Clinical benefits, referral practice and cost implications of an in-hospital pain service: results of a service evaluation in a London teaching hospital

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Abstract

Background: In-hospital pain services (IPS) are commonplace, but evidence of efficacy is inadequate, and patients' pain management in any hospital ward remains problematic. This service evaluation aimed to measure the effect of a contemporary IPS, its appropriate use and cost-efficacy.

Methods: Records of 249 adults reviewed by the IPS in an inner London Teaching Hospital over an 8-month period were analysed for demographic data, interventions, workload and change in pain intensity measured by numerical rating scale (NRS). Non-parametric tests were used to evaluate differences between initial and final NRS. Spearman's rank correlation analysis was used to create a correlation matrix to evaluate associations between all identified independent variables with the change in NRS. All strongly correlated variables ($p > 0.5$) were subsequently included in a binary logistic regression analysis to identify predictors of pain resolution greater than 50% NRS and improvement rather than deterioration or no change in NRS. Finally, referral practice and cost of inappropriate referrals were estimated. Referrals were thought to be inappropriate when pain was not optimised by the referring team; they were identified using a set algorithm.

Results: Initial median NRS and final median NRS were significantly different when a Wilcoxon signed-rank test was applied to the whole cohort; $Z = -5.5$ ($p = 0.000$). Subgroup analysis demonstrated no significant difference in the 'mild' pain group; $z = -1.1$ ($p = 0.253$). Regression analysis showed that for every unit increase in initial NRS, there was a 62% chance of general and a 33% chance of >50% improvement in final NRS. An estimated annual cost-saving potential of £1546 to £4558 was found in inappropriate referrals and patients experiencing no benefit from the service.

Discussion: Results suggest that patients with moderate to severe pain benefit most from IPS input. Also pain management resources are often distributed inefficiently. Future research is required to develop algorithms for easy identification of potential treatment responders.

Keywords

Pain service, cost-effectiveness, organisation, inpatient pain

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Introduction

Pain management is a top priority for patients and has been associated with minimising post-operative complications therefore forming an essential part of post-operative recovery.^{1–3} In 1990, a joint report from the Royal College of Surgeons of England and the Royal College of Anaesthetists highlighted post-operative pain management as 'inadequate', thus recommending the implementation of acute pain services in all major hospitals.⁴ In 2000, The Clinical Advisory Group defined the necessary organisational structures stating, 'Acute pain teams typically comprise of an anaesthetist and one more specialist nurse'.⁵ Although by 2004 the majority of hospitals in the United Kingdom offered an acute pain service, clinical demands are still growing.⁶ Whereas traditionally teams were only involved in the treatment of post-operative patients, services now are increasingly treating medical patients with challenging painful conditions as well.⁷ As a result, acute pain teams are transforming into multidisciplinary in-hospital pain management services offering reviews, management recommendations, and support for both medical and surgical patients with acute, acute-on-chronic and chronic pain conditions.⁸

Despite this growth, poorly managed pain remains a considerable concern in hospitals. In 2010, a UK national report described persistent failure in managing pain in the elderly post-operative population.⁹ Recent audit work indicates 25% to 33% of patients on medical and surgical wards are experiencing moderate to severe pain, a result that is in line with recent international reports.^{10–12}

Unsurprisingly, in this climate of change so far there is no clear consensus regarding clinical efficacy and cost-effectiveness of in-hospital pain services (IPS). However, isolated studies have demonstrated benefits in decreasing pulmonary complications, hospital morbidity and a favourable cost-benefit ratio.^{13–15} Nevertheless, systematic reviews of the topic have failed to unequivocally demonstrate positive outcomes.^{16,17} These results were attributed to a paucity of controlled clinical trials (which are ethically challenging to conduct), small study numbers, varied study populations, diverse interventions and differences in outcome measures. Furthermore, although pain teams often have ongoing input into patient care throughout their hospital admission, previous audits and research have mostly studied the impact of the service after a single time-restricted intervention.^{15,18}

