Managing chronic pain after breast cancer treatments: are web-based interventions the future?

Sue Hartup[a] *and Michelle Briggs*[b,c]

Purpose of the review
Chronic post-treatment pain in breast cancer affects a high proportion of patients. Symptom burden and financial costs are increasingly impacting patients and healthcare systems because of improved treatments and survival rates. Supporting long-term breast cancer symptoms using novel methodology has been examined, yet few have explored the opportunity to utilise these interventions for prevention. This review aims to explore the need for, range of, and effectiveness of such interventions.

Recent findings
Three papers describe risk factors for chronic pain, with six recent papers describing the use of interventions for acute pain in the surgical setting. The evidence for the effectiveness of these interventions to improve pain management in this setting is limited but tentatively positive. The results have to take into account the variation between systems and limited testing.

Summary
Multiple types of intervention emerged and appear well accepted by patients. Most assessed short-term impact and did not evaluate for reduction in chronic pain. Such interventions require rigorous effectiveness testing to meet the growing needs of post-treatment pain in breast cancer. A detailed understanding of components of web-based interventions and their individual impact on acute pain and chronic pain is needed within future optimisation trials. Their effectiveness as preventative tools are yet to be decided.

Keywords
breast cancer, chronic post-surgical pain, chronic post-treatment pain, web-based interventions

INTRODUCTION

Breast cancer is the most diagnosed cancer in women with 2.3 million new cases globally in 2020 and is the leading global cause of cancer death in women with 685 000 deaths in 2020 [1,2]. Breast cancer is the most prevalent cancer in the United Kingdom with incidence increasing and 55 920 new cases diagnosed annually [3,4]. Survival is improving, with the majority becoming long-term survivors [4], so survivorship issues, such as persistent pain are very important to patients. Chronic or persistent pain following the treatment for breast cancer is a well-documented phenomenon. Costs associated with long-term side effects are increasing significantly for healthcare systems regardless of geographical location. Post-treatment pain is pain related to treatments given and not those caused by the cancer.

This review aims to describe interventions for both acute and chronic pain in breast cancer briefly reviewing all parts of the treatment pathway, but focussing on surgery. Changes to clinical practice emerging from the COVID-19 pandemic have seen the rapid expansion in the development of web-based interventions (WBIs) in various fields of healthcare. There has been a paucity of prospective studies prior to the pandemic comparing WBIs in an acute setting in breast cancer. The majority of WBIs developed for the management of other chronic conditions provided an early indication of effectiveness, but insufficient evidence to suggest their widespread adoption. This review presents the rapid growth in evolution of WBIs for pain in breast cancer and summarises literature published between 2021

[a]St James's University Hospital, Leeds Teaching Hospitals NHS Trust, Leeds, [b]Pain Research Institute, School of Health Sciences, Faculty of Health and Life Science University of Liverpool and [c]Liverpool University Hospitals NHS Foundation Trust, Liverpool, UK

Correspondence to Sue Hartup, PhD, Leeds Teaching Hospitals NHS Trust, Post-Doc Nurse Research Fellow in Breast Oncology, Research & Innovation, Beckett Street, Leeds LS9 7TF, UK.
Tel: +44 0113 2068628; e-mail: s.hartup@nhs.net

Curr Opin Support Palliat Care 2024, 18:47–54
DOI:10.1097/SPC.0000000000000691

KEY POINTS

- The majority of breast cancer patients now become survivors, with around 50% experiencing long-term treatment side effects, including chronic pain.
- Providing adequate monitoring, support and information is a high priority to reduce the number of those who go on to develop chronic pain.
- Web-based interventions contain various elements to provide self-management support including information, symptom management, behaviour management, psychological support, interaction with HCPs, peer support and self-monitoring.
- Digital and web-based interventions may empower breast cancer patients to better self-manage their symptoms, reduce the risk of developing chronic pain and improve overall quality of life.

and 2023 concerning effectiveness and highlights the gaps between the emerging research evidence and adoption into the NHS. A systematic search of peer-reviewed literature published during 2022 and 2023 was undertaken using standard databases (Medline, CINAHL, CENTRAL, EMBASE, AMED and PsycINFO). The search excluded papers relating to children, those not published in English and those not relating to breast cancer. Search terms focused on web-based or technology interventions (and derivatives), breast cancer, chronic pain and acute pain.

