Supportive Care in Cancer (2020) 28:671–682
https://doi.org/10.1007/s00520-019-04836-8

ORIGINAL ARTICLE

An in-hospital clinical care pathway with integrated decision support for cancer pain management reduced pain intensity and needs for hospital stay

Erik Torbjørn Løhre[1,2] · Morten Thronæs[1,2] · Cinzia Brunelli[3,4] · Stein Kaasa[1,4] · Pål Klepstad[5,6]

Received: 4 April 2019 / Accepted: 23 April 2019 / Published online: 23 May 2019

Abstract

Purpose A clinical care pathway for pain management in a palliative care unit was studied with outcomes related to patients, physicians, and health care service. Mandatory use of patient-reported outcome measures (PROMs) and physician-directed decision support (DS) were integrated parts of the pathway.

Methods Adult cancer patients with pain intensity (PI) ≥ 5 (NRS 0–10) at admission were eligible. The patients reported average and worst PI at admission, day four, and discharge. The physicians completed the DS at admission and day four. The DS presented potential needs for treatment changes based on pain severity and pathophysiology. The physicians reported treatment changes due to input from the DS system. The two primary outcomes were average and worst PI changes from admission to discharge. Hospital length of stay (LOS) was registered.

Results Of 52 included patients, 41 were discharged alive. For those, the mean average PI at admission and at discharge was 5.8 and 2.4, respectively, a reduction of 3.4 points (CI 95% 2.7–4.1). The corresponding worst pain intensities were 7.9 and 3.8, a reduction of 4.1 points (CI 95% 3.4–4.8). The physicians completed DS forms for all patients. Fifty-five percent (CI 95% 41–69) of the patients had pain intervention changes based on the DS. A significant reduction in LOS (4.4 days, CI 95% 0.5–8.3) was observed during the study period.

Conclusions The interventions were implemented according to the intentions and PI was reduced as hypothesized. For evaluation of generalizability, the interventions should be studied in other settings and with a controlled design.

Keywords Clinical care pathway · Decision support · Cancer pain · Palliative care

✉ Erik Torbjørn Løhre
erik.t.lohre@ntnu.no

[1] Department of Clinical and Molecular Medicine, Faculty of Medicine and Health Sciences, NTNU, Norwegian University of Science and Technology , N-7491 Trondheim, Norway

[2] Cancer Clinic, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway

[3] Palliative Care, Pain Therapy and Rehabilitation Unit, Fondazione IRCCS Istituto Nazionale dei Tumori, Milan, Italy

[4] European Palliative Care Research Centre (PRC), Department of Oncology and Institute of Clinical Medicine, Oslo University Hospital and University of Oslo, Oslo, Norway

[5] Department of Circulation and Medical Imaging, Faculty of Medicine and Health Sciences, NTNU, Norwegian University of Science and Technology, Trondheim, Norway

[6] Department of Anesthesiology and Intensive Care Medicine, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway

Introduction

Cancer pain is undertreated, and deficiencies in cancer pain assessment and management may contribute to this lack of success [1–3]. The assessment of pain and response to pain management involves the patient, the health care professional, and their interaction [4]. Pain assessment by patient self-report, including a measure for treatment satisfaction, is recommended [1, 5, 6]. The use of standardized patient-reported outcomes has shown validity and reliability [6, 7]. However, a single measurement of patient-reported pain intensity (PI) alone, whether reported within the time frame "now" or as a pain average over the past 24 h, provides the physician with limited knowledge to guide the need for on demand (PRN) pain medication [6]. Information on patient satisfaction with pain control also must be collected [5].

A successful pain treatment is dependent on the physician's responsiveness to patient input on pain descriptors [4]. Analgesic treatment is potentially effective in most cases [1],

and recommendations and guidelines for cancer pain treatment are published [8, 9]. Furthermore, insight on pain etiology and pathophysiological mechanisms may provide additional information to optimize the pain treatment [5]. Without updated knowledge on alternatives for pain therapy such as the use of opioids [8], radiotherapy for painful bone metastases [10], and use of specific adjuvant drugs for neuropathic pain and visceral pain [11, 12], the physician might underuse available options for adequate pain management.