The range of service provision reported in the literature is likely an accurate reflection of the current services provided both internationally and in the United Kingdom.^{19,20} Some authors even advocate mergers with critical care outreach teams, which highlights the

lack of an optimal structural model for IPS, despite the Royal College of Anaesthetists' recommendations in the United Kingdom.^{21,22}

To be able to develop an organisational template for pain services in the future, more data are needed to describe the clinical effects of the services, the characteristics which determine positive patient outcomes and the factors which contribute to maximised cost-benefit. The aim of the present service evaluation was hence first to ascertain the longitudinal clinical efficacy of a contemporary UK IPS and second to assess whether this service is being utilised appropriately and cost-effectively.

Methods

Data collection

This single centre retrospective service evaluation was registered and approved with the Clinical Governance Department at Chelsea and Westminster Hospital National Health Service (NHS) Foundation Trust, London, United Kingdom (registration number CAPP 1077). The results are reported in accordance with the strengthening of the reporting of observational studies in epidemiology statement.²³

Chelsea and Westminster Hospital operates a nurse-led, anaesthetist supervised IPS. The service receives referrals for both medical and surgical patients with acute and acute-on-chronic pain management difficulties. It offers ongoing reviews, pain management recommendations and psychological support for both patients and staff.⁸ The service also provides specialist knowledge and input for patients requiring Patient Controlled Analgesia (PCA) and routinely reviews all patients with epidural infusions on the ward. The IPS operates Monday to Friday office hours. Out-of-hours queries are directed to the Anaesthetic Core Trainee on-call.

A new method of documenting inpatient pain management was introduced to the IPS in April 2013. Based on this, all records of adult (≥ 18 years of age) inpatients reviewed by the IPS during an observation period from 1 April to 30 November 2013 were included and analysed. Not included here were records from paediatric patients which amount to about a third of the IPS' workload. Also, other activities of the service, for instance, involvement in chronic pain clinics, administrative tasks and formal teaching activities, were not accounted for here as this would have exceeded the purpose of this study.

Information retrieved from records

In addition to patient demographics, information about pain intensity, analgesia prior to IPS review, the

service's workload and interventions performed by the service was extracted.

Pain intensity was routinely assessed at rest and on movement by employing an 11-point numerical rating scale (NRS) ranging from 0 (*no pain*) to 10 (*worst pain imaginable*).²⁴ Where NRS-based assessments were not possible, a verbal descriptive rating scale (VRS) was used to indicate the presence of mild, moderate or severe pain. VRS ratings were translated into NRS scores as described elsewhere.²⁵ The highest numeric value for each verbal descriptor group was subsequently recorded so that mild pain always received an NRS-value of 3, moderate pain a value of 7 and severe pain a value of 10. These same parameters for mild, moderate and severe pain were utilised in subgroup analyses.

To assess the workload of the IPS, the number of times each patient was reviewed and the total time spent reviewing each patient were documented. The interventions performed by the service were extrapolated and categorised into five groups: introduction of drugs, discontinuation of drugs, dosage changes, changes to the dose frequency and changes to PCA (including the initiation of PCA, changing the PCA protocol or drug and discontinuation of a PCA pump).

Referral practice

The IPS routinely reviews all patients on epidural infusions post-operatively. In addition, medical and surgical teams can refer patients whose pain they have not managed to control adequately. Patients on PCA are not reviewed routinely; however, changes to pump protocol can only be approved by the IPS or an anaesthetic doctor. Referrals should ideally be made to address challenging pain problems. However, subjective perception of the IPS team members suggested an increasing number of inappropriate referrals. We defined 'inappropriate referrals' as referrals that were premature and hence could have been prevented by the referring team through for instance simple adherence to the World Health Organization (WHO) analgesic ladder. These are problematic as they divert valuable resources away from patients in need and are likely to be cost inefficient. They should therefore be avoided or minimised. The rate of 'inappropriate' referrals was estimated by analysing the care provided to all patients who only required a single visit by the IPS. Patients with epidural infusions were excluded. Patients who were prescribed suboptimal multimodal analgesia contrary to WHO recommendations or required simple or no changes to their analgesia were considered inappropriate, indicating their attending medical team did not optimise their analgesia before referral for expert management.²⁶ The financial implications were estimated according to the time spent by IPS and the estimated

hourly cost for a London Trust to employ specialist pain nurses and an Anaesthetic Consultant. Referrals for patients on PCA were only considered inappropriate if no changes were required at all – this was to account for the greater complexity of caring for patients on PCA. Additionally, the cost of seeing patients who experienced no benefit in pain, excluding patients with epidural infusions, was calculated.