The prevalence and severity of post-treatment pain in breast cancer survivors depends on various influences including the type and order of treatments received, individual differences such as age, co-morbidities and overall health, and the duration since treatment completion (Table 1).

The review will highlight post-surgical pain as surgery is commonly the first treatment most breast cancer patients will have and is often where the pain experience begins.

Table 1. The main risks for developing chronic pain in breast cancer

Treatment	Specific risks
Surgery	The type of surgery performed; mastectomy, breast conservation, oncoplastic techniques, reconstruction and axilla surgery Nerve damage (especially with axillary node clearance) or the formation of scar tissue
Radiotherapy	Causes tissue inflammation and damage, leading to pain and discomfort in the treated area including underlying structures such as ribs. Length of time from surgery and the presence of on-going post-surgical pain may increase risk
Chemotherapy	Certain chemotherapy drugs can cause peripheral neuropathy, a condition characterised by nerve damage and pain in the hands and feet; especially associated with Taxanes
Endocrine therapy	Endocrine therapies commonly used in breast cancer treatment, such as aromatase inhibitors, can cause joint and muscle pain
Lymphoedema	Characterised by swelling in the arm or chest area. Common after lymph node removal or radiotherapy, leading to pain, discomfort and reduced functionality and quality of life
Psychological factors	Emotional distress, anxiety, and depression can contribute to the perception and experience of pain
Pre-existing pain	Individuals with pre-existing pain conditions or chronic pain may be more susceptible to experiencing post-surgical pain. Previous bad experiences of surgical recovery

PAIN AFTER SURGERY

Postoperative pain is common. Nearly, 20% of patients experience severe pain in the first 24 h after surgery, with postoperative pain management and prevention of chronic post-surgical pain (CPSP) being core responsibilities for healthcare professionals [5]. The Perioperative Quality Improvement Programme [6] 2018–2019 annual report highlighted that 48% and 19.8% of patients reported moderate or severe pain, respectively, at the surgical site within 24 h of surgery. They recommend individualised risk assessment and tailored preparation for surgery.

Most breast cancer operations are undertaken as day surgery, but pain following day surgery and its interference with normal activities extends beyond the immediate surgical period [7–9]. Pain is the most common negative consequence of breast surgery [10] with a significant proportion of breast cancer patients reporting moderate to severe pain after day surgery [11,12]. Lack of education and support into how to self-manage acute post-surgical pain is associated with increased pain [13–15]. Examples of patient surgical education exist but are not widespread and more needs to be done to improve our ability to prevent people from developing chronic pain after surgery [16]. Patients are routinely given written instructions to prepare for and following discharge for surgery, but less than 40% read those instructions and less than 20% can articulate the important information they contain [17]. Monitoring pain following discharge is difficult which increases patient anxiety and vulnerability which in turn affects their ability to self-manage [9]. Providing adequate monitoring, support

and information is a high priority to reduce the number of those who go on to develop CPSP [18–21]. Current pathways do not provide effective monitoring of post-surgical pain despite breast cancer surgery being associated with significant CPSP rates. Effective pain management can improve clinical outcomes and complication rates [21].

CHRONIC POST-SURGICAL PAIN

The definition of CPSP was standardised in 2019 after the inclusion in the new International Classification of Diseases, Eleventh Revision (ICD-11) [22]. It is defined as pain persisting at least 3 months after surgery, often showing characteristics of neuropathic pain [23]. CPSP can be caused by inadequate management of acute post-surgical pain [24–27]. The incidence varies with different types of surgery, but breast cancer surgery has one of the highest documented incidences of between 11–57% and 43–56% are still experiencing pain 12 months after surgery [11]. CPSP in breast cancer can significantly impact quality of life and activities of daily living. What is less understood or explored is, does having subsequent treatments with co-existing post-surgical pain increase the risk of developing chronic pain?

Frequently under-reported and often undertreated, chronic pain affects both physical and mental well-being and has a direct negative impact on quality of life. This review explores the potential of novel technology-based systems to support patients with breast cancer to self-manage their symptoms.

RISK FACTORS

With high rates of CPSP in breast cancer, it is vital to identify risk factors for development. A recent review in this journal by Rosenberger *et al*. [28] discusses the risks of acute-to-chronic pain after surgery so is not discussed in detail here. Papers specific to risks in breast cancer are shown in Table 2 and all considered of special interest [29▪,30▪,31▪].