Despite the evidence for both improved symptom control and overall survival by systematic monitoring [13, 14], and the evidence for pain treatment based on the etiological pain classification described in the 11th revision of the World Health Organization's International Classification of Diseases (ICD-11) [15, 16], there is a gap between available knowledge and real-world practice [1]. The systematic checklist approach used in aviation for decades may also in healthcare ensure that acknowledged standards are applied for every patient, every time [17]. Clinical care pathways are structured plans which detail essential steps in patient treatment, intended to optimize clinical outcomes and efficiency [18]. A care pathway aims to link evidence-based guidelines and clinical expertise and is a suitable method to implement structured pain assessment and checklists into clinical practice [18–20].

We hypothesized significant improvements in pain control if patients systematically registered patient-reported outcome measures (PROMs) and if the physicians applied an evidence-based decision support (DS). Elements from implementation research, which addresses both individual and system factors, were applicable to monitor the process [21].

Within the framework of a health care improvement project [22], a prospective intervention study was conducted in a specialized palliative care unit. The intervention was based upon a care pathway structure and included systematic and repeated use of PROMs and mandatory use of physician-directed DS [19]. The overall aim of the study was to investigate the effects and use of the intervention. The two primary outcomes were average and worst PI reductions from admission to discharge. In addition, the number of eligible patients included and reporting PROMs, if and how the physicians used and based their decision-making on the PROMs and DS, and development in hospital length of stay (LOS) during the study period, were secondary outcomes.

Methods

Context

The study was designed as a phase II interventional prospective uncontrolled trial, where the intervention represented measures to accomplish pain treatment according to recommended standards. The Regional Committee for Medical and Health Research Ethics classified the project as quality assurance (2016/548), without the need for expressive informed consent from the patients. The Data Protection Supervisor at St. Olavs Hospital, Trondheim University Hospital, Norway, endorsed the study.

As part of the routine symptom screening, PI is assessed for all patients admitted to the Palliative Care Unit, Cancer Clinic, St. Olavs Hospital, Trondheim University Hospital. Patients with a pain score ≥ 5 on the 11-point numeric rating scale (NRS 0–10) at admittance are in specific need of attention, as their pain is more intense than "mild" [23, 24]. In the period September 2016 to March 2017, all patients with locally advanced and/or metastatic cancer and with a pain score ≥ 5 (NRS 0–10) on admittance were screened for inclusion in the study. Patients < 18 years of age, patients with severe cognitive impairment, patients admitted for planned radiotherapy, and patients unwilling or unable to fill in symptom self-assessment reports were excluded.

Interventions

PROMs were collected at admission, at day four of the hospital stay, and at planned discharge. If needed, assistance from a health care professional was offered. The patients rated the average PI in the past 48 h (NRS 0–10), the worst PI in the past 24 h (NRS 0–10), and the degree of treatment satisfaction with both the around the clock (ATC) and the PRN pain medication (NRS 0–10, 10 representing completely satisfied) [5, 25]. Finally, the patients were asked whether they reported pain flares and requested extra pain medication for such pain (NRS 0–10, 10 representing every time), and if not so, reasons why.

The physicians had access to the collected PROMs when presented with a DS paper form. The DS was filled in by the physicians at admission and at day four of the hospital stay. It was formulated as ten questions with the response options "yes," "no," and "uncertain." By nature, the DS represented "reminders" on possible needs for changes in opioid dose, administration route or opioid rotation, or needs for additional treatment for neuropathic, visceral, or bone pain. The complete DS is presented in Table 3. In addition, the physicians were asked to report whether the pain treatment was changed based on the PROMs and/or the DS.

The regular staff of physicians at the palliative care unit, including the first and second author, conducted the treatment.

Primary outcome measures

Comparison of patient-reported average PI and worst PI at admission and discharge, respectively, were primary outcomes. A PI difference of two points (NRS 0–10) was considered clinically relevant for both primary outcomes [26, 27].

Secondary outcome measures

The number of patients with PI ≥ 5 (NRS 0–10) at admittance, the number of eligible patients included in the study, and the number of patients formally reporting PROMs were secondary patient-related outcomes.

The number of physicians who filled in the DS at admission and at day four was a secondary physician-related outcome. Further physician-related outcomes were the percentages of treatment revisions based on the PROMs and DS at admission, respectively, and changes in the percentage of treatment revisions based on DS information during the study period. Finally, to which degree the physician-reported need for treatment changes at admission was verified when the patient charts were searched for actual treatment changes at discharge, also constituted a secondary physician-related outcome measure.

