Adding value to care through live bedside music

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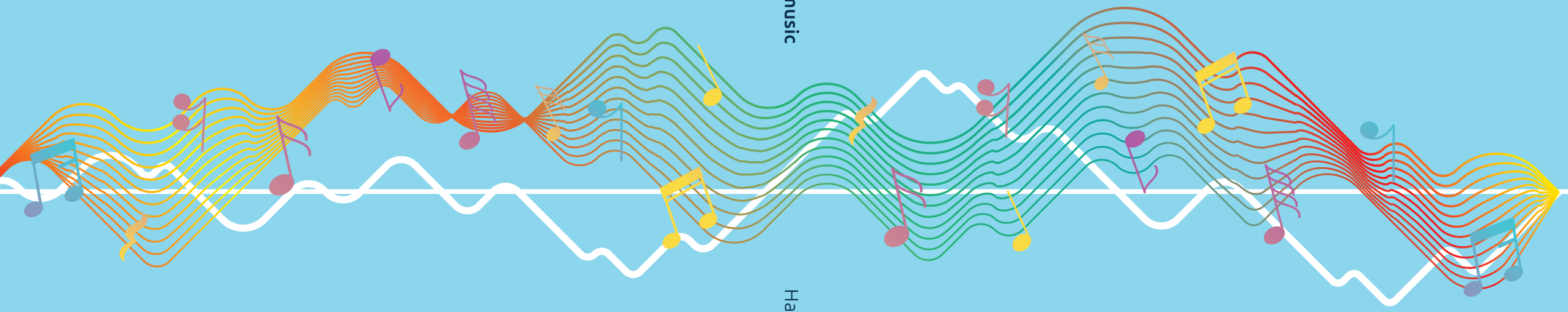

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CHAPTER 1

General Introduction and outline of thesis

AGEING POPULATION

In the twentieth century, advances in medicine, public health and living conditions have had a profound impact on life expectancy, resulting in rapid ageing of the population that is expected to peak in the next decades (1-3). Worldwide, it is expected that by 2050, 2.1 billion people will be aged 60 years or older (4), constituting the fastest-growing age group (5). This demographic development has profound impact on hospital care as older adults are more than twice as likely to need hospitalization (6). In 2019, more than 50% of the patients admitted to hospital, and 60% of patients requiring surgery in the Netherlands were 65 years or older (7). Surgery has become an essential component of health care (8).

OLDER SURGICAL PATIENT

Where previously the number of years a person had lived (chronological age) was a reason to decline surgery, it is no longer, due to the advances in surgical and anaesthesiologic techniques. The biological ageing process, the physical age, is not linear and consistent, and is influenced by external factors such as social circumstances and lifestyle (9,10). As a result, older people are a heterogeneous group in terms of health and functional status (11).

Unfortunately, older patients are more prone to develop postoperative complications with negative consequences and unfavourable outcomes such as functional decline, loss of dependency and cognitive decline (12-16). The age-related decline in physiological reserves affects how well older patients are able to tolerate stresses such as surgery (17, 21-23). Although the exact physiological mechanism is unclear, it is known that surgery is a physical strain that results in several hormonal and metabolic changes. One of the main components of this surgical stress response is activation of sympathetic branch of the autonomic nervous system (18). This activation contributes to general recovery, for example by activating the immune system (19). Achieving homeostasis requires a proper balance of the nervous system, otherwise disbalance occurs which can have detrimental effects such as the development of postoperative complications, especially in older patients (20).

The heterogeneity between older people and the increased risk of complication cause older patients to require specific attention during the perioperative period to prevent negative outcomes (24-26).

NURSING CARE

Nurses have an important role in restoring optimal health and preventing complications in older (surgical) patients and spend approximately 59-96% of their time providing care (27, 28). Nursing care encompasses promotion of health, prevention of illness and care of physically and/or mentally ill people (29). Although there are many models of nursing, there are two underlying basic assumptions; nursing is interpersonal and it is holistic, rejecting mind-body dualism (30).

Nurses identify the health needs, values and preferences of the patient (31). They collect information from the patient, establish diagnoses, perform interventions and evaluate the outcomes (32). Their assessment focuses on physical as well as emotional, social and spiritual needs. Utilizing non-pharmacological interventions, nurses can play an important role in providing adequate, fitting care, especially in the care for the older patient (33). Non-pharmaceutical interventions, interventions that do not involve taking medicine or other active substances, can be preferable in caring for older patients due to the risk of adverse effects and drug interactions (34-37). Music is such a non-pharmacological intervention. Although Florence Nightingale, who can be seen as the founder of modern nursing, already noted the influence of music on her patients (38), its use is still limited in care for older hospitalized patients.

MUSIC

Music is a universal guise; (often) ubiquitous, accessible and meaningful. It has a prominent role in daily life of many people worldwide (39). People are exposed to music approximately three hours per day, consciously and unconsciously (40). Music is often of meaning in both joyful and sad life events, and has been used to promote human well-being for centuries. Since the beginning of the 21st century there is renewed interest in the role of the arts, particularly music, on health and well-being (41,42). Music is used in different ways in healthcare. Although recorded music seems to be the least intrusive way to facilitate music, live music is distinctive. It has a social aspect, can create shared experiences, engagement and in addition, there is the visual aspect of seeing the music being performed (43,44). Live music is adaptive and flexible. The sound, the intensity and content, can be adapted to the particular circumstances in which the music is played. One can listen to music passively, but also participate in the music practice, so called participatory music practice. Participatory music practice is characterized by activities that take place when people engage in music interaction and creates a shared experience (45). It requires no skills from the participants (46). Musicians can play at the bedside for patients, whit or without active participation of the patient, depending on

one's situation. However, knowledge on practice and outcomes of live music sessions at the bedside of older hospitalized (surgical) patients is limited, as well as knowledge on patient related outcomes and experiences.

AIM AND OUTLINE OF THE THESIS

Although there is an increased awareness of the role of music in healthcare worldwide, live bedside music is relatively new in the Netherlands and not yet embedded in clinical practice. It remains unclear how live bedside music can be of meaning for the growing population of older (surgical) patients. Therefore, the aim of this thesis was to gain insight in the practice, the underpinning theoretical mechanism, the effect and the added value of live bedside music for older hospitalized patients, with primary focus on the older surgical patient. Chapter 2 describes a systematic review assessing the effect of music on postoperative recovery in older patients and to gain insight in the underpinning theoretical mechanisms. Chapter 3 provides an overview of the trial protocol describing the innovative live bedside music practice named Meaningful Music in healthCare (MiMiC). Chapter 4 investigates the effect of live bedside music on clinical outcomes in older patient after surgery, primarily on the level of perceived pain, before and after the live bedside music session. In chapter 5 the response of the autonomic nerve system on live bedside music is explored using heart rate variability as a proxy in order to contribute to a better understanding of how music can contribute to the (physical) recovery of older patients. In chapter 6 the added value of the live bedside music practice for older hospitalized patients is investigated in Austria and the Netherlands. Finally, chapter 7 describes focusses on future perspectives of the role of live bedside music in care, how it fits in the transition in which human values are more central in healthcare. Recommendations are made for research, funding, education and training so music can be complementary and contribute to meaningful care.

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CHAPTER 2

The effect of music on postoperative recovery in older patients: A systematic review

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ABSTRACT

Objective

Surgery is an important part of the treatment modalities offered to older patients with cancer. Natural ageing processes lead to deterioration of organ function, making older patients more vulnerable and at risk for experiencing less-favourable outcomes and complications after surgery. Non-pharmaceutical interventions, such as music, may be preferable to medical interventions in older people, who are at risk for adverse effects and drug interactions due to altered physiology and drug metabolism. We aimed to assess the effect of music on postoperative recovery in older patients and to determine the underpinning theoretical models.

Materials and Methods

This systematic review used the databases PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychINFO, and Répertoire International de Littérature Musicale (RILM). Clinical studies published, until 2015, investigating music as a single intervention for hospitalised patients postoperative, population mean age 60 years or older were selected. All types of postoperative music interventions, consisting of single or more sessions, which take place at a hospital ward. All patient outcomes were included. The search and screening was performed twice, independently, and seventeen articles were finally selected.

Results

Four theoretical models were detected underpinning the effect of music on postoperative recovery. The way the music interventions were shaped, varied strongly. Therefore it remained unclear what is the most effective way of performing the music in the postoperative period. Although evidence is still limited, results do show that music has a positive effect on the recovery of older patients after surgery. Pain and anxiety are reduced, and relaxation, cognitive functioning, and patient satisfaction increase during postoperative recovery. No negative side effects of music as an intervention were found and therefore seems a non-harming and non-invasive intervention.