Table 2. CPSP identified risks in breast cancer surgery

Reference	Identified risks
Tan *et al*. [29▪]	Age, diabetes, pre-operative pain score at sites other than the breast, previous mastitis and perceived stress
Chiang *et al*. [30▪]	42.9% report likely neuropathic pain. Moderate-to-severe preoperative pain and psychological distress at postoperative day 14 are risk factors
Leblanc *et al*. [31▪]	Younger age, axillary lymph node dissection, and unresolved acute pain, with those reporting moderate-to-severe pain being more likely to have neuropathic pain features, pain-related interference, and delayed opioid cessation

Understanding the risks for developing CPSP in breast cancer may allow for early identification of patients at risk and implementation of preventative measures.

HARNESSING TECHNOLOGY ADVANCES IN PAIN MANAGEMENT

One under-utilised type of intervention with the potential to have a positive impact in preventing chronic pain are WBIs utilising patient self-reporting and self-management. Studies have utilised these interventions to help manage chronic post-treatment symptoms in breast cancer survivors. These include encouraging patients to exercise, adhere to endocrine treatments, and cope with longer term outcomes from adjuvant treatments including anxiety and depression, loss of functionality, lymphoedema and reduced quality of life [32–36].

WEB-BASED INTERVENTION VERSUS APP

WBIs and apps are both digital tools used to deliver interventions with the main difference lying in their platform and accessibility. Trying to define a WBI is challenging; how do we compare the varying components they contain; how do we assess effectiveness and is this affected by the individual components; and how do we adopt them across the NHS with its diverse and varied IT systems?

In simple terms, a WBI is an intervention delivered through a web-based platform using the internet, typically via a website. WBIs are designed to be compatible with different operating systems so can be easily accessed on any device connected to the internet including smartphones, tablets, laptops and PC.

Conversely, an app, short for application, is a software program specifically designed to be installed and run on a mobile device, such as a smartphone or tablet. Apps are typically used without being connected to the internet. They may offer the user advice in real-time, but if patient information entered needs to be reviewed by others, such as HCPs, this will only be transferred when the device is connected to the internet. This may result in delayed advice and monitoring.

Interventions vary, containing different elements to provide support to self-manage including information, symptom management, behaviour management, psychological support, interaction with HCPs, peer support and self-reporting. Their design means they are accessible and convenient, allowing patients to engage in interventions from any location. WBIs and apps have been used widely in chronic conditions including mental and physical health. They often utilise behaviour change techniques and promote self-awareness with some

being tailored to patient responses and provide individual advice.

Terminology makes identifying evidence involving such interventions difficult. Terms used include web-based, internet-based, technology-based, digital interventions, and self-monitoring apps. We need to be able to identify studies involving these interventions to be able to undertake systematic reviews with meta-analyses to guide our clinical practice.

INTERVENTIONS IN BREAST CANCER FOLLOW-UP

There is a plethora of studies exploring options for managing chronic symptoms and follow-up in breast cancer, some which are generic and others aimed specifically at established pain. The majority of studies included in a recent review [37] targeted quality of life, anxiety and depression, psychological distress, physical variables, social support or self-efficacy. None had the specific aim of supporting pain as a primary outcome. Digital solutions designed for breast cancer follow-up aim to reduce patient and healthcare system burden. One study found no differences in health-related quality of life or overall satisfaction between 'usual care' follow-up and a digital intervention [38]. However, patients rated the timeliness of response better while using the digital solution. Similarly, no difference was found in outcomes using an intervention that started a minimum of 6 months after treatments [32] at which point, any CPSP would already be established.

A pilot study involving patients with CPSP using a personalised eHealth self-management intervention demonstrated a significant improvement in pain-related functioning, physical functioning, and quality of life [39]. It concluded that personalised eHealth interventions appeared supportive for chronic pain management after breast cancer surgery but acknowledged that a large controlled clinical trial is needed to determine effectiveness.

INTERVENTIONS FOR CHEMOTHERAPY

WBIs for breast cancer patients undergoing chemotherapy using real-time monitoring with electronic patient-reported outcomes resulted in improved physical well-being (6 and 12 weeks) and self-efficacy (18 weeks) [40▪▪]. Whilst pain was not a specific outcome, monitoring and acting on reported symptoms may reduce the risks from chemotherapy known to promote development of chronic pain. A chatbot was similarly reported as a useful and cost-effective intervention to improve self-management and reduce chemotherapy side effects in breast cancer by providing personalised education and improve the accessibility to real-time information [41▪].