Data analysis

Data were entered into an excel worksheet (Microsoft Corporation, Reading, UK) by four investigators (M.S., E.G., I.F. and J.B.), then coded by a single investigator (M.S.) into SPSS version 20.0 (IBM, Portsmouth, UK) database. Patient demographics were analysed using descriptive statistics only.

For analysis of pain intensity data, only NRS scores at rest were utilised. Given that NRS is ordinal rather than continual or ratio fashion, non-parametric tests (Wilcoxon signed-rank) were used to evaluate differences between initial (NRS score of patients when first seen by the IPS) and final (NRS score on last visit) NRS.²⁷ Spearman's rank correlation analysis was used to create a correlation matrix to evaluate associations between all identified independent variables (*patient-related*: change in NRS, initial NRS, age, gender, specialty, epidural versus non-epidural management; *time-related*: number of visits by IPS, total time spent by IPS; and *intervention-related*: number of medications introduced, number of medications discontinued, number of times the dosage was changed, number of times the dose frequency was changed, number of PCA changes and total number of interventions) with the change in NRS between initial and final IPS review. All strongly correlated variables ($\rho > 0.5$) were then included in a binary logistic regression analysis to identify predictors of pain resolution greater than 50% NRS and improvement rather than deterioration or no change in NRS.²⁸ Goodness of fit of the employed models was assessed using Nagelkerke pseudo- R^2 values. Throughout the article, data are shown as median (interquartile range (IQR) [range]) for non-parametric data, mean (standard deviation (SD)) for parametric data and number (proportion). P-values < 0.05 were considered significant.

Results

Patient demographics

A total of 249 referrals were identified during the time period studied. A search for duplicate cases identified 16 patients who had 2 IPS referrals on 2 separate admissions during the time period studied. A single

Table 1. Summary of patient demographics, pain team interventions and numerical rating scale (NRS) scores according to initial resting NRS. Values are mean (SD), median (IQR [range]) and number (percentage).

	NRS ≤ 3 (mild pain)	4 ≤ NRS < 8 (moderate pain)	NRS ≥ 8 (severe pain)	All
N	64 (26%)	83 (33%)	56 (23%)	249 (100%) ^a
Age (years)	60 (18.8)	46 (16.5)	55 (21.4)	54 (20.5)
≥ 65 years	31 (49%)	13 (16%)	21 (38%)	85 (34%)
Female gender	32 (50%)	40 (48%)	36 (64%)	137 (55%)
Surgical specialties	57 (89%)	61 (74%)	39 (70%)	184 (74%)
General surgery	28 (44%)	30 (36%)	16 (27%)	82 (33%)
Orthopaedics	19 (30%)	19 (23%)	11 (30%)	56 (23%)
Plastics	3 (5%)	5 (6%)	6 (11%)	20 (8%)
Obs & Gynae	3 (5%)	4 (5%)	2 (4%)	10 (4%)
Bariatric	1 (1%)	1 (1%)	3 (5%)	7 (3%)
Urology	3 (5%)	1 (1%)	0 (0%)	6 (2%)
Vascular	0 (0%)	1 (1%)	1 (2%)	3 (1%)
Medical specialties	6 (9%)	20 (24%)	17 (30%)	59 (24%)
Unknown	1 (2%)	2 (2%)	0 (0%)	6 (2%)
Epidurals	21 (33%)	9 (11%)	8 (14%)	39 (16%)
Number of visits	2 (1–4 [1–20])	2 (1–3 [1–18])	3 (2–4 [1–29])	2 (1–3 [1–29])
Total time spent (minutes)	71.3 (86.1)	76.3 (71.4)	103.7 (102.6)	77.9 (85.4)
Number of interventions	3 (1–5 [0–22])	3 (1.75–6 [0–18])	4 (2–6 [0–37])	3 (1–5 [0–37])
Initial NRS ^b	2 (0–3 [0–3])	6 (4–7 [4–7])	8 (8–10 [8–10])	5 (3–8 [0–10])
				Missing* 46
Final NRS ^c	1 (0–4 [0–10])	3 (1.5–5 [0–9])	4 (1.5–6 [0–10])	3 (0–5 [0–10])
	missing 36	missing 42	missing 26	missing 142
Wilcoxon signed-rank test, ^d Z value (p-value)	–1.1 (0.253)	–4.5 (0.000)	–4.4 (0.000)	–5.5 (0.000)
Change in NRS	n = 29	n = 41	n = 30	n = 100
Deterioration/no change in NRS	24 (83%)	12 (29%)	5 (17%)	41 (41%)
Final NRS > 3	7 (24%)	19 (46%)	18 (60%)	46 (43%) ^e
≥ 50% improvement	5 (17%)	20 (49%)	19 (63%)	40 (40%)