Conclusion

It seems worthwhile to further explore live music making in music interventions with older hospitalised surgical patients

1. INTRODUCTION

The number of people aged 60 years or older will rise by up to two billion in years to come and the ageing of the global population is a fundamental factor for the development of solid tumours (1,2). Surgery is an important part of the treatment modalities offered to older patients with cancer. However, the natural ageing process causes physiological deterioration of organ function and makes older patients more vulnerable for less-favourable outcomes such as more-frequent readmissions and a higher rate of complications after surgery (3,4). Post-operative complications such as delirium, pain and, functional decline lead to worse outcomes in older patients (5,6). Since the mid-20th century there has been a growing interest in music within the medical community because of its therapeutic effects (7). Non-pharmaceutical interventions, such as music, may be preferable to medical interventions in older people who are at risk for adverse effects and drug interactions due to altered physiology and drug metabolism (8,9). Music is an attractive intervention, especially for older patients due to low costs and it has few, if any, side effects. Recently published studies and reviews describe the effect of music on a specific symptom such as pain or emotional stress and/or anxiety (10-16). However, these reviews do not focus specifically on older surgical patients.

This systematic review aims to identify the effect of music on postoperative recovery in older hospitalized surgical (oncological) patients. Furthermore, it seeks to identify the theoretical models used to underpin their findings.

2. METHODS

This systematic review was conducted following the recommendations of the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) method (17). The following databases were used: PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychInfo, and Répertoire International de Littérature Musicale (RILM). Medical Subjects Headings (MeSH) were used to select search terms. The initial search used the string "'music' AND 'elder OR older' AND 'operation OR surgery'", even without the term 'oncology' revealed a limited number of results in the electronic databases PubMed (12), CINAHL (7), PsychInfo (9), and RILM (11) with only three relevant articles.

To increase the number of retrieved articles, the search was extended by eliminating the terms 'elder OR older.' Publication type was limited to (academic) journals or field: title/abstract (only for PubMed), period till December 2015 and a filter for Dutch and English language were used. The studies were screened manually on their compliance with the following inclusion and exclusion criteria (Fig. 1).

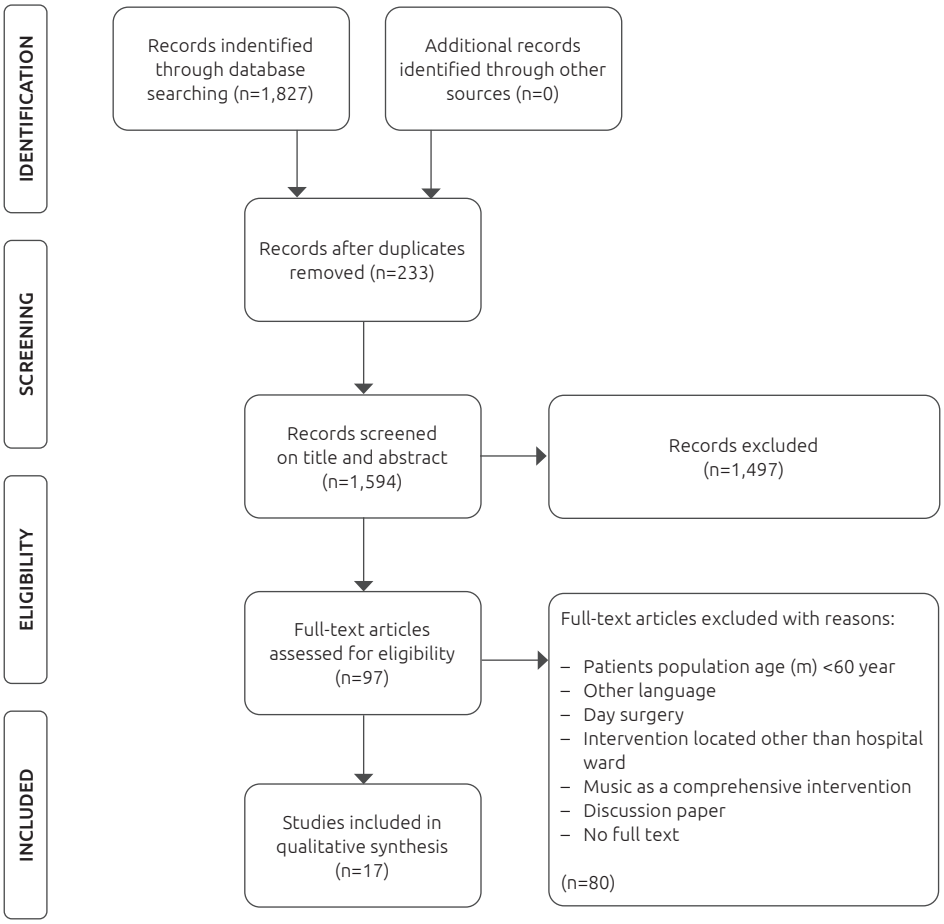

Figure 1. PRISMA flow diagram.

2.1. Inclusion criteria

- Hospitalized surgical postoperative patients (no out clinic surgery);
- Age (mean) ≥60 years;
- Music as single intervention;
- All types of music, single or more occasions, all durations and decibels;
- Outcomes measured during admission.

The search and screening were performed twice, independently by HWH and KD. Points of disagreement were discussed with HWH, KD, and BL to reach consensus. This review did not focus on the effects of a music therapist in a hospital setting.

2.2. Synthesis

Due to the heterogeneity of the articles in study design, mean age, and outcome a meta-analysis was not possible. Instead, the studies were synthesized by summarizing and integration according to the following questions: 1. What are the theoretical models that underpin the studies? 2. How were the music interventions operationalized? 3. What is the effect of music on postoperative recovery?

3. RESULTS

A total of 1827 articles were identified. After removal of duplicates and screening of titles and abstract, 97 full-text articles were selected and assessed for eligibility (Fig. 1). For the purpose of this review, seventeen articles were finally selected in which the effect of music as an intervention in older postoperative patients was determined.

First, a summary is presented of the theoretical models of the retrieved studies. Second, a description is given of the operationalization of music as an intervention. Finally, the results concerning the effect of music on postoperative recovery are described. An overview of the included studies is shown in Table 1.

3.1 Theoretical mechanisms

Four theoretical models were distinguished as visualized in Fig. 2. The Cognitive-behavioural framework model (reducing stress via distraction) combines behavioural/cognitive and physiological theoretical models (18). These models stipulate that music is able to increase competence, autonomy, and relatedness resulting in distraction and better coping. Distraction is facilitated through a more comfortable environment for patients and music may contribute to a more positive hospital experience (18). Three studies refer to the Gate Control Theory (GCT) (19–21). This theory, first described by Melzack (22), focuses on behavioural (attention and distraction) and coping aspects. GCT advocates that pain impulses are transmitted from the nerve receptor to synapses in the grey matter. The synapses are thought to act as gates that may either open or close to allow or prevent the impulses from reaching the brain. Whether these gates are open or closed, depends on what other kinds of sensory impulses are simultaneously bombarding the gates. Music may deviate sensory input from the brainstem, close the gating mechanism and as a result reduce the pain experience. A third theoretical model states that music releases endorphins and changes catecholamine levels in ways that facilitate pain relief and a decrease of blood pressure, heart rate, respiratory rate, and oxygen consumption (23). The fourth theoretical model described by Pasero (24) states that the stress caused by pain in turn may cause the cardiovascular system to respond by activating the sympathetic nervous system (25). This results in an increased heart rate, blood pressure, and higher oxygen demand.

Table 1. Included studies.