INTERVENTIONS FOR RADIOTHERAPY

Interventions for monitoring breast radiotherapy (RT) have included pain monitoring, a recognised side-effect of RT. Two studies demonstrated feasibility of monitoring and supporting patients using the intervention, noting that patients who had received chemotherapy before RT reported slightly more severe pain than patients who did not receive chemotherapy before RT [42,43].

INTERVENTIONS FOR POST-SURGICAL PAIN

Most WBI research in breast cancer surgery are pilot or feasibility studies, therefore further testing is required to determine effectiveness and suitability for adoption into clinical practice. Table 3 describes details of the reviewed studies.

Mohammadzadeh *et al*. [44] study involved a self-management programme accessed via an android app. Outcome measure completed before use and after 3 months. A reported pain average of 6.37 pre-implementation, dropped to a minimum of 4.97 after the post-implementation, which can be considered a positive effect.

Ponder *et al*. [45] reported an app designed to improve patient's surgical experience, whilst tracking quantifiable outcomes from surgery, specifically anxiety, depression, fatigue, pain interference, sleep disturbance, physical function, and ability to participate in social roles and activities. Preliminary PROMs data collected by the app suggested improvements in anxiety, depression, fatigue and sleep disturbance. No comment was made on pain outcomes. This may be because of the reported low completion rate of outcome measures.

Lim *et al*. [46] intervention aimed to support integrated and long-term self-management immediately after surgery and throughout treatments, with the addition of a connected smart band to track steps, heart-rate and sleep. This small study had a high rate of non-completion making it hard to draw conclusions. However, this was the only study exploring the entire treatment pathway.

Two studies explored similar methodology using daily reporting after surgery and providing an insight into feasibility, acceptance and tentative evidence for improved pain management.

Simon *et al*. [47] involved day case surgery of different types including breast surgery. A brief electronic survey sent daily to patients via a Patient Portal for 10 days, assessed common postoperative

Table 3. Interventions for post-surgical pain in breast cancer

Reference	Study type	Sample size	Intervention	Outcomes	Findings
De Groef *et al.* [39]	Feasibility study (for CPSP)	29	Personalised eHealth intervention containing a pain education program and self-management support strategies	Patients completed outcome measures at baseline, 6 weeks, and 12 weeks Acceptability, comprehensibility, and satisfaction were measured with a self-constructed questionnaire after 6 weeks of use. Feedback was sought via focus groups	Patients found the eHealth program easy to use, supportive and overall was well received Significant improvement in pain-related functioning, physical functioning, and quality of life
Mohammadzadeh *et al.* [44]	Cross-sectional descriptive study	24 with a limited age range (51–60)	Self-management programme accessed via an android app. The app comprised five main categories including information acquisition, lifestyle management, psychological management, symptom management, and compatibility with changes. Participants could contact a HCP via a contact us section	QLACS (Quality of Life in Adult Cancer Survivors) questionnaire before and after 3 months	Reported pain average of 6.37 after the pre-implementation, dropped to a minimum of 4.97 after the post-implementation. Improvement in pain quality of life
Ponder *et al.* [45]	Prospective single arm evaluation feasibility study	33, median age 58 years; 19 underwent lumpectomy & 14 mastectomy	App designed to improve the surgical experience for breast cancer patients and tracking of quantifiable outcomes from surgery. Patients could start using the app 2–4 weeks before surgery and they were delivered perioperative information before surgery. Postoperative surveys were automatically available to patients after discharge, and reminders to complete were sent via their smartphones	Baseline and postoperative patient-reported outcomes (PROMs) at 1 week, 1 month, 3 months, and 12 months after surgery PROMs measured anxiety, depression, fatigue, pain interference, sleep disturbance, physical function, and ability to participate in social activities	Users logged onto the application an average of 3.5 times. The median number of questions viewed was 12 (range 2–35). 82.3% said that the app was helpful postoperatively, and 94.1% would recommend it to others Suggested improvements in anxiety, depression, fatigue and sleep disturbance
Lim *et al.* [46]	Single arm	29 recruited but only 18 completed	Personalized rehabilitation intervention according to five key criteria: general user information, breast operation type, lymph node surgery type, chemotherapy and hormonal therapy, and change in treatment after surgery. Addition of a connected smart band to act as a step counter, to track heart rate and sleep	Assessed at 1, 2, 4, 6, 9, 12 months Satisfaction and usability measured after 12 months	Reasons given for non-completion as the smart band was uncomfortable (36%), they felt no need for the app (27%), returned to work (18%), difficulty with continuous use because of treatment (9%), and dissatisfaction with exercise (9%)

