were ‘PCA equipment-related’, which required a mean of 11.0 minutes and mean cost of Euros 11.20.

Resources used on the ward

More contacts were reported per patient on the ward than in the recovery room. All patients (100%) required at least one staff contact on the ward, with a mean frequency of 15.5 contacts (mean site range, 8.4–28.4 contacts) per patient for an average duration of 47.1 minutes (mean site range, 26.9–78.5 minutes) per patient (see Table 2); the mean cost associated with this time was Euros 56.60 (mean site range, Euros 27.20–Euros 134.20). Patient contacts with nurses occurred with a mean frequency of 13.8 (mean site range, 6.5–27.6 contacts) per patient for an average duration of 39.3 minutes (mean site range, 26.9–74.3 minutes) per patient (see Table 2); these contacts were associated with a mean cost of Euros 43.40 (mean site range, Euros 27.20–Euros 89.60) per patient.

The majority of patients on the ward (96%) had at least one routine observation with a staff member of any category; these patients had a mean of 9.3 reported contacts with a staff member for routine observations for a mean of 20.8 minutes. Other task categories that required a considerable amount of staff time were ‘analgesia-related problems’ (mean time for patients who had at least one staff contact, 12.5 minutes)

and ‘pump-related problems’ (mean time for patients who had at least one staff contact, 10.4 minutes).

The total mean staff time spent in the recovery room and on the ward was 71.3 minutes (mean site range, 31.4–97.8 minutes). The total mean staff costs spent on recovery and on the ward at each site ranged from Euros 39.0–Euros 154.40.

Table 2: Nursing and staff time required for IV PCA-related activities

Activity	Nurses		Staff*	
	Patients with ≥1 contact (%)	Mean time required for patient contact (minutes)	Patients with ≥1 contact (%)	Mean time required for patient contact (minutes)
Recovery (n = 315)				
Routine observation	61	2.1	63	2.2
Assisting with movement	13	0.3	13	0.3
Analgesic related	44	3.6	49	3.7
Patient related	46	1.6	64	2.4
PCA equipment related	90	8.9	92	11.0
Switching on PCA machine	67	2.8	89	3.3
Discontinuation of IV PCA	14	1.1	14	1.1
Uncoded	2	0.0	4	0.0
Total recovery	98	20.4	100	24.2
Ward (n = 270)				
Routine observation	89	14.2	96	19.9
Assisting with movement	92	5.1	92	5.1
Analgesic related	29	3.4	33	4.1
Additional ‘when required’ analgesia	34	3.3	37	3.5
Patient related	37	3.2	43	3.6
IV line related	28	1.7	29	2.0
Pump related	4	0.4	6	0.7
Discontinuation of IV PCA	100	8.0	100	8.0
Uncoded	2	0.2	7	0.2
Total ward	100	39.3	100	47.1
*Depending on the site, staff members included nurses, anaesthetists, surgeons, pharmacists and technicians.				

Costs associated with an IV PCA episode

The mean and standard deviation (SD) total estimated costs (including staff, consumable and pump costs) for IV PCA treatment per patient for each country, including both recovery room and ward costs, were Euros 86.40 (39.8), Euros 109.40 (68.5), and Euros 85.60 (30.2) in France, Germany and the UK, respectively. The mean overall cost of an episode of IV PCA therapy at all sites was Euros 96.40 (54.2) (mean site range, Euros 57.60–Euros 169.40; see Figure 1). Mean staff labour costs accounted for the majority of total IV PCA-related costs at all centres (78%; range, 53–91%) in France (65%), Germany (85%) and the UK (79%). Mean total per-patient pump costs (Euros 10.50; 11% of total cost) and consumable costs (Euros 11.0; 11% of total cost) were similar. The first 24 hours of IV PCA therapy were the most costly (mean, Euros 66.40) compared with Euros 31.40 and Euros 29.70 for the second and third 24-hour periods, respectively. The mean per-patient cost per day of an episode of IV PCA was Euros 76.90 (mean site range, Euros 49.0–Euros 99.0). Including all factors, the highest mean estimated cost (Euros 122.0) of an episode of IV PCA therapy was reported for the category of ‘other abdominal’ surgical procedures (see Figure 2).