Reference	Objective	Study design	Type of surgery	Patients	Measurements
Allred et al. (25)	To determine if listening to music or having a quiet rest period just before and after the first ambulation postoperative can reduce pan and/or anxiety or affect mean arterial pressure, heart rate, respiratory rate and/or oxygen saturation	Experimental design (music vs bedrest)	Orthopaedic surgery	Music n = 28 Bedrest n = 28	Pain: T1, T2, T3, T4, (T1) Anxiety: T1, T2, T3, T4 Physiologic parameters: T1, T2, T4 T1: 20 min before ambulation T2: just before ambulation T3: immediately after ambulation T4: 20 minutes after ambulation T5: 6 h after ambulation
Barnason et al. (35)	To examine the influence during the early postoperative period of selected nursing interventions on mood and anxiety op patients undergoing heart surgery	Prospective, repeated measures, quasiexperiemental	Cardiovascular surgery	Music n = 33 Music video n = 29 Scheduled rest n = 34	Anxiety: before surgery, POD 2 & 3 Mood: before and after intervention POD 2 & 3 Blood pressure, heart rate: before and during intervention at 10-minute intervals
Bauer et al. (36)	To test the effects of structured music with nature sounds on the level of pain and anxiety in cardiac surgical patients	Randomized experimental trail	Cardiovascular surgery	Music n = 49 Control n = 51	Visual Analog Scale (0–10), blood pressure and heart rate before and after intervention
Chaput-McGovern and Silverman (18)	To examine the effects of single-dose patient preferred live music therapy sessions on pain anxiety, nausea and perception of treatment	Pre-, post test	Surgical oncology	Music n = 27	Pre-test, posttest, 30–45 min follow-up
Lin et al. (26)	To evaluate the effects of music therapy on anxiety, postoperative pain and physiological reactions to emotional and physical distress in patients undergoing spinal surgery	Quasi- experimental pre and posttest design	Spinal surgery	Music n = 30 Control n = 30	Pain: before and after listening Anxiety: evening before surgery and second day after surgery Physiological functions: before and after listening Urine: collected POD-1 till POD3
Masuda et al. (27)	To elucidate effects of music listening on postoperative pain and/or stress in elderly orthopedic patients	Randomized controlled trail	Orthopaedic surgery	Music n = 22 Control n = 22	Pain: before start and after 10 and 20 min after starting listening Vital signs: heart rate, systolic and diastolic blood pressure (just before start, at 10 and 20 min) Skin temperature & skin blood flow: during music listing

Table 1. Continued.

Reference	Objective	Study design	Type of surgery	Patients	Measurements
McCaffrey and Locsin (32)	To determine the effect of music on acute confusion and delirium in postoperative elders who underwent elective hip or knee surgery	Randomized controlled trail	Orthopaedic surgery	Music n = 33 Control n = 33	Notes and checklist: until discharge. Readiness –to-ambulate: once, postoperative day
McCaffrey and Locsin (33)	To examine the effects of music listening in older adults following hip or knee surgery on pain, cognition, the ability to ambulate after surgery and patient satisfaction	Randomized controlled trail	Orthopaedic surgery	Music n = 62 Control n = 62	Preoperative and each of the 3 postoperative days
McCaffrey (34)	To determine the effects of music listening on acute confusion in older adults after hip or knee surgery	Randomized controlled trail	Orthopaedic surgery	Music n = 11 Control n = 11	Pain: every 8 h post-surgery Consumption pain medication: POD 1. Nurses notes Satisfaction: by telephone 2 weeks after surgery
Nilsson (28)	To compare the effect of bed rest with or without music on relaxation after coronary artery bypass grafting and/or aortic valve replacement surgery on postoperative day one	Randomized controlled trail	Cardiovascular surgery	Music n = 20 Control n = 20	Before intervention, after 30 min and after 60 min
Sendelbach et al. (29)	To test the effect of music therapy compared to rest in bed on patient's pain intensity, anxiety levels, HR, BP as well as opioid consumption on patients undergoing open- heart surgery	Randomized controlled trail	Cardiovascular surgery	Music n = 50 Control n = 36	POD 1 till 3, 2 times a day, before and 20 min after intervention
Twiss et al. (23)	To determine the effect of music listening on postoperative anxiety and intubation time in patients undergoing coronary artery bypass graft and valve replacement	Randomized controlled trail	Cardiovascular surgery	Music n = 30 Control n = 30	Anxiety: the night before surgery & third POD. Intubation period: from moment patient left operating room until extubation (minutes)

Table 1. Continued.

Reference	Objective	Study design	Type of surgery	Patients	Measurements
Vaajoki et al. (19)	To evaluate the effects of music listening on blood pressure, heart rate, and respiratory rate in postoperative abdominal surgery patients	Quasi- experimental pre-post -test design	Abdominal surgery	Music n = 83 Control n = 85	Blood pressure, heart and respiratory rate: all measured with an automatic machine before and after intervention and on 3 day postoperative once
Vaajoki et al. (30)	To evaluate the effects of listening to music on pain intensity and pain distress after abdominal surgery	Prospective clinical study	Abdominal surgery	Music n = 83 Control n = 85	Pain intensity and distress: in bed rest and active state Fear; POD 3
Vaajoki et al. (30)	To assess the effect of music listening on analgesic use, length of hospital stay, and adverse effects in adult patients having laparotomy	Prospective clinical study	Abdominal surgery	Music n = 83 Control n = 85	Analgesic use: 72 h post-operative. Length of hospital stay: from day of admission to day of discharge from the hospital Adverse effects; 72 h post-operative
Voss et al. (39)	To examine the effects of sedative music and scheduled rest on self-reported anxiety, pain sensation, and pain distress during 30 minutes of chair rest in postoperative open-heart surgery	Randomized controlled trail	Cardio-thoracic surgery	Music n = 19 Scheduled rest n = 21 Control n = 21	Before intervention and 30 min after chair rest.
Zimmerman et al. (21)	To determine the effects of second and third day postoperative music interventions on pan and sleep in postoperative patients having CABG surgery.	Prospective, repeated measures, quasiexperimental random	Cardiovascular surgery	Music n = 33 Music video n = 29 Scheduled rest n = 34	Pain: before and after intervention (VRS) and before intervention on POD 2 and after intervention on POD 3 (MPQ) Sleep: preoperative and morning of POD 3

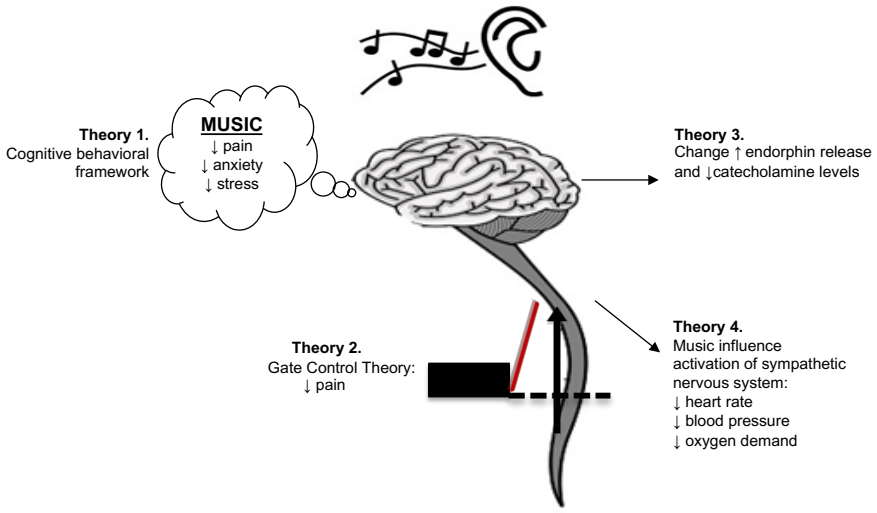

Fig. 2. Theoretical models underpinning the effect of music.

3.2. Music as an intervention

In all studies (18,19,21,23,25–36), patients were exposed to recorded music except for one study (18) where the intervention consisted of live music performed on an acoustic guitar (Table 2). In the other studies, patients listened through music devices such as head- or earphones (19,21,23,25,30,31,35,37), CD player (32–34,36,39), or a Wellness MusicPillow (28). In one study the continuous playing of music started at the beginning of surgery and continued in the intensive care area until the third day after surgery (23). In the other studies, the exposure to music varied in timing in the post-operative period, frequency, and duration. Seven studies performed the intervention just once or twice, three studies (23,26) offered a minimum of three or four listening sessions, and seven studies (19,20,30,31,33,36) offered six or more sessions. The duration of each intervention varied between 20 to 60 minutes; with the exception of one study offering 3-hour walk-in sessions (18). One study did not mention the duration of the intervention (23). All studies offered patients the option to select music from a set of pre-composed songs. The live music intervention (18) also made use of pre-composed music, as patients could request songs to be played on guitar. Three studies (32–34) report to have offered 20 records to choose from in the genres lullaby, pop, classical, folk, and sedative. Two studies (21,35) offered a selection of five tapes, from three musicians, containing soothing types of music. Three studies (19,30,31) used domestic or foreign hit songs, dance, pop, rock, soul, blues, spiritual, and classical music. The remaining studies offer mainly domestic traditional music (26,37), western classical (20,37), and/or nature sounds (26,36). Six studies (19,23,28,30,39) had music professionals select music from a pre-defined set of six Prescriptive Music CDs containing music, that has shown to help relax hospitalized patients, in cooperation with

a music therapist. Five studies (20,23,25,37,39) indicated to have chosen music in a slow tempo or within the range of 60 to 80 beats per minute (bpm).