Table 3. (*continued*)

Reference	Study type	Sample size	Intervention	Outcomes	Findings
Simon *et al.* [47]	Retrospective. comparison of pre- and post-intervention introduction patients	7156, median age 53 (not all breast cancer) 2970 used the intervention	A brief electronic survey was sent daily to patients via a Patient Portal for 10 days to assess common postoperative symptoms including pain. Each response has pre-set thresholds which, if exceeded, automatically alert the surgeon's care team to contact the patient		22% decrease in emergency visits in patients using the tracker, rising to 42% reduction associated with those who completed at least one survey Completing the survey might contribute to increased self-management of symptoms by increasing patient awareness of their symptoms. Also improved communication to the clinical team
Hartup *et al.* [48▪]	Prospective non-randomised 2-arm feasibility study (intervention vs usual care)	69; mean age 57.7 years (range 38–82). 48 had access to intervention	Web-based intervention (ePainQ) to support pain self-management following breast cancer surgery. Website with educational information and daily reporting of symptoms. Integrated with electronic patient record in real time. Tailored advice based on symptoms reported	Outcomes measured at baseline (pre-surgery), 2 weeks, 3 and 9 months post-operatively: EORTC C30, BR23, HADS, BPI, EQ5D-5 L & PAM	97.5% highlighted ePainQ easy to use with 90% felt very confident using it. Feedback sought via interviews. Confirmed feasibility of conducting a phase III RCT for efficacy of ePainQ

symptoms including pain. Each response had pre-set thresholds which, if exceeded, automatically alerted the surgeon's care team to contact the patient. The intervention was used by 2970 patients. The most common symptom generating alerts was pain, highlighting the need for post-op pain monitoring. The authors suggest that completing the survey might contribute to increased self-management by increasing patient awareness of their symptoms, reinforcing that these are expected and increasing the sense of connection to the clinical team. Results showed a 22% decrease in emergency visits in patients using the tracker, rising to 42% reduction associated with those who completed at least one survey. As a retrospective study, and not all breast patients, results need to be interpreted with caution, but are positive.

Hartup *et al.* [48▪] feasibility study (intervention vs usual care) tested a WBI (ePainQ) to support pain self-management following breast cancer surgery. The intervention involved daily online symptom questionnaire completion for 2 weeks commencing the day after surgery. Participants received immediate advice based on severity of the reported symptoms, either self-management advice or in cases of clinical concern, advice to contact the hospital. Reports were immediately available to healthcare professionals as ePainQ was linked to the electronic patient record. Outcomes were measured at baseline (pre-surgery), 2 weeks, 3 and 9 months post-operatively. A total of 69 patients were recruited with 48 completing the daily intervention. The majority (97.5%) highlighted ePainQ easy to use and 90% felt very confident using it and supportive of pain self-management. The study confirmed feasibility to conduct a RCT of the WBI effectiveness, with the primary outcome of pain intensity and will test the ability of ePainQ to improve pain self-management in breast cancer surgery.

SO, CAN WBIS MANAGE CHRONIC PAIN?

The interventions described which involve the monitoring of post-operative symptoms may help both patients and HCPs identify problems early and thus potentially reduce the risk of developing chronic pain.

There is a need to start monitoring and providing support to self-manage pain from the very first treatment, typically surgery, to reduce the chance of developing chronic post-treatment pain. It is possible that treatment combinations and the presence of on-going acute post-surgical pain at the time of

RT may induce chronic pain. Data from clinical audits in two acute NHS Trusts (unpublished) tentatively suggest that rates of pain immediately before RT are higher than previously thought, with patients feeling this low-level post-surgery acute pain is not of concern. Whilst it is acknowledged that moderate-to-severe post-operative pain increases the risk of chronic pain, are we missing the fact that low-level ongoing pain at the time of adjuvant treatments means patients are almost resigned to getting CPSP? There is a need to compare patients treated with surgery alone vs different combinations of adjuvant treatments to gain an improved insight into occurrence of chronic pain. Are there differences between the order in which treatments are given or is it the severity of acute surgical pain as previously described? Optimisation trial designs may help unpick such questions. If we wish to reduce symptom burden, especially chronic pain, then we should provide improved pain monitoring and support at every stage of breast cancer.