SD: standard deviation; IQR: interquartile range.

^aA total of 46 (18.5%) patients had no initial NRS recorded; thus, number of patients in mild, moderate and severe groups do not add up to 'All' patients.^bInitial NRS: NRS on first contact with the IPS.^cFinal NRS: NRS on last contact with the IPS.^dWilcoxon signed-rank test with a Bonferroni correction was used to compare initial and discharge NRS.^ePercentage calculated from a total of 106 patients.

*Missing; missing data.

patient had six admissions with IPS involvement. These patients were not excluded from the final analysis, given they still made up an important workload of the IPS.

Table 1 summarises patient demographics, pain team interventions and outcome NRS, grouped according to NRS on first assessment (Initial NRS).

Epidurals were solely applied to surgical patients. More than half of all patients managed with an epidural reported 'mild' pain on initial review (21 of 39; 54%); all were reviewed routinely.

Interventions used

The most frequent IPS intervention was the 'introduction of drugs' with a median (IQR [range]) of 2 (1–3

[0–11]) followed by 'discontinuation of drugs' 1 (0–1 [0–7]). 'Dosage changes' 0 (0–1 [0–17]), 'PCA changes' 0 (0–1 [0–6]) and 'changes to dose frequency' 0 (0–1 [0–5]) were used less commonly. The median number of visits and interventions, as well as the total mean time spent in minutes, were all greatest in the group of patients reporting 'severe' pain on initial assessment; 3 (2–4 [1–29]), 4 (2–6 [0–37]) and 103.7 (102.6), respectively (Table 1).

Change in NRS

Of the 249 entries identified, 203 (83%) had pain scores recorded on initial assessment, and only 106 (43%) entries had pain scores recorded on last review.

Table 2. Results of binary logistic regression.

Outcome	Coefficient	95% confidence interval	p-value	R ²
Change in NRS $\geq 50\%$ ⁽¹⁾	1.33	1.14–1.56	0.000	0.19
'Improvement' in NRS ⁽²⁾	1.62	1.34–1.97	0.000	0.40

NRS: numerical rating scale.

Outcomes 'change in NRS $\geq 50\%$ ' and 'any improvement in NRS' were dependent variables and 'initial NRS' (NRS on first visit) the independent variable. For analysis (1) variables were coded as '0' if NRS changed $<50\%$ from initial NRS and '1' if initial NRS changed $\geq 50\%$. For analysis (2) as '0' if initial NRS did not change or deteriorated and 1 if initial NRS improved.

In total, 100 (41%) entries had both an initial and final NRS recorded.