All studies offered the intervention in the patient's hospital room, except for one (23) where the intervention commenced in the operating theatre. Four studies (26,37,39) reported to have given additional aids to support the comfort of the music listening group in comparison to the control group. This consisted of encouraging a comfortable position, placing a 'do-not-disturb'-sign on the door, or conducing the environment for rest, through reducing ceiling light and/or ambient noise. The choices of the songs played to the patient were determined in three ways. First, in some studies patients were invited to select their preferred music from the given set (19,20,26,30,31,36,37,39). In one study (39) participants were first presented with a 30 s excerpt, on the basis of which the continuation of listening was pursued (or not). Second, researchers defined the selection of songs for each participant (28). And finally pre-defined music listening was combined with patient-selected listening in the remaining studies (21,23,32–35). In two studies (37,39) the intervention setup allowed real time adjustments in the volume and pitch of the music playing. Patients were able to change volume or volume was reported so that music was heard comfortably. Live music can adapt to the patients' situation in a way that recorded cannot. It was used in one study (18) playing guitar music real time on demand.

3.3. Effects on patient recovery

3.3.1. Pain

Eleven studies (18,19–21,25,26,30,33,36–39) described the effect of music focused on different aspects of postoperative pain. Table 3 shows that all studies found that music had a positive effect even though the postoperative day and frequency of the intervention varied. However, three of five studies found no significant difference in opioid consumption between the intervention and control group, despite the overall lower pain scores in the music group (20,25,30). Table 3. Effects on patient recovery.

3.3.2. Anxiety

Eight studies examined the effect of music on anxiety (18,20,23,25,26,35,36,39). using different methods including a Visual Analogue Scale (VAS) or Numeric Rating Scale (NRS) (25,26,35,36,39), the state anxiety portion of Spielbergers' State Anxiety Inventory (SAI), (20,23) the Trait portion of the STAI (26,35) and a ten point Likert type scale (18). Three (18,26,39) of the six studies using the VAS, NRS or Likert scale found lower postoperative anxiety scores among patients in the music group. In the remaining three studies (25,35,36), the overall anxiety scores in the music group failed to reach significance. A study by Lin (26) found a decrease in anxiety in the music group throughout the entire observation period using VAS, however this was not confirmed with the SAI. This is in contrast to two other studies that did find significantly lower scores in the music group with the SAI (20,23).

Table 2. Operationalization of music as intervention.

Author	Location	Activity	Music genre	Moment of intervention	Frequency of intervention	Duration of intervention
Allred et al. (25)	Patients room, in bed	Listening CD with headphones	Easy listening music, no lyrics, sustained melodic quality, 60-80 bpm or less, no strong rhythms or percussion.	Before first ambulation and a 20 min rest period after the ambulation	Twice on first post-operative day (POD)	20 min
Barnason et al. (35)	Patients room	Listening audiotapes through headphone	A selection of five tapes from three musicians was offered, all soothing types of music.	Postoperative day 2 & 3	Once	30 min
Bauer et al. (36)	Patients room, in bed	Listening CD/CD player	A selection of four CDs: Summer Song, Autumn Song, Bird Song or Night Song.	Postoperative day 2 till day 4	Daily twice	20 min
Chaput-McGovern and Silverman (18)	Patients room	Listening to live music, potentially interacting and responding to musician	Live music, patient-preferred, by a steel string acoustic guitar.	Postoperative, day unknown	Once	20 min
Lin et al. (26)	Patients room, in bed, stimuli reduced	MP 3 player	Soft melodies in Chinese including pop music, classical music, nature sounds, sacred music. Patient-selected.	Moring on the day before surgery, 60 min before surgery, first and second day after surgery in the afternoon	Four times	30 min
Masuda et al. (27)	Patients room, lying in bed	Listening using portable CD player with headphones	Patients selected Enka: melodramatic and representative genre of Japanese popular songs, lyrics about sad aspects of life and are sung with a slow tempo.	Postoperative ca day 3	Once	20 min
McCaffrey and Loscin (32)	Patients room	Listening using CD player	Upon arrival lullaby, then patient-selected from a varied selection including Glenn Miller, Barbara Streisand, Andrea Bocelli, Bach, Vivaldi, Celtic, Nature sounds, Guitar and music for mediation.	Postoperative	At most 3 times a day, minimum of 1 h, daily until discharge	Minimum of 1 h

Table 2. Continued.

Author	Location	Activity	Music genre	Moment of intervention	Frequency of intervention	Duration of intervention
McCaffrey and Loscin (33)	Patients room	Listening using CD player	CD player, upon arrival patient room from the recovery patients listened to soothing lullaby music played continuously, after awakening patient could choose from a variety of music provided by the researchers.	Postoperative for 3 days	At least four times a day	Minimum of 1 h
McCaffrey (34)	Patients room	Listening using CD player	Upon arrival lullaby, then patient-selected from a varied selection including Glenn Miller, Barbara Streisand, Andrea Bocelli, Bach, Vivaldi, Celtic, Nature sounds, Guitar and music for mediation.	Postoperative for 3 days	At least four times a day	Minimum of 1 h
Nilsson (28)	Patients room, stimuli reduced, lying in bed on Wellness Musicpillow	Listening through Wellness Musicpillow connected to a MP3 player	Predefined set of music called MusiCure: a soft, relaxing and including different melodies of 60 to 80 bpm with a volume of 50–60 dB.	Postoperative day 1 at 12 noon	Once	30 min
Sendelbach et al. (29)	Patients room, in bed, environment made conducive	Listening taped music by headphone	Relaxing music with: no dramatic changes, consonance, instrumental music an 60-70 bpm. Patient chose easy listening, classical and jazz.	Postoperative day 1 till 3: between 8 am and 10 am & between 4 pm and 9 pm)	Daily twice	20 min
Twiss et al. (23)	Patient in bed	Listening using CD player and headphone	6 CDs purchased from Prescriptive Music Inc. with relaxation and calming music, patients selected the music the night before.	Continuously throughout the surgery until 3rd day after surgery	Continuously	–
Vaajoki et al. (19)	Patient in bed	Listening through headphone and MP3 player	Patient chose favorite music out of 2000 songs: domestic or foreign hit songs, dance, pop, rock, soul and blues, spiritual or classical.	Evening of the operation, 1 & 2 postoperative day in the morning (8–9 hours), midday (13–15 h) and evening (18–20 h)	Day 0: once Day 1: three times Day 2: three times Day 3:-	30 min

Table 2. Continued.

Author	Location	Activity	Music genre	Moment of intervention	Frequency of intervention	Duration of intervention
Vaajoki et al. (30)	Patient in bed	Listening through headphones by an MP3 player	Patient chose favorite music out of 2000 songs: domestic or foreign hit songs, dance, pop, rock, soul and blues, spiritual or classical.	Evening after operation, 1 & 2 postoperative day in the morning (8–9 hours), midday (13–15 h) and evening (18–20 h)	Day 0: once Day 1: three times Day 2: three times Day 3: -	30 min
Vaajoki et al. (30)	Patient in bed	Listening through headphones by an MP3 player	Patient chose favorite music out of a selection of domestic and foreign hit songs, dance, pop, rock, soul and blues, spiritual and classical.	Evening after operation, 1 & 2 postoperative day in the morning (8–9 h), midday (13–15 h) and evening (18–20 h)	Day 0: once Day 1: three times Day 2: three times Day 3: -	30 min
Voss et al. (39)	Patients room (private, intensive care), in chair, stimuli reduced	Listening through soft open-air headphones and a tape player	Sedative music without lyrics, general absence of strong rhythms or percussion. Six types of music: synthesizer, harp, piano, orchestra, slow jazz and flute.	First day postoperative	Once	30 min
Zimmerman et al. (21)	Patients room	Listening audiotapes through headphone	A selection of five tapes from 3 musicians was offered, all soothing types of music.	Postoperative day 2 & 3	Once	30 min

Table 3. Effects on patient recovery.

Outcome	Reference	Instruments	Outcomes	Effects (+positive/-no difference/±trend)
Pain	Zimmerman et al. (21)	VRS[a] MPQ[b]	VRS: lower scores over time[i] MPQ: lower scores over time[i]	+
	Voss et al. (39)	VAS[c]	Pain distress: lower scores[i] Pain sensation: lower scores[i]	+ +
	Masuda et al. (27)	VAS[c] FS[d]	VAS: lower scores[i] FS: lower scores[i]	+ +
	McCaffrey and Locsin (33)	NRS[a] Pain medication	Lower scores[i] Less usage of pain medication[i]	+ +
	Allred et al. (25)	VAS[c]	VAS: no difference between group	-
		MPQ-SF[b]	MPQ-SF: decrease within groups over time[i]	+
		Opioid consumption	Opioid consumption: no difference	-
	Sendelbach et al. 2010	NRS[a]	Reduction between groups[i]	+
		Opioid consumption	Opioid consumption: no difference	-
	Bauer et al. (36)	VAS[c]	Decrease in pain score[i]	+
		Opioid consumption	Trend of decreasing opioid use	±
	Lin et al. (26)	VAS[c]	Lower scores in music group[i]	+
	Vaajoki et al. (19)	VAS[c]	Lower scores on pan intensity and distress[i]	+
	Chaput-McGovern and Silverman (18)	Likert scale	Pain is positively affected by music therapy[i]	+
	Vaajoki et al. (30)	Opioid consumption	No difference between music and control group	-

Table 3. Continued.