This current and previous reviews [35,37] suggest that digital interventions promoting symptom monitoring and support patients to self-manage symptoms have been shown to improve outcomes in cancer patients. Additionally, these interventions can facilitate early detection and intervention by promoting regular monitoring via self-assessment tools and symptom tracking. By identifying potential risk factors or early signs of pain, individuals can take proactive measures to prevent its onset or progression to chronicity.

However, most WBIs are aimed at monitoring during one treatment or at those with already established chronic pain. This results in gaps between systems used during treatment and those aimed at supporting chronic side effects. The difficulty in comparing the available interventions because of their heterogeneity and lack of long-term outcomes makes an accurate assessment of their use in managing or preventing chronic pain in breast cancer challenging. It is important to note that each individual's pain experience will vary, requiring the development of personalised pain management strategies. Linking interventions with electronic patient records, provides benefits in healthcare settings including a more comprehensive view of a patient's medical history, treatment plans, and interventions, which can help inform and personalise the support provided.

CONCLUSION

Digital and WBIs may empower breast cancer patients to better self-manage their symptoms, reduce the risk of developing chronic pain and improve overall quality of life. Without long-term follow-up it is not possible to prove WBIs are effective beyond the acute treatment phase and reduce the risk of chronic pain. We need to move beyond using interventions purely for monitoring purposes and start thinking of them as preventative tools. The next stage of evolution would be trials involving interventions which provide support and monitoring from the first treatment and throughout and beyond subsequent treatments. Whilst we may need to ask different questions at various stages, we always need to employ real-time monitoring, education, advice, communication and tailoring of advice. Linkage of interventions to electronic patient records would reduce burden and encourage interaction. Is it time to embrace WBIs and provide an all-around better experience for patients and reduce the risk of chronic pain in breast cancer once and for all?

Acknowledgements

None.

Financial support and sponsorship

None.

Conflicts of interest

There are no conflicts of interest.

REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:
- ■ of special interest
- ■■ of outstanding interest

1. Bray F., Ferlay J., Soerjomataram I., *et al.* Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2018; 68:394–424.
2. WHO. Breast cancer fact sheet global breast cancer facts. World Health Organisation. 2021. https://www.who.int/news-room/fact-sheets/detail/breast-cancer. [Accessed 7 November 2023].
3. MacMillan. Cancer prevalence. https://www.macmillan.org.uk/about-us/what-we-do/research/cancer-prevalence. [Accessed 7 November 2023].
4. Cancer Research UK. Breast cancer statistics. https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/breast-cancer. [Accessed 7 November 2023].
5. Small C, Laycock H. Acute postoperative pain management. Br J Surg 2020; 107:e70–e80.
6. The Perioperative Quality Improvement Programme (PQIP). Annual Report 2018–2019. https://pqip.org.uk/pages/ar2019. [Accessed 7 November 2023].
7. Rosén HI, Bergh IH, Lundman BM, Mårtensson LB. Patients' experiences and perceived causes of persisting discomfort following day surgery. BMC Nurs 2010; 9:16.
8. Rosén HI, Bergh IH, Odén A, Mårtensson LB. Patients´ experiences of pain following day surgery – at 48 hours, seven days and three months. Open Nurs J 2011; 5:52–59.
9. Schumacher KL, Plano Clark VL, West CM, *et al.* Pain medication management processes used by oncology outpatients and family caregivers part II: home and lifestyle contexts. J Pain Symptom Manage 2014; 48:784–796.
10. Hickey OT, Burke SM, Hafeez P, *et al.* Severity of acute pain after breast surgery is associated with the likelihood of subsequently developing persistent pain. Clin J Pain 2010; 26:556–560.
11. Wang L, Cohen JC, Devasenapathy N, *et al.* Prevalence and intensity of persistent post-surgical pain following breast cancer surgery: a systematic review and meta-analysis of observational studies. Br J Anaesth 2020; 125:346–357.
12. Vaughn F, Wichowski H, Bosworth G. Does preoperative anxiety level predict postoperative pain? AORN J 2007; 85:589–604.
13. Chou R, Gordon DB, de Leon-casasola OA, *et al.* Management of postoperative pain: a clinical practice guideline from the American Pain Society, the