Initial median NRS 5 (3–8 [0–10]) and final median NRS 3 (0–5 [0–10]) were significantly different when a Wilcoxon signed-rank test with Bonferroni correction was applied to the whole cohort; $Z = -5.5$ ($p = 0.000$). Subgroup analysis demonstrated no significant difference in the 'mild' pain group, $z = -1.1$ ($p = 0.253$), unlike the 'moderate' and 'severe' pain groups, $z = -4.5$ ($p = 0.000$) and $z = -4.4$ ($p = 0.000$), respectively.

Deterioration or no change in NRS was most frequent in patients with 'mild' pain on initial assessment followed by those with 'moderate' pain, 24 (83%) and 12 (29%), respectively. On final assessment, a total of 46 (43%) patients were still in considerable pain (NRS > 3).

Spearman's rank correlation analysis demonstrated a strong positive correlation ($\rho = 0.64$; $p = 0.000$) between the initial NRS and change in NRS, suggesting that patients with severe pain benefit more from IPS involvement.

Evaluation of all independent variables in a correlation matrix identified initial NRS as the only independent variable strongly correlated with the change in NRS. When applied to a binary logistic regression analysis, for every unit increase in initial NRS, there was a 62% chance of improvement, rather than deterioration or no change in NRS and a 33% chance that this improvement would be greater than 50%. Both results were statistically significant ($p = 0.000$) as demonstrated in Table 2.

Inappropriate referrals and estimated costs

A total of 83 (33%) patients requiring only a single IPS review were identified (Figure 1(a)).

Of these, 28 (11%) referrals were identified as 'inappropriate' (see Figure 1(a) and (b) for derivation). The total time spent on these visits was 728 minutes (12.1 hours) over the 8-month evaluation period, and if extrapolated 18.2 hours per year (Table 3).

The estimated cost, according to the hourly pay of a single band 6 nurse, of spending those 18.2 hours

Figure 1. (a) Flow chart demonstrating the derivation of number of 'inappropriate' referrals; (b) ladder to demonstrate baseline analgesia in those patients with no epidural infusions and no PCA pump (Figure 1(a)) in rank order as described by WHO's pain ladder.²⁶

PCA: Patient Controlled Analgesia; WHO: World Health Organization.

Black boxes: number of patients with given top rank of analgesia prescribed according to WHO analgesic ladder.

White boxes: number of patients with missing ranks in analgesia prescribed. All patients in first and second ranks prescribed 'sub-optimal analgesia'. Additionally, those with missing ranks in the third rank were also included.

¹See Figure 1(b) for a full breakdown.

²Simple changes include dosing or interval of dosing.

on the wards is £461.37 per annum. However, given that the IPS at Chelsea and Westminster Hospital employs nurses from pay bands 6, 7 and 8 as well as a consultant anaesthetist, this is probably a

Table 3. Calculated costs of inappropriate referrals according to the role and grade of team member that reviewed the patient.

	Band 6 nurse	Band 7 nurse	Band 8 nurse	Consultant
Annual Cost to a London Trust According to Mid-Point Salary ^a (£)	42,307	49,565	60,192	124,704 ^b
Hourly costs ^c (£)	25.35	29.70	36.06	74.72
Total time spent with all patients during observation period ^d (minutes)	19,329 (322.2 hours)			
<i>Estimated annual time spent with all patients (minutes)</i>	28,993.5 (483.2 hours)			
Total costs for all patient contacts during observation period ^d (£)	8167.77	9569.34	11,618.53	24,074.78
<i>Estimated total annual costs for all patient contacts (£)</i>	12,249.12	14,351.04	17,424.19	36,104.70
Total time spent on 'inappropriate referrals' during observation period ^d (minutes)	728 (12.1 hours)			
<i>Estimated annual time spent on 'inappropriate referrals' (minutes)</i>	1092 (18.2 hours)			
Total costs of 'inappropriate referrals' during observation period ^d (£)	36.74	359.37	436.33	904.11
<i>Estimated total annual costs for 'inappropriate referrals' (£)</i>	461.37	540.54	656.29	1359.90
Total time spent on patients experiencing no benefit during observation period ^{d,e} (minutes)	1710 (28.5 hours)			
<i>Estimated annual time spent on patients experiencing no benefit (minutes)</i>	2565 (42.8 hours)			
Total cost of caring for patients experiencing no benefit ^{d,e} (£)	722.48	846.45	1027.71	2129.52
<i>Estimated annual cost of caring for patients experiencing no benefit^e (£)</i>	1084.98	1271.16	1543.37	3198.02
<i>Estimated annual saving potential^f (£)</i>	1546.37	1811.70	2199.66	4557.92
<i>Percentage estimated annual saving potential^f (of total annual costs of all patient contacts)</i>	13%			