Outcome	Reference	Instruments	Outcomes	Effects (+positive/-no difference/±trend)
Anxiety	Barnason et al. (35)	STAI[e]	STAI: no difference between groups	-
		NRS[a]	NRS: no difference between groups	-
	Voss et al. (39)	VAS[c]	Lower scores[i]	+
	Twiss et al. (23)	SAI[e]	Lower scores[i]	+
	Allred et al. (25)	VAS[c]	No difference between groups	-
			Decrease within groups over time[i]	+
	Sendelbach et al. 2006 (20)	SAI[e]	Reduction between groups[i]	+
	Bauer et al. 2011 (36)	VAS[c]	Overall trend lower score (n.s.)	±
	Lin (26)	VAS[c]	VAS: Lower scores[i]	+
		STAI[e]	STAI: no difference	-
	Chaput-McGovern (28)	Likert scale	Anxiety is positively affected[i]	+

Table 3. Continued.

Outcome	Reference	Instruments	Outcomes	Effects (+positive/-no difference/±trend)		
Physiologic parameters	Barnason et al. (35)	Blood pressure Heart rate	No difference			-
	Masuda (37)	Blood pressue Heart rate	No difference			-
	Nilsson (28)	Heart rate	Heart rate: no difference			-
		Mean arterial blood pressure	Blood pressure: no difference between groups,			-
			difference within music group[i]	+		
		PaO_2	PaO_2:higher level in music group[i]	+		
		SaO_2	SaO_2: trend of higher values in music group		±	
	Allred et al. (28)	Blood pressure Heart rate Oxygen saturation Respiratory rate	No difference			-
	Sendelbach et al. 2010	Blood pressure Heart rate	No difference			-
	Bauer et al. (36)	Blood pressure	Blood pressure (diastolic): decrease[i]	+		
		Heart rate	Heart rate: lower mean[i]	+		
	Lin et al. (26)	Blood pressure	Systolic & mean blood pressure: lower[i]	+		
		Heart rate	Heart rate: no difference			-
	Vaajoki (19)	Blood pressure	Systolic blood pressure: lower[i]	+		
		Heart rate	Heart rate: no difference			-
		Respiratory rate	Respiratory rate: lower[i]	+		

Table 3. Continued.

Outcome	Reference	Instruments	Outcomes	Effects (+positive/-no difference/±trend)		
Relaxation and stress	Masuda et al. (27)	skin temperature and blood flow	No difference	-		
	Nilsson (28)	Oxytocin	Increased level of oxytocin in music group[i]	+		
		NRS[a]	NRS: higher subjective relaxation level in music group[i]			+
	Bauer et al. (36)	VAS[c]	Relaxation scores improved[i]	+		
	Lin et al. (26)	Cortisol, norepinephrine, epinephrine (urine)	No difference	-		
	Chaput-McGovern and Silverman (18)	Likert scale	Relaxation is positively affected[i]			+
Perception, satisfaction and mood	Barnason et al. (35)	NRS[a]	Higher rating, indicating better mood[i]	+		
	McCaffrey and Locsin (33)	NRS[a] (1–10)	Increased mean satisfaction score[i]	+		
	Allred et al. (25)	Four-question survey (five-point Likertscale design)	84% forgot pain for a while	+		
			88% agreed that music was an enjoyable experience	+		
			92% music helped to improve their general mood	+		
	Bauer et al. (36)	VAS[c]	Overall trend of increased satisfaction		±	
	Chaput-McGovern and Silverman (18)	Likertscale	No difference			-
Cognitive function	McCaffrey and Locsin (32)	Signs & symptoms from nurses notes and checklists	Decrease in number of episodes of postoperative confusion in the music group[i]	+		
	McCaffrey and Locsin (33)	Nurses narrative notes	Fewer episodes of acute confusion[i]	+		
	McCaffrey (34)	NEECHAM ACS[f]	NEECHAM ACS: higher scores[i]	+		
		MMSE[g]	MMSE: higher scores[i]	+		
Ambulate	McCaffrey and Locsin (32)	Readiness to ambulate: score (1(not)-10 (ready))	Higher scores on readiness-to-ambulate profile[i]	+		
	McCaffrey and Loscin (33)	Willingness & distance	Readiness-to-ambulate is higher[i]	+		
			Larger number of feet ambulated by the music group[i]	+		
Sleep	Zimmerman et al. (21)	RSQ[h]	Trend of lower scores in music group (n.s.)		±	

Table 3. Continued.

Outcome	Reference	Instruments	Outcomes	Effects (+positive/-no difference/±trend)
Intubation time	Twiss (23)	Minutes of intubation	Reduction in intubation time[i]	+
Length of hospital stay	Vaajoki et al. (30)	Days of admission	No difference	-
Adverse events, nausea	Vaajoki et al. (30)	Number of adverse events	No difference	-
	Chaput-McGovern and Silverman (18)	Likert scale	No difference	-

a VRS/NRS = Verbal Rating Scale/Numeric Rating Scale (patient rates outcome on a scale from 0 till 10).
b MPQ-SF = McGill Pain Questionnaire Short Form (measures sensory and affective dimensions of pain and pain intensity).
c VAS = Visual Analog Scale (consist of a 10 cm horizontal line with right angels at each end with word anchors depicting extremes in the phenomenon being measured).
d FS = Wong/Baker Faces Pain Rating Scale (subjective pain scale, visual representation of the numerical scale on which the patient rates on a 10 cm horizontal line).
e S(T)AI = State-Trait Anxiety Inventory (20 item questionnaire with a scoring range of 1–4, measures patient's current state of anxiety).
F NEECHAM ACS = NEECHAM scale for acute confusion (9 item observational instrument for detecting the presence and severity of acute confusion).
g MMSE = Mini Mental State Examination (11 item questionnaire, score 0–30, examining the cognitive function of elderly, higher score indicates better functioning.
h RSQ = Richards-Cambell Sleep Questionnaire (measures the sleep construct on five separate scales, each self-reported with an VAS measuring on a scale from 0 to 10)
i Significant.

3.3.3. Physiologic parameters

Eight studies (19,20,25,26,35–37,40) measured the effect of music as an intervention on vital signs. Blood pressure and heart rate were measured in all eight studies. Four (19,26,36,40) studies found significantly lower values in systolic, mean, and/or diastolic blood pressure. Only one study (36) found a significantly lower mean heart rate following the music intervention.

Three (19,25,40) of the six studies also measured parameters of the respiratory system. Lower respiratory rates were found among patients that underwent abdominal surgery (19), this in contrast with a study including orthopaedic patients (25). A study (40) conducted among patients undergoing cardiovascular surgery did not report respiratory rate, but found significantly higher levels of partial pressure of alveolar oxygen (PaO2) and a trend of higher saturation levels in patients exposed to music.

3.3.4. Relaxation and stress

Five studies (18,26,36,37,40) examined the effect of music on relaxation or stress. Three studies (18,36,40) examined the effect of music on relaxation; although using different parameters, they all demonstrated a positive effect. One study of 40 patients undergoing cardiac surgery (40) compared the effect of music on oxytocin plasma levels as a measurement of relaxation. Oxytocin levels increased significantly in the intervention group compared with the control group, indicating that music stimulated the secretion of oxytocin. Relaxation scores, measured on a NRS, significantly increased over time in the music group. The study (18) using a ten-point Likert-Type scale, among patients undergoing oncological surgical procedures, also demonstrated significantly lower scores in the music group, indicating a higher degree of relaxation.

Two studies (26,37) focused on emotional and stress reactions, but failed to show a significant difference between the music group and control group.

3.3.5. Patient satisfaction and perception of music as an intervention and mood

Four studies (18,25,33,36) measured patient perception of the intervention and hospital experience. In one study (33) the music group showed significantly higher mean scores of satisfaction than the control group. In another study (36), patients in the music group had higher overall satisfaction scores, but results failed to reach statistical significance. Participants, patients, and caregivers, were also given the opportunity to give comments. In one study (18) a total of 32 of the possible 45 participants responded with a generally positive comment. This is consistent with the results of another study (25) which found that 84% of the patients receiving music agreed that the music helped them forget about their pain for a while and additionally 88% and 92%, respectively, agreed that music was an enjoyable experience and helped to improve their general mood. Overall, music tends to have a positive effect on patient perception and satisfaction. One study examined mood level with an NRS showing significant improvement in mood in the

music intervention group (35).