Besides the secondary outcomes related to the patients and the physicians, change in LOS during the study period was a secondary health care service-related outcome.

Analysis

Recently published research reported a standard deviation (SD) of 2.1 for average PI and an SD of 2.7 for the worst PI for cancer in-patients [28]. Power analysis based on two primary outcomes (reduction in average and worst PI), an SD of 2.7 and an alpha error of 0.025, indicates that a one-sided paired *t* test carried out on 40 patients will have a minimum power of 0.9 to detect a two-point (NRS 0–10) pre-post PI difference, allowing for repeated measurements correlation of 0.1 or higher. As varying and high attrition rates are reported in supportive care and palliative oncology trials [29], the study was run until the necessary number of consecutive patients with complete data was obtained.

Patients who died during the hospital stay resulted in missing data. Single imputations with last value carried forward were performed for the patients with missing data. Afterwards, the mean average PI and mean worst PI at discharge for all included patients were computed for comparison with the complete cases. The subgroup not able to fill in the PROMs constituted patients in need of end-of-life care, and they were not included in the subsequent effect outcome analyses.

For the patients discharged alive, mean pain intensities at admission and discharge were compared using a paired sample *t* test.

The number of patients filling in PROMs at admission, at day four of the hospital stay and at planned discharge, were compared to the number of available patients at the respective points of time, and completion rates were calculated.

The completion rate of the DS forms by the physicians at admission and at day four was computed. The percentages of physician-reported treatment changes based on PROMs and DS at admission, respectively, were calculated with 95% confidence intervals (CI). In addition, the percentages of physician-reported treatment changes based on the DS were computed for patients enrolled early, in the mid-phase, and late in the study period. Differences between patients enrolled early versus those enrolled late were tested using independent samples *t* test and *z* test for independent proportions, for continuous and binary variables, respectively. Finally, the percentage of concordance between the physician-reported need for treatment changes at admission and documented treatment changes recorded from the medical charts was calculated for each item in the DS. For these calculations, DS responses were dichotomized into "yes" and "no/uncertain," and treatment changes were dichotomized into "increased" and "decreased/unchanged."

LOS was reported for patients enrolled early, in the mid-phase, and late in the study period. The difference between early and late enrolment was calculated with 95% CI.

Results

Patient characteristics

From September 2016 to March 2017, 246 patients were admitted to the Palliative Care Unit, Cancer Clinic, St. Olavs Hospital, Trondheim University Hospital. Fifty-two patients with PI ≥ 5 (NRS 0–10) at admission were included in the study, and basic patient characteristics at admission are presented in Table 1. Mean LOS was 10.6 days for the 52 included patients. The reasons for exclusion are listed in Fig. 1. Data registrations at discharge were available for 41 patients.

Pain registrations with imputations for incomplete cases

At admission, for all 52 included patients, the mean average PI in the past 48 h and mean worst PI in the past 24 h were 5.9 and 7.8 (NRS 0–10), respectively. At discharge, with last value carried forward imputations in the 11 patients who died during the hospital stay, mean average PI in the past 48 h and mean worst PI in the past 24 h were 3.0 and 4.3 (NRS 0–10), respectively.

Primary outcomes

For the 41 patients discharged alive, mean average PI in the past 48 h at admission and at discharge were 5.8 and 2.4 (NRS 0–10), respectively. There was a reduction in average PI during the hospital stay of 3.4 points (CI 95% 2.7–4.1, $p = 0.00$) (Fig. 2). For the same group of patients,

Table 1 Patient characteristics ($n = 52$)

		%
Age (years)	Mean (range)	67 (44–91)
Sex	Female	54
	Male	46
Metastatic cancer		96
ECOG[a] performance status	Median (range)	III (0-IV)
On systemic anti-cancer therapy		21
Pain intensity at inclusion (NRS 0–10)[b]	Mean (range)	6.9 (5–10)
Discharged to	Home	64
	Institutional care	15
Died during hospital stay		21
Survival after admission (days)	Median (95% CI[c])	27 (20–34)

[a] ECOG: Eastern Cooperative Oncology Group

[b] NRS 0–10: the 11-point numeric rating scale

[c] *CI*, confidence interval

mean worst PI in the past 24 h at admission and at discharge were 7.9 and 3.8 (NRS 0–10), respectively. There was a reduction in worst PI during the hospital stay of 4.1 points (CI 95% 3.4–4.8, $p = 0.00$) (Fig. 2).