American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. J Pain 2016; 17:131–157.
14. Rosiek A, Kornatowski T, Rosiek-Kryszewska A, *et al.* Evaluation of stress intensity and anxiety level in preoperative period of cardiac patients. Biomed Res Int 2016; 2016:1248396.
15. Harrington CB, Hansen JA, Moskowitz M, *et al.* It's not over when it's over: long-term symptoms in cancer survivors—a systematic review. Int J Psychiatry Med 2010; 40:163–181.
16. Bruce J, Shug S. Chronic pain after surgery. 2019. https://painconcern.org.uk/chronic-pain-after-surgery/. [Accessed 7 November 2023].
17. Simone C, Zeldin R, Safieddine N, *et al.* Use of mobile device reminders and web-based modules to improve surgical outcomes. Chest 2015; Suppl 48:18A.
18. Ganz PA, Kwan L, Stanton AL, *et al.* Physical and psychosocial recovery in the year after primary treatment of breast cancer. J Clin Oncol 2011; 29:1101–1109.
19. Richards M, Corner J, Maher J. The National Cancer Survivorship Initiative: new and emerging evidence on the ongoing needs of cancer survivors. Br J Cancer 2011; Suppl 105:S1–4.
20. Meissner W, Coluzzi F, Fletcher D, *et al.* Improving the management of post-operative acute pain: priorities for change. Curr Med Res Opin 2015; 31:2131–2143.
21. Kooij FO, Schlack WS, Preckel B, Hollmann MW. Does regional analgesia for major surgery improve outcome? Focus on epidural analgesia. Anesth Analg 2014; 119:740–744.
22. International Association for the study of Pain. IASP Announces Revised Definition of Pain. 2020. https://www.iasppain.org/publications/iasp-news/iasp-announces-revised-definition-of-pain/. [Accessed 7 November 2023].
23. Qian B, Fu S, Yao Y, *et al.* Preoperative ultrasound-guided multilevel paravertebral blocks reduce the incidence of postmastectomy chronic pain: a double-blind, placebo-controlled randomized trial. J Pain Res 2019; 12:597–603.
24. Saporito A, Aguirre J, Borgeat A, *et al.* Persistent postdischarge pain and chronic postoperative pain after breast cancer surgery under general anesthesia and single-shot paravertebral block: incidence, characteristics and impact on quality of life and healthcare costs. J Pain Res 2019; 12:1193–1199.
25. Moka E, Argyra E, Siafaka I, Vadalouca A, *et al.* Risk factors (anaesthetic technique, surgery) and genetics (genetic polymorphism). Reg Anesth Pain Med 2013; 38:Suppl 1.
26. Schug SA., Bruce J. Risk stratification for the development of chronic post-surgical pain. Pain Rep 2017; 2:e627.
27. Macrae WA. Chronic post-surgical pain: 10 years on. Br J Anaesth 2008; 101:77–86.
28. Rosenberger DC., Segelcke D, Pogatzki-Zahn EM. Mechanisms inherent in acute-to-chronic pain after surgery – risk, diagnostic, predictive, and prognostic factors. Curr Opin Support Palliat Care 2023; 17:324–337.
29. ■ Tan HS, Plichta JK, Kong A, *et al.* Risk factors for persistent pain after breast cancer surgery: a multicentre prospective cohort study. Anaesthesia 2023; 78:432–441.

Multi-centre study of 210 patients which importantly includes different ethnicities highlighting PPSP rate of 64% and identified risk factors.

30. ■ Chiang DLC, Rice DA, Helsby NA, *et al.* The incidence, impact, and risk factors for moderate to severe persistent pain after breast cancer surgery: a prospective cohort study. Pain Med 2023; 24:1023–1034.

Australian study of 173 patients which identified risk factors for PPSP which importantly highlights high rates of neuropathic pain.

31. ■ Leblanc D, Guichoux A, Sail M, *et al.* Unresolved early post-operative pain trajectory predicts moderate-to-severe persistent pain after breast cancer surgery—an observational cohort study. Acta Anaesthesiol Scand 2023; 67:448–454.

French study of 608 patients which used pain at 24 h to accurately model pain trajectories and identified risk factors for PPSP.