3.3.6. Cognitive functioning and sleep

Three studies (32–34) focused on acute confusion in combination with cognitive function or delirium. The studies were all conducted by the same authors in patients undergoing knee or hip surgery. Results show that patients in the music group had significantly higher scores on the Neelon and Champagne(NEECHAM) Acute Confusion Scale indicating lower levels of acute confusion (34). In addition, results of a further two studies showed significantly less episodes of confusion and delirium in patients exposed to the music intervention (32,33). The patients in the music group also scored significantly higher on cognitive tests on postoperative day one to three, indicating better cognitive function (34). In addition, the patients in the music group had fewer episodes of confusion and were also able to ambulate significantly earlier and for a longer distance (32,33). The results of these three studies indicate that music has a positive effect on postoperative cognitive functioning among older patients undergoing hip or knee surgery. One study examined the effect of music, music-video, and scheduled rest on the quality of night sleep (21). Patients in the music group had higher sleep scores, indicating better quality of night sleep, and approached statistical significance.

3.3.7. Postoperative complications and hospital stay

Two studies (18,30) examined the effect of music on adverse effects in patients undergoing a surgical oncological operation or abdominal surgery. One study (18) focused specifically on the effect of a single participation in music therapy on nausea but found no significant effect. The other study (30) also found no difference in the occurrence of postoperative complications between the music and control groups. In the single study (30) that analysed differences in length of hospital stay, results showed that there was no significant difference between the group that received music and the control group.

4. DISCUSSION

This systematic review identified seventeen articles describing the effects of music on the postoperative recovery of older patients. Our results show that music as an intervention for older surgical patients has a positive effect on a broad range of outcomes, including physical, cognitive, and emotional aspects. Furthermore, the operationalization of the intervention was explored and four theoretical models were identified describing the underlying theoretical models of the found effects. Although studies with non-oncological surgery were included, the concepts in the effects of music on patients recovery are also relevant for older patients undergoing oncological surgery.

Pain and anxiety were most often measured. All studies examining pain, found a positive result among the patients in the music group. This supports the GCT, that music may deviate sensory input from the brainstem to close the gating mechanism and as a result reduce the pain experience (22). Although pain is positively affected by music, no significant effect on opioid usage was found, in contrast with a review by Cepeda (4).

The positive effect of music on anxiety, patient satisfaction and positive experiences might suggest that music as an intervention distracts. This is in line with the Cognitive-behavioural framework, aiming at stress reduction by distraction. Music also seems to have a positive effect on relaxation, measured with both physical and non-physical measurements; however, studies focusing on stress hormone levels did not find significantly lower serum levels of cortisol, norepinephrine or epinephrine (26,37,4). This suggests that there is a minimum of physical evidence for the assumption that melodies and rhythms alter the functions of the neuro-endocrine systems (theoretical model 3). There is also minimum effect on heart rate, except for one study (36) that found a lower mean heart rate after a music intervention In contrast to what would be expected according to the fourth theoretical model, none of the four studies (19,26,36,40) found a decrease in blood pressure, heart rate and oxygen demand combined, following music interventions. Concerning postoperative complications and length of hospital stay, no difference was found between the music and control group (18,30,31). Possibly because the adverse effects were measured only during a 72 h period. Music did have a positive effect on symptoms of delirium.

Although a positive effect was determined on pain, anxiety, and stress using rating scales, this was not structurally endorsed by physiological parameters such as heart rate. A possible explanation could be that the surgery itself causes a physical stress reaction through which heart rate is already increased. An objective parameter as heart rate variability, also a marker for stress, could be used as a more objective tool. The frequency of the heartbeat is influenced by the sympathetic and parasympathetic nervous system and is considered a measure of neuro-cardiac function that reflects heart-brain interactions and autonomic nervous system dynamics (41–43).

The way the music interventions were shaped, varied strongly amongst papers. As a result, it remains unclear what is the most effective way of performing the music in the postoperative period. Some of the interventions demonstrated limitations that may have affected the validity of the results. One study (18), with an intervention involving the playing of live music for patients, demonstrated significant positive effects on pain, anxiety, relaxation, and perception of the intervention. Here, the interpersonal interaction between the musician and patients may have elicited an additional effect. In their design, the music listening interventions in this review indicate attempts to fit the

music intervention to each person individually, for instance by having the patient select their music of preference. Different moments may elicit different musical experiences depending on a person's physiology, state of mind, and mood (19). Because of that, it is essential to identify the musical preference of listeners (44). Given the positive patient outcomes of the study (18) with live music, it seems worthwhile to further explore live music making in music interventions with older hospitalised surgical patients. One concrete item to explore could be the use of applied improvisation, a form in which the making live music reflects or interacts with patients in the moment. In such an approach, the music making is tailor-made and personal interactions between musicians and patients may additionally increase the value of the musical intervention.

This systematic review focused specifically on the fast growing group of older patients and included studies with a mean population age of ≥60 in order to present a broad overview of studies involving music as intervention among older surgical patients. This cut-off point of age can be debatable. It is extremely difficult to characterize the typical elder person. Ageing processes already start in young adults but the speed of ageing processes differs in all human beings. At the age of 60 however, we can assume that the biological ageing process has started.

The selected studies vary considerably in type of surgery and methodological quality. The operation of intervention varies, there is a difference in measurements over time and in instruments. In three studies (20,30,31) missing data caused incomplete analysis. Small sample sizes may indicate that studies lacked adequate power, which may have influenced the results. Therefore, caution is needed in interpreting and in generalizing the effects of the presented results. Despite all the methodological differences between the studies, they all point in the same direction: music has a positive effect on the postoperative recovery of older patients and no negative side effects were reported. Therefore music seems a safe and effective intervention to use in practice especially for older patients recovering for surgery and who are at increased risk for complications due to hospital admission.

5. CONCLUSION

This review shows that there is evidence that music has a positive effect on postoperative recovery, particularly on postoperative pain and anxiety. However, in spite of the fairly consistent positive effect of music on wellbeing conveyed by the studies in this review - including their references to previous research - the studies did not show regularity in measurement instruments, patient population, or intervention design. Further studies are required to identify the effect of the interventions and to strengthen the indications

of music's effectiveness across all variables. It seems worthwhile to further explore live music making in music interventions with older hospitalized surgical patients.

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Conflict of Interest

The authors have nothing to disclose.

Author Contribution

Concept and design: H. van der Wal- Huisman, K.S.K. Dons and B.L. van Leeuwen. Data collection: H. van der Wal-Huisman, K.S.K. Dons and B.L. van Leeuwen. Analysis and interpretation of data: H. van der Wal- Huisman, K.S.K. Dons, R. Smilde, E. Heineman and B.L. van Leeuwen. Manuscript writing and approval: H. van der Wal- Huisman, K.S.K. Dons, R. Smilde, E. Heineman and B.L. van Leeuwen. Sponsor's role: None

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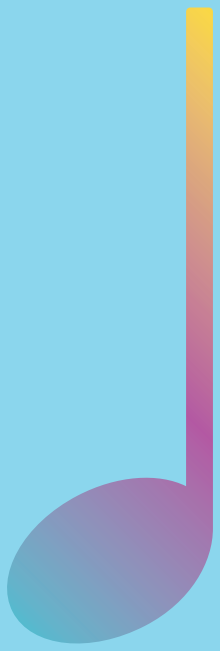

PART II

Meaningful Music in Healthcare

CHAPTER 3

Live bedside music in daily clinical practice of a surgical hospital ward among older patients: A controlled study design of an innovative practice

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ABSTRACT

Objective

There is an increasing interest in the role of the arts, particularly music, in healthcare. Music seems an attractive non-pharmacological intervention for older patients to improve postoperative outcomes. Although live music elicits more meaningful responses from an audience than recorded music, the use of live music is still rare on hospital wards. In view of the positive effects of recorded music on older surgical patients, we designed, in collaboration with a conservatoire, an innovative practice named Meaningful Music in Health Care (MiMiC). The aim is to determine whether live bedside music implements into daily practice and allows improves patient outcomes.

Method

This manuscript provides an overview of a trial evaluating if live bedside music can improve postoperative outcomes in older patients. The MiMiC initiative is a non-randomized controlled trial study among older surgical patients on three hospital wards. Live bedside music is performed by professional musicians, once a day for six or seven consecutive days. The primary outcome is experienced pain; secondary outcomes are anxiety, relaxation and physical parameters (heart rate, heart rate variability, blood pressure, respiratory rate and oxygenation). Measurements of these variables are collected before the intervention, 30 min afterwards and again after three hours. Daily evaluations determine whether this innovative practice can be implemented in daily practice.