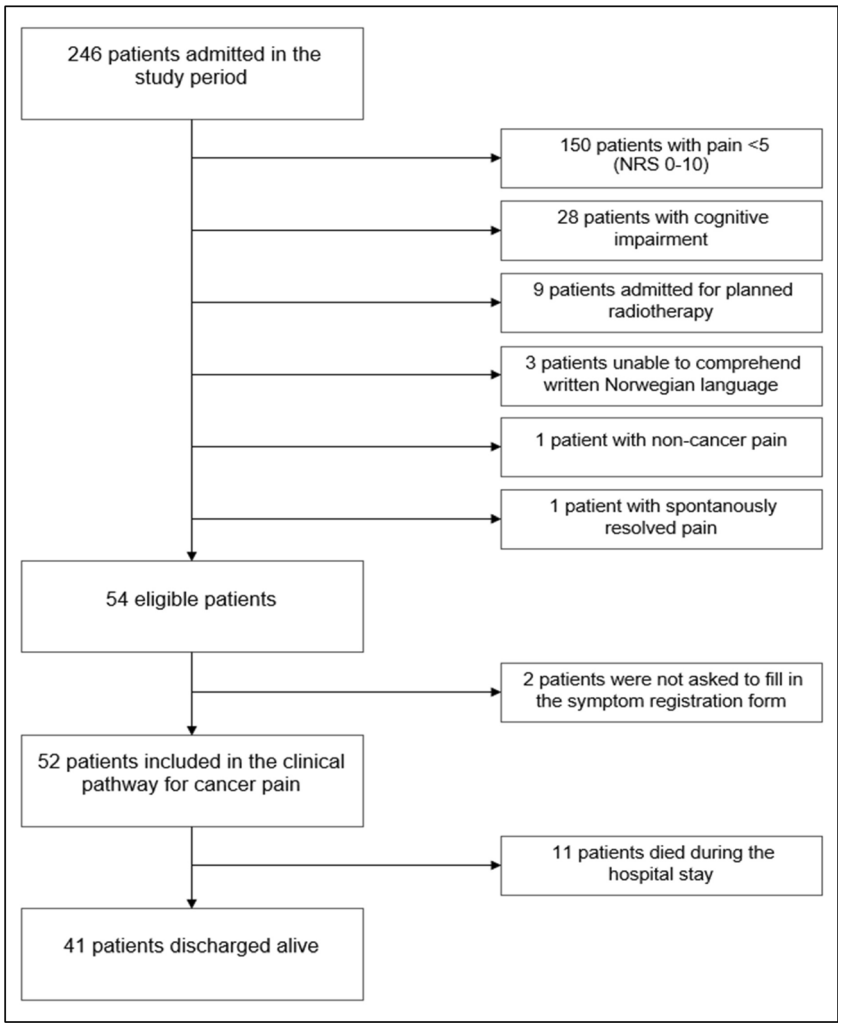

Fig. 1 Patient exclusion and inclusion

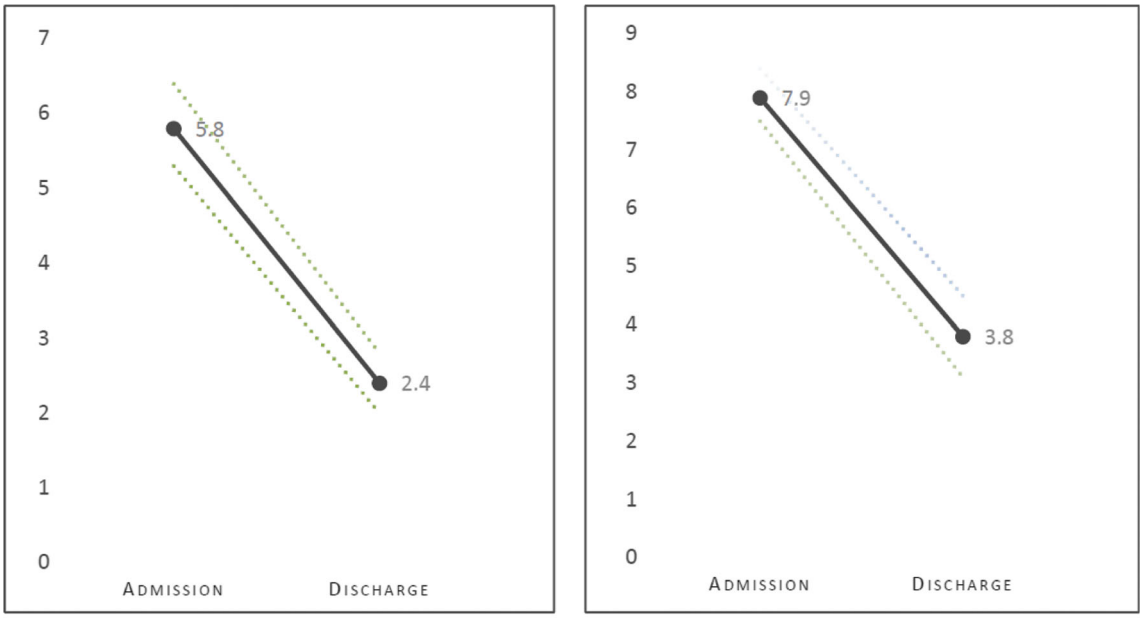

Fig. 2 Mean average and worst pain intensity (NRS 0–10) at admission and discharge with 95% confidence intervals

Secondary outcomes

In the study period, 22% (54/246) of the admitted patients had PI ≥ 5 (NRS 0–10). Only two eligible patients were not included (Fig. 1). All 52 included patients reported PROMs at admission, and all 46 and all 41 available patients reported PROMs at day four and at discharge, respectively.

DS forms were filled in by the physicians for all 52 and for all 46 available patients at admission and day four, respectively. For 80% (95% CI 69–90%) of the patients, the physicians reported pain intervention revisions at admission based on the PROMs. For 55% (95% CI 41–69%) of the patients, the physicians reported pain intervention revisions at admission based on DS information. The percentages of treatment changes based on the DS throughout the study period are displayed in Table 2. The increase in physician-reported treatment changes based on the DS, for patients enrolled early versus late in the study period, from less than 50% to approximately 70% of the patients, was not statistically significant ($p = 0.17$). The percentages of concordance between the physician-reported need for treatment changes at admission (collected from the DS forms), and documented treatment changes made during the hospital stay (collected from the charts) are displayed for each item in the DS in Table 3, which also shows selected treatment measures taken during the stay. Besides the 98% concordance for neuraxial pain management in 4% of the patients, the concordance was highest for the DS on ATC opioid dose based on PIs, and for the DS on bone, visceral, and neuropathic pain. The concordance was lowest for the DS on specific treatment for tumor edema and the need for opioid rotation.

Comparing the first third and the last third of the enrolled patients, mean LOS were 12.9 days and 8.5 days, respectively (Table 2). There was a significant reduction in LOS of 4.4 days (CI 95% 0.5–8.3 days, $p = 0.03$) from patients enrolled early to late in the study period.

Table 2 Development (from early to late in the study period) in treatment changes based on the decision support and in-hospital length of stay

Time point for inclusion during the study period (thirds)	Pain treatment changed based on decision support (%)	Mean hospital length of stay (days)
Early	47.1	12.9
Mid-phase	47.1	10.1
Late	70.6	8.5

Discussion

The use of standardized and repeated PROMs and DS showed effect in the current study. The reduction in average and worst PIs was in the range of three to four points (NRS 0–10), combined with a significant reduction in LOS during the study period. Both the PROMs and the DS were used, and for approximately half of the patients, the physicians reported treatment changes based on the DS.