32. Cheng KKF, Siah R, Zhang M, *et al.* Effect of an e-home based symptom management and mindfulness training program on quality of life in breast cancer survivors: a randomized clinical trial. J Clin Oncol 2021; 39:12080.
33. Ester M, Wagoner CW, Dreger J, *et al.* Effectiveness of a self-monitoring app in supporting physical activity maintenance among rural Canadians with cancer after an exercise oncology program: cluster randomized controlled trial. JMIR Cancer 2023; 9:e47187.
34. Pimentel-Parra GA, Soto-Ruiz MN, San Martín-Rodríguez L, *et al.* Effectiveness of digital health on the quality of life of long-term breast cancer survivors: a systematic review. Semin Oncol Nurs 2023; 39:151418.
35. Obrero-Gaitán E, Cortés-Pérez I, Calet-Fernández T, *et al.* Digital and interactive health interventions minimize the physical and psychological impact of breast cancer, increasing women's quality of life: a systematic review and meta-analysis. Cancers (Basel) 2022; 14:4133.
36. Sella T, Snow C, Freeman H, *et al.* Young, empowered and strong: a web-based education and supportive care intervention for young women with breast cancer across the care continuum. JCO Clin Cancer Inform 2021; 5:933–943.
37. Huang Y, Li Q, Zhou F, Song J. Effectiveness of internet-based support interventions on patients with breast cancer: a systematic review and narrative synthesis. BMJ Open 2022: 12:e057664.
38. Mattson J, Peltola M, Poikonen-Saksela P, *et al.* Digital solution in the follow-up of early breast cancer a randomized study. Acta Oncol 2023; 62:513–521.
39. De Groef A, Evenepoel M, Van Dijck S, *et al.* Feasibility and pilot testing of a personalized eHealth intervention for pain science education and self-management for breast cancer survivors with persistent pain: a mixed-method study. Support Care Cancer 2023; 31:119.
40. ■■ Absolom K, Warrington L, Hudson E, *et al.* Phase III Randomized Controlled Trial of eRAPID: eHealth Intervention During Chemotherapy. J Clin Oncol 2021; 39:734–747.

Very important paper highlighting the use of an ePROM intervention, which demonstrates efficacy and ability to be used as part of the routine care clinical pathway and supports patient self-management and HCP decision making.

41. ■ Tawfik E, Ghallab E, Moustafa A. A nurse versus a chatbot – the effect of an empowerment program on chemotherapy-related side effects and the self-care behaviors of women living with breast cancer: a randomized controlled trial. BMC Nurs 2023; 22:102.

Highlights that personalised education and accessibility to real-time, high-quality information in web-based interventions play an active role in supporting patients to self-manage their symptoms.

42. Takala L, Kuusinen TE, Skyttä T, *et al.* Electronic patient-reported outcomes during breast cancer adjuvant radiotherapy. Clin Breast Cancer 2021; 21: e252–e270.
43. Lam E, Wong G, Zhang L, *et al.* Self-reported pain in breast cancer patients receiving adjuvant radiotherapy. Support Care Cancer 2021; 29:155–167.
44. Mohammadzadeh Z, Eghtedar S, Ayatollahi H, Jebraeily M. Effectiveness of a self-management mobile app on the quality of life of women with breast cancer: a study in a developing country. BMC Womens Health 2022; 22:446.
45. Ponder M, Venkatraman V, Charalambous L, *et al.* Mobile health application for patients undergoing breast cancer surgery: feasibility study. JCO Oncol Pract 2021; 17:e1344–e1353.
46. Lim JY, Kim Y, Yeo SM, *et al.* Feasibility and usability of a personalized mHealth app for self-management in the first year following breast cancer surgery. Health Informatics J 2023; 29:14604582231156476.
47. Simon BA, Assel MJ, Tin AL, *et al.* Association between electronic patient symptom reporting with alerts and potentially avoidable urgent care visits after ambulatory cancer surgery. JAMA Surg 2021; 156:740–746.
48. ■ Hartup S. M., Ashley L., Briggs M., *et al.* Developing and feasibility testing a web-based intervention (ePainQ) to support post-operative pain and symptom self-management following surgery for breast cancer. Cancer Res 2023; 83:P6-05-57.

Highlights high rates of acceptance and usability of a web-based intervention in breast cancer surgery which can be integrated with the electronic patient record in real time offering support to both patients and HCPs.