Conclusion

This manuscript describes a new practice, live bedside music by professional musicians, on surgical hospital wards aiming to improve patient outcomes. It offers a new field of interprofessional collaboration for the benefit of patients. Further research must be conducted focussing on patient outcomes, including cost-effectiveness and the experiences of patients and healthcare professionals.

1. INTRODUCTION

The incorporation of arts in healthcare has significantly increased in the past decade (1). For several years, recorded music has been used to improve the outcome of hospitalised patients (2). Several reviews and meta-analyses have indicated the positive effects of music played through headphones, music pillows, MP-3 or CD players or background sound systems on pain, anxiety and stress (2-4). Considering that the population worldwide is ageing and surgery is an important part of treatment for various diseases including cancer, music may be a suitable non-pharmaceutical intervention, for the increasing population of older (cancer) patients. There is, however, quite a difference between recorded music and live music. People visit live concerts for a reason. Live music elicits more meaningful responses, partly as a consequence of the social connection of listening to music together, and feelings of connection and engagement with the musicians by sharing a physical space (5,6).

Increasingly, musicians work in venues outside of concert halls in practices that meaningfully contribute to society (7,8). However, live bedside music for hospitalised patients is still rare, and documentation regarding the intervention has not often been addressed in the literature (9). In view of the positive effects of recorded music on surgical patients and the additional benefits of live music, the present study examines whether live bedside music improves patient outcomes, integrates into the daily practice on a surgical hospital ward and allows feasible patient monitoring (2-4). Below, we describe the study design concerning Meaningful Music in Health Care (MiMiC), a new initiative in the Netherlands.

2. METHODS

We initiated a non-randomized in September 2016 among adult surgical patients at the University Medical Center Groningen in collaboration with the professorship of the Prince Clause Conservatoire in Groningen, the Netherlands, with convenience sampling. As there was a lack of data concerning the possible effect of live music on pain in the older surgical patient, no sample size was calculated for this exploratory study. Based on the number of admitted older patients that meet the inclusion criteria, we assumed it feasible to include 8–12 older patients during each live bedside music session. This was also true for the control group. The study is registered in the Netherlands Trial Register (NTR number: NL6046).

2.1. Collaborating Conservatoire and Musicians

A partnership was established with the Prince Claus Conservatoire and their research

group, Lifelong Learning in Music. This research group fosters the development of musicians by helping them to become learning, inquisitive and entrepreneurial musicians in society. The focus of the research group is the meaning of musical practice for both musicians and health care professionals and the development of the practice of live music for hospital patients. The conservatoire selected the musicians for this study: a violinist, a cellist, a clarinettist and a flautist (who also plays the bass flute and bass clarinet). All the performers involved in MiMiC are professional and multi-faceted musicians. They are accomplished chamber musicians who can play solo, improvise and arrange music and have adequate social awareness. As the musicians work in changing compositions, the choice of instruments is important because of practicality and range. One or two instruments have a bass range, and one or two have a higher range for a more melodic role or a middle voice (7,10).

2.2. Preparation Phase

In the preparation phase, we consider several aspects regarding the collaboration between the musicians and the nursing ward. The hospital ward is a new working environment for the musicians; therefore, they are educated on privacy regulations, infection prevention and (hand) hygiene. They are also informed of what to expect regarding sensory perceptions on a hospital ward so they are prepared for their performances. The possible emotional impact of encounters with patients is discussed.
In collaboration with the nursing management of each participating ward, an appropriate period during the day is chosen for the intervention with as little disruption as possible to the daily routine of essential patient care. It is discussed with the head nurse of each ward how musicians should act if a patient's situation acutely deteriorates. All nurses and other medical personnel on the ward are informed about the aim of this live bedside music project through presentations, emails and posters before its start.

2.3. Live Bedside Music Intervention

A live bedside music session, called a 'MiMiC session', takes place on a surgical ward once a day, for six or seven consecutive days, according to a predetermined schedule. Consecutive days are deliberately chosen so a bond can be built between the musicians and the patients. Each session starts on the ward with a briefing between the musicians, a mediator, the coordinating nurse of the ward and the researchers. During this session, the panel discusses which patients are present and able to participate that day. The response of the patients to the music on the previous day is evaluated. Furthermore, patient details that are relevant for the musicians and the mediator are discussed (for example, the emotional or cognitive status, in the case of delirium). After the briefing, the musicians play for the nurses during their coffee break, often referring to a live bedside musical moment the performers experienced the day before. In this way, the involvement of the nurses is stimulated. Each ward participates for two separate weeks.

After the joint session, one of the musicians walks the hallway and plays an improvisation to notify the patients that 'the music' is present. Then the musicians visit the patients at their bedside. The mediator acts as an intermediary between the nurses, patients and musicians, managing the planning of the visits to the patients' rooms. The mediator enters the room before the musicians to ensure appropriate timing. The music consists of the repertoire of the musicians, genre-based improvisation, idiomatic improvisation and person-centred improvisation. For person-centred improvisation, the musician seeks input from the patient by asking them to describe a landscape, a feeling or a colour. By using improvisation, the musician can meaningfully communicate with the patient and involve the patient in the music creation process. For more information regarding person centred improvisation see attached video. Each session lasts approximately 10–15 min; one or two pieces are played, depending on the patient's wishes or condition. The musicians perform for approximately 75 min each day, and afterwards, there is a brief evaluation in which the experiences of the musicians and nurses and the reactions of patients are discussed.

2.4. Data Collection

Because we do not want to compromise on the quality of the musicians, the availability of the musicians is the guiding principle for planning the MiMiC sessions. In the week before a MiMiC session, all eligible patients on the participating wards are informed by posters, and a patient information letter is distributed to patients who meet the inclusion criteria. Before surgery, or as soon as possible after surgery in the case of emergency surgery, informed consent is obtained according to local regulations by the researchers and research assistant. Patients must be aged 60 years or older and able to provide informed consent. Patients are excluded if they are unable to communicate or have total (perception) deafness. There are no selection criteria regarding type, duration or location of surgery.

Patients are excluded if the patient deteriorates at the moment of participation to such an extent that live music cannot be performed or data collection is not realistic.

The same research assistants collect data on patient outcomes from the control group, in which no live music is played. The data from the control group are collected during six separate weeks for five consecutive days when the musicians are absent. The same inclusion and exclusion criteria and sampling method are used in the control group. Patients cannot participate in the intervention prior to participating in the control group.

2.4.1. Outcomes

The primary outcome measure is a change in the level of experienced pain. Pain is measured using a visual analogue scale (VAS). Patients rate pain on a 10-cm horizontal line, with one end representing no pain (0 cm) and the other representing severe pain (10 cm). The VAS, used in previous studies related to music, measures various subjective

clinical phenomena, including pain and anxiety; the scale is reliable as well as easy and convenient to use (11-15). In addition, the type and dosage of pain medication used are collected from the patient's file.

Secondary endpoints are anxiety, physical parameters, relaxation and satisfaction (see Table 1.). Levels of anxiety and relaxation are measured using a VAS (16). Furthermore, the chosen structure of a MiMiC session is evaluated to determine the feasibility of registering patients' experiences and the daily evaluation with the nursing team.

Table 1. Study design.

	STUDY PERIOD				
	Enrolment	**Allocation**	**Post-allocation**		**Follow-up**
Time point	-T	T-1. -30 minutes	T0 Intervention	T1 +30 minutes	T2 +3 hours
ENROLLMENT:					
Eligibility screening	X				
Informed consent	X				
Baseline characteristics	X				
INTERVENTION:					
Live bedside music			X		
Standard care					
ASSESSMENTS:					
Pain:					
VAS		X		X	X
Pain medication		X			X
Anxiety: VAS		X			X
Physical parameters:					
Blood pressure		X		X	X
Heart rate		X		X	X
Heart rate variability		X	X	X	X
Respiratory rate		X		X	X
Oxygenation		X		X	X
Relaxation: VAS		X		X	X

To measure the physical effects of music during and after the intervention, blood pressure, oxygenation and respiratory rate are measured. In addition, heart rate variability (HRV) is measured during the intervention with the HeartMath emWave 2 (Boulder Creek, CA) using an ear clip. Heart rate variability is the change in time intervals between two consecutive heartbeats. The frequency of the heartbeat is under the influence of the sympathetic and parasympathetic nervous systems and is considered a measure of neuro-cardiac function that reflects heart-brain interactions and autonomic nervous

system dynamics (17-19). Music may act as a medium to increase parasympathetic outflow and therefore inhibit sympathetic activity, improving variability indicating a better physiological state (20,21). Experiences of the patients are evaluated using open questions. In addition, the following baseline measurements are registered:

- Date of birth, sex and nationality
- Clinical data including admission date, date of surgery, description of surgery (classification based on location: head/neck, extremities, intracavitary), American Society of Anesthesiologist, physical status classification, comorbidities (Charlson comorbidity index (22)), use of beta-blockers and cigarette smoking
- Patient personal experience with playing a musical instrument or singing

Based on daily evaluations of music sessions with patients, this practice is developed to make it optimally suitable for daily practice. Moreover, a group of 'critical friends' advise us throughout the research project. This group of critical friends consists of professionals from several fields of expertise as well as members of the layman audience.