Appraisal of methods

Randomized trials provide robust evidence about intervention effects [30]. However, studies with observational

Table 3 Physician-directed decision support with responses at admission and treatment changes at discharge, including concordance between indicated needs at admission and documented changes collected from the charts

No	Decision support	Physicians' response at admission, n=52 (%)		From charts, measures taken during stay, n=52 (%)		Concordance between response to decision support at admission and actual changes (%)
				ATC [a] opioid dose:		
1	Does the average pain intensity indicate a need for an increase in the ATC [a] opioid pain medication?	Yes	87	Increased	81	83
		No	6	Decreased	10	
		Uncertain	7	Unchanged	9	
				PRN [b] opioid dose:		
2	Does the worst pain intensity indicate a need for an increase in the PRN [b] opioid pain medication?	Yes	77	Increased	67	67
		No	8	Decreased	12	
		Uncertain	15	Unchanged	21	
3	Does the worst pain intensity indicate a need for an increase in the ATC [a] opioid pain medication?	Yes	89			85
		No	4			
		Uncertain	7			
4	Does the patient treatment satisfaction response indicate a need for an	Yes	75			*ATC [a] opioid dose:* 78

Table 3 (continued)

	increase in the ATC [a] and/or PRN [b] opioid dose?	No	16			
						PRN [b] opioid dose:
		Uncertain	9			73
				Rotation of opioid or route:		
5	Do you find an indication for rotation of opioid or administration route?	Yes	27	Yes	54	65
		No	56	No	46	
		Uncertain	17			
				Intrathecal pain therapy started:		
6	Do you find an indication for referral to neuraxial pain management?	Yes	2	Yes	4	98
		No	92	No	96	
		Uncertain	6			
				Radiotherapy given:		
7	Do you find an indication for palliative radiotherapy for uncomplicated painful bone metastases?	Yes	14	Yes	17	84
		No	71	No	83	
		Uncertain	15			
				On anti-epileptics and/or esketamine at discharge:		
8	Do you find an indication for a specific treatment approach for neuropathic pain?	Yes	14	Yes	21	84
		No	64	No	79	

Table 3 (continued)

		Uncertain	22			
				On anti-cholinergics and/or octreotide at discharge:		
9	Do you find an indication for a specific treatment approach for visceral pain?	Yes	14	Yes	15	86
		No	54	No	85	
		Uncertain	32			
				Corticosteroids started or dose increased:		
10	Do you find an indication for a specific treatment approach for local inflammation or tumor edema?	Yes	24	Yes	42	65
		No	29	No	58	
		Uncertain	47			

[a] ATC, around the clock

[b] PRN, on demand (pro re nata)

designs are often used to measure the effectiveness of an intervention in "real-world" scenarios [31]. Despite high compliance with the study protocol and substantial pain reduction during the hospital stay, the current study provides no certain inference of causality between the intervention and the effect. Lack of information on pre-study treatment results and no comparison group contribute to this feature. However, we observed that the patients and the physicians filled in the PROMs and the DS and that pain treatment was changed based on the PROMs for three quarters of the patients and on DS for half of the patients, respectively. These observations ensure that the interventions were applied.

The open-label, one-group study design opens for systematic errors, including bias and confounding [32]. The protocol patients represent a selection of the patients with pain admitted to a palliative care unit, which may limit the generalizability of the results. However, in a "real-world" scenario, these are the patients with the greatest need for improved pain management. The present study showed a large positive effect size. These findings might be interpreted that the intervention works in "real life," but further studies are needed in order to confirm the results. Furthermore, the generalizability of the results may be limited by the single-center design in a specialized palliative care unit. The complexity of the

palliative care given in a specialized hospital unit may influence both the intervention and the outcome and represent confounding factors [32].

Comparison with previous work

Cancer pain treatment according to guidelines has proven efficacy for decades [33]. In addition, treatment algorithms based on guidelines for cancer pain management, and educational interventions promoting their implementation, have resulted in reduced PI [34–36]. Still, a recent study combining computerized assessment and DS did not improve cancer pain management [37]. That study provided specific suggestions for treatment modifications. However, 15 years ago, ten "commandments" for effective clinical DS was published, emphasizing the importance of clinicians' autonomy [38]. The DS in the present study consisted of ten questions, encouraging the clinician to reflect on potential needs for changes in pain treatment. The results indicate that the clinicians addressed the questions raised in the DS and followed up the identified need for treatment changes.