Considerable variations in costs were observed among centres. For example, a three-fold difference in the mean cost associated with an episode of IV PCA was observed between the centre with the lowest cost (Euros 57.60 per episode) and the centre with the highest cost (Euros 169.40 per episode); these differences were driven largely by differences in mean staff costs (Euros 39.0 and Euros 154.20, respectively). Regression analysis confirmed the

significant association between the centre and the cost of an episode of IV PCA ($p < 0.01$). However, there were no statistically significant associations between patient-related factors, such as age, gender and surgical procedure, and the cost of episode of IV PCA (data not shown).

Other resource utilisation

Considerable staff time (mean, 12.2 minutes per day [mean site range, 2.1–35.0 minutes]) and maintenance and staff costs (Euros 10.50 per episode) were required to manage logistics associated with the use of IV PCA, including cleaning, dismantling, moving pumps to and from storage and tracking equipment movement.

IV PCA-related incidents

Overall, the most frequently occurring IV PCA-related incidents that required staff time were analgesic-related problems (mean frequency, 0.7 incidents per patient) and patient-related problems (mean frequency, 0.8 incidents per patient). Based on the costs of staff and consumables, the mean costs associated with each analgesic-related or patient-related problem were Euros 9.10 and Euros 5.30, respectively. IV line-related and pump-related problems (mean frequency, 0.4 and 0.1 per patient, respectively) had mean costs of Euros 6.20 and Euros 8.70 per incident, respectively. The mean frequency of incidents that led to discontinuation of IV PCA therapy (e.g. nausea or problem with IV line) was 0.1 per patient.

Exit interviews

During exit interviews that were conducted at eight centres, nurses reported that they performed a mean of 11.0

routine observations per patient in the first 24 hours, while a mean of 5.7 routine observations were recorded on the patient case record forms during the first 24 hours at these same eight centres. All but one interviewee indicated that discrepancies could have been a result of underreporting (the remaining interviewee was unable to comment). Interviewees indicated

Figure 1: Mean per-patient cost of an IV PCA episode

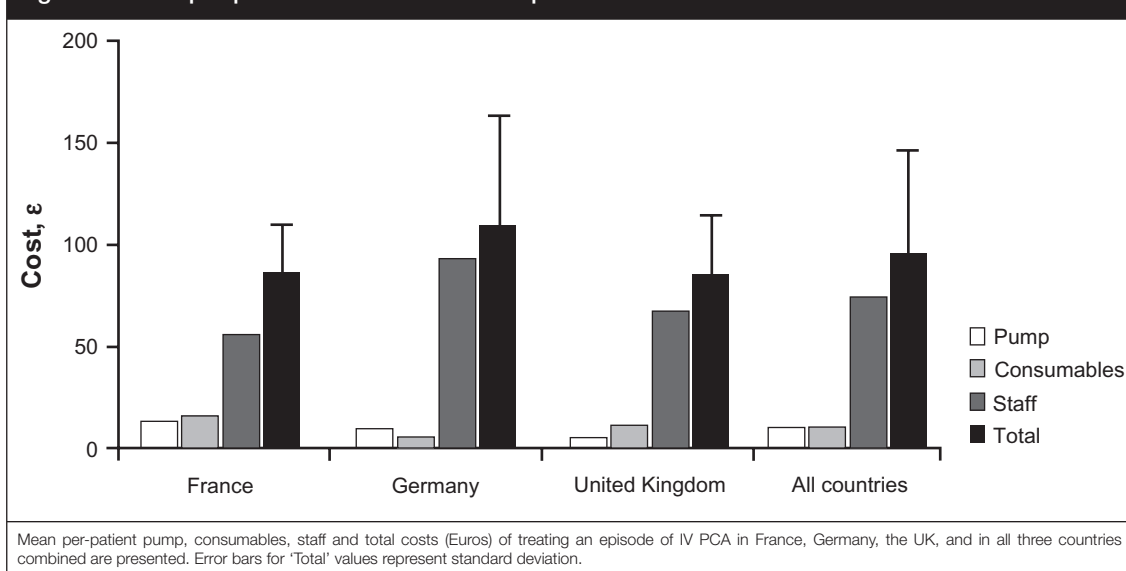
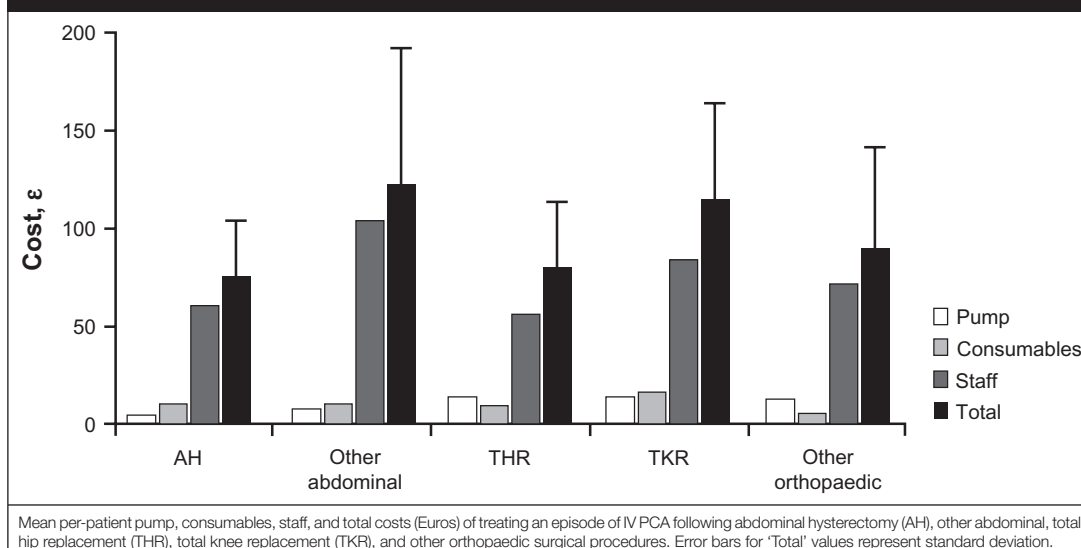