^aTotal costs to a trust per annum in employing full time staff. Data provided by personal communication (personal communication, November 2015. Finance Department, Epsom and St Helier University Hospital, Carshalton, UK).

^bBased on the average cost of a London Trust employing a pain consultant with 10 programmed activities (PAs) per week and 2% on-calls.

^cCalculated according to mean working hours per week in the United Kingdom in 2013 [1669 hours].²⁹

^dAn 8-month observation period.

^eDefined as 'deterioration' or 'no change' in numerical rating scale (NRS) [time spent on patients with epidural were excluded given that they are reviewed routinely].

^fSum of costs incurred through 'inappropriate referrals' and caring for patients not benefitting from service input ('non-responders').

considerable underestimation (Table 3). Furthermore, in the observation period, a total of 28.5 hours were spent reviewing patients who despite IPS input experienced no change or even deterioration in their reported pain intensities, *excluding* those patients with epidural infusions. Although measuring pain scores (NRS) might not fully represent a patient's pain experience or show success of treatments, according to this widely used metric, these patients might be regarded as 'non-responders' to treatment. The estimated cost of seeing these patients is between £1084.98 and £3198.02 annually according to the grade of nurse or consultant reviewing them. Hence, with operational and treatment optimisation there is a potential for cost savings of between £1546.37 and £4557.92 per year, which equates to 13% of the total costs of the IPS' inpatient reviews.

Discussion

Effective pain relief is a human right.³⁰ It has broad implications for patient outcomes, hospital length of stay, patients returning to their usual daily activities, preventing hospital acquired infections and chronic pain.³¹ It is therefore appropriate to routinely allocate considerable human and financial resources to IPS, which provide essential knowledge and expertise in specialist analgesia devices and managing complex pain needs. For the same reasons, it is imperative to monitor these services for clinical efficacy and cost-effectiveness.

The data presented here show that the IPS at Chelsea and Westminster Hospital has a substantial patient workload, receiving referrals from a large number of specialties, both surgical and non-surgical.

An overall trend in improvement of pain exists, as demonstrated by the Wilcoxon signed-rank test when applied to the whole cohort. However, the efficacy was unbalanced across groups, and improvement was not universal. No change or worsening pain was most prevalent in the group of patients reporting 'mild' pain on initial review. Conversely, the proportion of patients benefiting from service input increased considerably in patients with 'moderate', and especially with 'severe' pain. This finding is further supported by the results from the regression analysis where for every unit increase in initial NRS there was a 62% greater chance of improvement, rather than deterioration or no change in pain intensity on follow up and a 33% greater chance that the improvement in NRS would be greater than 50%. Furthermore, deterioration or no improvement was noted in 41% of patients and 43% of patients still had moderate to severe pain on final assessment. However, the high proportion of patients remaining in pain at the final IPS visit is at

odds with the results of previous audits conducted in our hospital. In 2012, for instance, the point-prevalence of moderate to severe pain at rest was found to be 33% for surgical and 25% for medical patients.¹⁰ This discrepancy between the previous results and the data presented here is most likely due to a recording bias as there was no gross change of practice in the year between the two studies.