Simplicity and user-friendliness are success criteria for clinical DS systems [38, 39]. In the current study, the concordance between the need for treatment changes indicated in the DS and the documented treatment changes made during the hospital stay was more than 80% for six questions. Neuraxial pain management was, despite the high concordance, a relevant treatment option for only a small proportion of the patients, and therefore perhaps not needed in a general DS for all pain patients. The questions on average and worst PI at admission, with respect to ATC opioid dose at discharge, both yielded high concordance. These findings are in line with previous research, supporting both alternatives [6, 9]. For simplicity, one of the questions might be chosen in routine clinical use. To ensure the necessary focus on treatment needs based on pain etiology and pathophysiology [16], the DS might be supplemented by three questions on the need for radiotherapy for painful bone metastases, indication for adjuvant drugs for neuropathic, pain, and indication for specific treatment for visceral pain.

The concept of personalized symptom goals is suggested incorporated in future symptom assessment [6]. A personalized pain goal represents the PI level the patient would be comfortable with and [6], compared with actual PI, provides indirect information on treatment satisfaction with the ongoing pain management. In addition, the degree of treatment satisfaction with specific pain management includes some evaluation of side effects. We found a concordance between the physician-interpreted PROM on pain treatment satisfaction at admission and documented change in ATC opioid dose during the hospital stay of almost 80%. Based on this finding, and previous research underlining the importance of treatment satisfaction when evaluating pain control [5], both patient-reported treatment satisfaction and personalized symptom goals might be relevant in pain assessments.

Knowledge deficiencies are demonstrated in several areas of cancer pain management, including opioid titration, opioid rotation, and cancer pain pathophysiology [2, 4]. Among oncologists, knowledge on cancer pain management and adherence to pain treatment guidelines vary widely [2, 3]. Surprisingly enough, also in the study conducted in a specialized palliative care unit, the physicians reported pain intervention revisions at admission based on DS information for half the patients. The findings may implicate that a DS both may guide health care personnel with limited knowledge and act as a reminder for health care providers more competent in cancer pain treatments. The current study is an example of the latter situation, where a simple intervention, when used rigorously, yielded large reductions in PI. The effects from the clinical pathway for health care workers less proficient in pain treatment must be observed in future studies. The potential for improvement will depend on different factors ranging from pain assessment and response to patient input, to knowledge on cancer pain management, adherence to clinical practice guidelines, and available treatment options.

A care pathway should ideally include explicit statements of the goals and key elements of care, the roles, and sequence of the activities of the multidisciplinary team, and the monitoring and evaluation of variances and outcomes [19]. The aim of the care pathway is to organize and standardize the care process in order to maximize patient outcomes and improve organization efficiency [40]. Within the existing framework of the multifaceted care process in a specialized palliative care unit, the systematic approach represented by the intervention, triggered by NRS ≥ 5 on PI and consisting of the planned use of PROMs and DS, is a "micro" care pathway for a sub-cohort of patients admitted to a specialized palliative care unit. In addition to better pain management, the use of clinical care pathways has been associated with a reduction in LOS [41], as also shown in our study.

Bundles of care are evidence-based practices grouped together to encourage delivery of evidence-based care [42]. They usually consist of a small, straightforward set of practices, that when performed collectively and reliably, improve patient outcomes [43]. The repeated assessments and pain treatment reminders in the present study, based on clinical guidelines, also could be considered a bundle of care. As in studies on care bundles, drawing conclusions about which combinations of individual interventions that maximize the effect is difficult [43].

Implications and further work

Our findings support the importance of systematic and repeated cancer pain assessment and treatment according to existing guidelines [4, 6, 7]. In addition, the study demonstrated high compliance with the interventions. Before definitive conclusions can be drawn, the interventions should be studied in a randomized trial. For generalizability, the intervention also must show effect in other patient populations. A systematic review, based on 148 randomized trials, reported improved "health care process measures" due to clinical DS systems [44]. However, with physician response rates to the presented prompts as low as 50% [45], compliance with the DS is a challenge that needs to be addressed. Another challenge in clinical settings is developing DS simple enough for practicality and complex enough for effect.

Conclusions

In a specialized palliative care unit, and studied in a single sample with an open-label design, standardized assessments and physician-directed DS were used and PI reductions were demonstrated. LOS was reduced during the study period. The interventions should be studied in other settings and with a controlled design.

Acknowledgments The Norwegian Cancer Society supported this study. All authors had full access to all of the data in the study and take complete responsibility for the integrity of the data and accuracy of the data analysis. All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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