Figure 2: Mean per-patient cost of an IV PCA episode by surgical procedure



that nurses were responsible for tasks associated with the discontinuation of IV PCA, which required a mean of 8.0 minutes (range, 3.0–14.0 minutes) of their time. Nurses reported that 58%, 47% and 44% of their time was spent performing tasks that did not require patient contact, in France, Germany and the UK, respectively.

DISCUSSION

The administration and use of IV PCA is a complex process that is associated with substantial resource implications, including staff time and costs. Results of this study suggest that the use of IV PCA is labour-intensive and requires staff attention for a number of IV PCA-related tasks, in particular those performed to address analgesic-related and patient-related problems. Staff time was the largest contributor to costs associated with each episode of patient care using IV PCA. In addition to the cost implications, the significant time requirements of IV PCA could potentially impact the performance of other critical patient-care tasks, because excessive nurse workloads have been cited as a potential reason for reductions in the quality of patient care in North America and Europe [23]. Furthermore, the majority of patients in this study reported either moderate or severe pain during the first 24 hours of IV PCA therapy, which supports findings from previous studies that suggest acute post-operative pain management is not adequate for all patients [13, 24, 25].

The mean number of staff contacts per patient varied from centre to centre in this study, which could have been influenced by centre-specific policies and protocols, because

the presence of an APS or pain management protocol that covered IV PCA procedures also varied. Hospitals with an APS could be more likely to have protocols in place for the documentation of specific pain management-related tasks [26], which could lead to more accurate reporting.

The greatest strength of this study is its inclusion of multiple hospital centres from different European countries and its comprehensive anal-

ysis of direct and indirect costs associated with IV PCA treatment (equipment, consumables, nursing and staff time, and hospital overheads) to estimate the overall cost of an episode of IV PCA for the treatment of acute post-operative pain. Previous studies of the costs of IV PCA have varied in their inclusion of specific factors that contribute to the costs incurred during an episode of therapy. It has been suggested that a comprehensive cost analysis of IV PCA should include the direct costs of the infusion pump, the cost of analgesic and consumables, storage, transportation and maintenance costs of the pump, as well as nursing and pharmacy time required for IV PCA therapy [27]. This study incorporated all of these factors, as well as hospital overhead costs and on-costs, to provide a more complete evaluation of the real cost of IV PCA therapy. Therefore, it is not surprising that the total estimated cost per episode of therapy (Euros 96.40) is higher than most previously reported estimates [8, 9, 11].