Considering these results, it is not unreasonable to suggest that patients who experience only mild pain and who have no epidural catheters in situ should not be routinely seen by the IPS. Responsibility for pain management in this cohort of patients should be transferred back to the admitting specialty and the nursing staff on the ward. However, to be able to succeed with this reintroduction of ownership over analgesic treatment to the wards, clear and easily accessible treatment guidelines as well as referral algorithms and procedural policies need to be provided and maintained. Furthermore, hospitals need to improve on their culture of informal learning for their staff.³² Therefore, in the future, IPS need to reinvigorate their own promises from the past as they increasingly cross the boundaries of pure patient management to progressively assume a role of educators. Subsequently, they need not only be equipped to provide best-practice therapies but also to offer evidence-based guidance, around the clock peer-to-peer advice as well as regular and structured teaching.

A total of 13% of total time spent by the IPS on direct patient contact was dedicated to patients where little clinical benefit was observed ('non-responders') and where expert opinion was not required ('inappropriate referrals'). A total of 11% fell into the category of 'inappropriate' referrals. Patients of this group were either referred to the IPS before their pain management was optimised using simple multimodal analgesia, as described by the WHO analgesic ladder, or required simple or no changes to their analgesia.²⁶ In turn, human resources were distributed inefficiently with care diverted away from patients with more complex needs, who require and benefit most from specialist attention.

The number of hours and costs spent seeing 'inappropriate' referrals by specialist staff depend on how the visiting group of the IPS is constituted. For instance, at Chelsea and Westminster Hospital, Mondays and Fridays a consultant-led ward round was conducted with at least a pharmacist, a psychologist and a specialist nurse attending. The nurse could either be junior (band 6) or senior (band 8), depending on availability. On other weekdays, however, the visiting team comprised a specialist nurse only. Therefore, costs for seeing 'inappropriate' referrals could vary between £461.37 (single band 6 nurse visit) to

£2016.19 (band 8 nurse and consultant ward round) annually. Together with the costs for visiting patients who were referred to the team, but unlikely to experience any clinical benefit, there could be a potential to save the trust between £1546.37 and £4557.92 annually.

The number of inappropriate referrals is only an estimation, as is the calculated financial costs, and is likely to be understated. For example, the costs of the pharmacist and psychologist attending the ward rounds have not been factored in. Additionally, some referrals might have been discussed over the phone and were thus not documented. Finally, in the calculation of costs, we have only considered contracted hours of work, and neglected any over-time commitments.

Given the current climate of austerity and budget cuts, it is essential that inefficiency within the NHS is minimised and cost-effectiveness maximised to provide the best possible patient outcomes, comfort and satisfaction. In this regard, there are further consequences to inappropriate referrals. The fact that patients are being referred to the IPS before their pain management is optimised introduces a delay in achieving effective pain relief given that patients are waiting for specialist review. Moreover, there is also a risk that junior doctors will become deskilled and unable to take simple steps in optimising analgesia. This notion is reminiscent of the worry of junior doctors becoming deskilled in treating minor injuries with the introduction of emergency nurse practitioners.³³ It also adds further argument to the above-mentioned strategy to transfer part of the ownership for pain management back to the admitting teams and ward nurses. However, current referral pathways and structures need to be modified so that junior doctors are encouraged to optimise their patients' analgesia before involving the IPS, which would also have educational and training benefits. In this regard, more outcome studies are warranted to help identify patients who are unlikely to benefit from IPS input, subsequently enabling the development of these refined referral algorithms.

Study limitations

It could be argued that because of the single centre nature of this study, the results presented here are not generalisable. However, findings presented here might be of interest to other hospitals as well. The reasons are that despite existing variability between services a common ground is provided through adherence to current Royal College of Anaesthetists recommendations.^{19,20,22} Also, issues surrounding 'inappropriate referrals' and patients unlikely to benefit from IPS input can be expected to exist in other hospitals as well.

In terms of the general improvement demonstrated for pain intensity in this study, it is not possible to differentiate the effect of the IPS versus the natural history and resolution of acute pain, as there was no control group for comparison. Chapman et al. demonstrated three different pain trajectories over 6 days in patients discharged from the emergency department following presentation with an acutely painful condition: (1) patients with high levels of pain initially, that resolves rapidly (79%); (2) no meaningful change in pain over the 6 days (14%); (3) low-intensity pain initially followed by steady exacerbation (7%), which is similar to the trends found in our own data.³⁴ However, Bardiau et al.³⁵ have shown a beneficial effect of the IPS, even when the natural resolution of pain is taken into account.