Perhaps the most comprehensive IV PCA costing study conducted to date was a 1994 US study; an estimated mean cost of US\$30.15 (Euros 20.72) per day of therapy was reported [9]. Overhead costs were not accounted for and labour was recorded by an observer and may not have reflected the actual amount of hospital staff time used to administer IV PCA. Another US study conducted in 1995 suggested that the nursing time and materials associated with an episode of IV PCA cost US\$58.58 (Euros 40.26). However, this study did not adjust for overhead costs [8]. A Canadian study showed that costs in 2004 were estimated to range from Canadian dollars \$60.19–\$78.72 (Euros 39.05–Euros 51.08), depending

on the assumed staff salary (\$18, \$25 or \$32 per hour) (Euros 11.68, Euros 16.22 or Euros 20.76) for 48 hours of IV PCA administration [11]. However, overhead costs and costs associated with PCA pump maintenance were ignored.

The estimate reported in the current study is most similar to that of a 2004 Hong Kong study in which staff time, pump costs and consumables were estimated to cost HK\$939.44 (Euros 83.29) for an episode of IV PCA therapy [12]. The estimate from a 2005 Swedish study was substantially higher than that reported in the current study (Euros 627.0 versus Euros 96.40, respectively) because a local tariff for post-operative care was incorporated into that cost analysis [10]. That estimate also included three days of IV PCA therapy, whereas patients in the current study received IV PCA for an average of 1.6 days [10]. It is important to note that the mean overall cost calculated per episode of patient care could still be underestimated because exit interviews with nurses indicated that the incidence of IV PCA-related tasks could have been higher than those reported on the patient-level case record forms. Data obtained during exit interviews suggest that previously reported estimates of nursing labour required for IV PCA administration and associated costs could also be underestimated.

One limitation of this study was that it did not include other modalities of post-operative pain relief in its cost analysis. Results of a meta analysis [28] of 55 randomised clinical trials that included 2,023 patients who received IV PCA and 1,838 patients who received conventional treatment found that IV PCA provided superior pain relief and patient satisfaction compared with conventional parenteral 'when required' analgesia. In addition, a systematic review by Dolin and colleagues [13] found that fewer patients reported severe pain with PCA (mean, 10.4%; 95% confidence interval, 8.0–12.8%) compared with IM analgesia (mean, 29.1%; 95% confidence interval, 18.8–39.4%).

It is anticipated that IV PCA reduces demands on staff time compared with conventional staff-administered analgesia because patients can provide dosing when needed and adjust their doses within pre-defined ranges rather than summon staff to administer medication; however, much more limited data are available to evaluate the time required for IV PCA administration compared with that available to evaluate clinical endpoints. A Canadian study [11] that compared nursing time required to administer PCA versus scheduled IM analgesia administration in the 48 hours following surgery found that less time was required for PCA administration (79.4 minutes

versus 110.4 minutes, respectively). Although nursing time required for PCA administration in that study [11] was higher than that reported for IV PCA for nurses in recovery (20.4 minutes) and on the ward (39.3 minutes) in the current study, the duration of that study was also slightly longer (48 hours versus 1.6 days).

A meta analysis [29] of studies that compared epidural with parenteral opioids found that patients receiving epidural analgesia reported lower pain intensity compared with patients receiving parenteral opioids. It is anticipated that staff time required for administration of epidural analgesia can be affected by the need for complex procedures, such as catheter placement; however, data regarding staff time requirements are limited. Results of a 2004 German cost analysis of epidural PCA [30] suggest that an episode of epidural PCA is several times more expensive than results of the current study indicate for an episode of IV PCA (Euros 447.00 versus Euros 96.40, respectively); however, comparing the results of these two studies is difficult because of methodological differences.

Another area for further research would be to incorporate additional countries into analyses of resource utilisation. Given the significant differences in costs and hospital policies between European nations, the inclusion of more countries may provide better insight into the costs of IV PCA for patients in Europe.

CONCLUSION

This study provides detailed information about the staff time and costs associated with administration of IV PCA, which is currently considered a standard post-operative acute pain management technique. Labour costs account for the majority of IV PCA costs. The incidence of various staff interventions (e.g. to provide rescue analgesia or to address line problems), along with patient-reported pain scores in some centres, supports ongoing efforts to measure and improve the quality of care provided with IV PCA or to develop new pain management modalities.

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