Deterioration of pain in this study was most likely to occur in patients with 'mild' pain on initial assessment, which coincides with the group in which epidural analgesia was most prevalent. Therefore, one may speculate whether epidurals were confounding for change in NRS in the mild pain group. Previous studies have shown increasing pain after discontinuation of epidural infusions, for example after accidental catheter displacement or early epidural failure, which are acknowledged adverse events of epidurals.^{36–38} Conversely, epidural catheter removal within the correct timeframe has been shown to be unlikely to lead to rebound increases in pain intensity.³⁹

This study was also possibly hampered by the variable quality of data recorded and provided for analysis. As patients were often reviewed several times by the IPS, it was therefore important to acknowledge the service's impact over that full period of involvement, which the design of this service improvement project endeavoured to do. The observational retrospective design is useful in attempting to understand what happens in daily practice, rather than what happens under controlled research environments.⁴⁰ However, the quality of such data collected might be limited – a particular issue in this dataset was missing data secondary to variable quality of clinical documentation. Although a large number of patient episodes were available for analysis, only 43% had an initial and final NRS documented. This in itself might have been a source of bias, given that those who improved may not be seen again, and thus their improved NRS not recorded. In future, such data may be recorded electronically as part of routine patient care and monitoring, also improving the completeness of datasets.

A further limitation of the data was the recording of out-of-hours work. During hospital hours, the IPS at Chelsea and Westminster Hospital is run by specialist pain nurses and out-of-hours by on-call anaesthetic core trainees (CT1/2). There were no data available for

the latter, as clinical documentation for on-call purposes was separate to the proformas used by the IPS during the day. Not having these data is likely disadvantageous, as night-time and weekend pain issues might constitute special challenges and therefore might have influenced results. If the above mentioned modified referral algorithms were indeed widely used and expanded to include not only referral criteria, but also the facility to track changes to treatment and monitor the patients' response, this would serve to improve communication between the day team and out-of-hours team, as well as improving data collection for future assessment of the efficacy of the IPS.

Data were also not corrected for the influence of origin and timing of pain. Patients were followed up for different lengths of time according to the number of IPS reviews, therefore the final NRS recorded would be at varying time intervals from the initial painful insult, which in itself was variable in our cohort, including both medical pathology and post-operative pain. In this regard, there is increasing awareness among anaesthetists that different surgical procedures might have different 'pain signatures'.⁴¹ However, as number of visits or time spent with a patient did not influence final NRS in this study, omitting time dependent data correction is unlikely to have biased results. This is not to say that time spent with patients has no impact on outcome, the impact was just too variable to statistically become a predictor for treatment success.

Identification of 'pain signatures' and their determining factors will be of great importance for future research. It is likely that 'phenotyping' acute pain will develop into a key diagnostic tool similarly to what is currently emerging in neuropathic pain.⁴² This is even more critical in light of the considerably high number of patients in this study remaining in pain after IPS input.

The consistently high treatment failure rates observed here highlight again the dilemma of modern IPS.¹¹ Despite considerable efforts, pain still remains an issue in present day hospitals and new avenues of treatment need urgently be sought.⁸ This service evaluation should hence be repeated as part of a multicentre longitudinal design in order to establish variables that predict treatment responders and to determine the true incidence of suboptimal uses of IPS within UK hospitals.

Conclusion

This service evaluation suggests that Chelsea and Westminster Hospital's IPS benefits patients with moderate and severe pain. However, currently resources are distributed inefficiently in 13% of cases as a result of either 'inappropriate referrals'

or provision of care for patients who are unlikely to benefit from IPS input ('non-responders'). Future service improvement and research projects should address these issues to develop algorithms that help identification of treatment responders and thus the prevention of inefficient use of resources.

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