2.5. Data Management

Data will be entered by the researcher and research assistant in a secured database. Monitoring will be done by a fellow researcher. To promote data quality, data will be checked on double entry, range checks for data values and source data verification will take place in 10% of the study subjects. According to the guidelines for on-site monitoring, this study is classified as a study with negligible/no risks, therefore requiring minimal monitoring.

2.6. Planned Analyses

Statistical analyses will be performed using IBM SPSS Statistics version 23 (IBM Corporation, Armonk, NY). Outliers will be detected visually with parametric and non-parametric tests. Endpoints will be assessed on distribution using Q-Q plots and the Shapiro-Wilk test ($p > 0.05$). Data will be presented as the mean and standard deviation if normally distributed or as the median and range. Numbers and percentages will be used for categorical data. Analyses will be performed in both groups as well as between the live bedside music group and the control group. The chi-squared test will be used for categorical data. To determine an effect between the pre-test and pos*t*-test or follow-up test, a paired *t*-test will be used; the Wilcoxon signed-rank test will be used if the data is not normally distributed. To determine a difference between the control group and the live bedside music group, we will use an independent t-test or ANOVA if the data are normally distributed and the Mann-Whitney U test if not. Data on HRV, measured using the HeartMath emWave 2, will be analysed in both time and frequency domains using Kubios HRV Premium software (23). Automatic correction to the measurements will be applied to remove artefacts, such as extra systoles.

2.7. Ethical Considerations

The medical ethical board concluded that this study did not fall within the scope of the Dutch Medical Research Involving Human Subjects Act and provided dispensation for further assessment. The study is registered in the Netherlands National Trial Register (trial ID: NTR 5874). Common ethical principles in clinical research are followed. Data collection is conducted following the Declaration of Helsinki.

3. DISCUSSION

Based on the evidence of the positive effects of recorded music on postoperative outcomes, such as pain and anxiety, we have designed a study on live bedside music by trained professional musicians on surgical hospital wards. To our knowledge, this is one of the first European studies examining the effect of live bedside music on surgical patients in collaboration with a conservatoire.

3.1. First Experiences

The initial reaction of the healthcare professionals, especially the nurses, to musicians on the ward was to maintain a professional distance focussed on patient wellbeing. There was a concern that the live bedside music intervention could disrupt the daily routine, and some nurses were apprehensive about participation in a music session. This changed positively as more nurses experienced the live music sessions and saw the reactions of patients.

> *At first, I thought that this music would be disrupting for the patients and also our routine. But I saw what it did to my patient, he started to talk more about himself, and I saw a smile on his face that I had not seen for such a long time. We shared something. And it offered a pleasant break during the day, and the whole atmosphere on the ward changed.* - Nurse.

Though they did not know what to expect, almost all the patients responded positively and were surprised that live bedside music was offered. Some patients were reluctant to have the musicians in the room because the attention of the musicians playing specifically for them alone was overwhelming. In that case, the musicians played in the hallway, and often the next day, the musicians were welcome in the patient's room. Because the live bedside music was offered for several consecutive days, relationships were often built between the team of musicians, the patient and nurse.

> *The first day I was still very ill and tired, just listening to the music from the hallway was enough. It was emotional for me. The next day, they came into my*

> *room, and I started to know them. It offered me distraction during this tough period. It was not about me being sick and being a patient, but about me as a person. I enjoyed it.* - Patient.

The support of the head nurses was crucial during the process of implementation. By involving the nurses on each ward in the live bedside music sessions, they became more willing to adjust their procedures, make time available and motivate the patient to participate.

3.2. Barriers and Facilitating Factors

There have been several barriers and facilitating factors regarding the MiMiC initiative. The bedside music does not interfere with the medical treatment and, to the best of our knowledge, has no side effects. An important facilitating factor is the professionalism of the musicians that enables them to respond to the patients' needs concerning the type of music, volume and interaction level. A disadvantage of this flexibility is the lack of standardisation of the intervention because of the varying duration and composition of the intervention. Due to the limited availability of the musicians, it takes time to attain a suitable sample size.

Positive experiences and subjective effects on patients are encouraging and lead participants in this practice to believe that musicians could have a permanent role in hospital settings. However, more research must be conducted to gain insight into the effects on patients and the interprofessional collaboration between healthcare professionals and musicians. This is necessary for the further development of this new practice. One of the aspects that also must be explored, and is relevant for further implementation is, the cost-effectiveness of this intervention. Findings from this study will inform a future study with a larger sample, potentially creating the opportunity for clustering and offering the possibility for in-depth interviews with patients and healthcare professionals about their experiences and further optimisation of the intervention.

4. TRIAL STATUS

The recruitment of the patients will start on September 17th, 2016. Recruitment is expected to be completed by October 01th, 2021. The data analysis and- writing of the scientific manuscripts will be carried out after completion of recruitment.

5. CONCLUSION

Collaboration between professionals from the field of arts and healthcare in everyday practice is possible. Live bedside music in daily clinical practice by professional musicians is realistic and offers a new field of interprofessional collaboration for the benefit of older patients after surgery. Further research must be conducted that focuses on patient outcomes, cost-effectiveness and the experiences of patients and healthcare professionals.

Contributor ship statement
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Declaration of Competing Interest
The authors declare no conflict of interest.

Appendix A. Supplementary data
https://ars.els-cdn.com/content/image/1-s2.0-S1879406821000072-mmc1.mp4
supplementary video

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CHAPTER 4

The Effect of Live Bedside Music on Pain in Elderly Surgical Patients. A Unique Collaboration

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ABSTRACT

Postoperative pain has a negative influence on physical and mental recovery and may result in a variety of postoperative complications. Listening to recorded music has been revealed to reduce pain, but in addition to that, live bedside music further offers the possibility to interact with the patient, respond to their emotions, and help them in adapting their conditions. It, therefore, seems appropriate for older surgical patients. This study examines the effect of live bedside music on postoperative elderly patients. The study was designed as a prospective clinical pilot study with a control group. During six separate weeks, between September 2016 and May 2017, data were collected using convenience sampling among the postoperative patients aged ≥60 years (n = 35) accounting to 83 sessions. The intervention was live music, person-centred improvisation and existing repertoire, performed by professional musicians of a collaborating conservatoire for 10–15 min, one session a day on three surgical wards of a university hospital. The control group (n = 43; 80 sessions) did not receive the intervention. The primary endpoint was pain, measured with a visual analog scale (VAS; score 0-10) before the intervention and after 30 minutes and 3 hours of the session. Secondary endpoints were hemodynamic parameters, oxygen saturation, and respiratory rate and anxiety. The Wilcoxon signed-rank test and Mann-Whitney U test were performed to determine differences within and between groups. Perceived pain was decreased in the live bedside music group at the time of the first post-test and continued to be so for up to three hours ($p = .004$; $p = .000$). This decrease in pain was not observed in the control group. There was no clinically relevant effect on secondary endpoints. Live bedside music, performed by professional musicians, has a positive effect on the perceived pain of elderly patients after surgery. Further research on the underlying mechanisms as well as possible clinical implications is required.

1. INTRODUCTION

In modern medicine, despite the introduction of new standards and guidelines, up to 40% of patients experience moderate or severe pain after surgery (1). Inadequate pain management adversely influences physical and psychological factors, which may lead to severe complications, such as delirium, pneumonia, anxiety, stress, and delayed wound healing (2, 3). Elderly patients experiencing pain can be given less pain medications compared with younger patients. Moreover, the elderly are more likely to experience medication-related side effects (4-6). This is relevant considering that the current prevalence of polypharmacy in the elderly is 40 to 60% (7). It is pertinent to explore the effect of non-pharmaceutical interventions, which can be provided to a group of potentially vulnerable elderly surgical patients. Some recently conducted studies indicated that recorded music is effective in reducing postoperative pain in elderly patients (8-17). Music has, to the best of our knowledge, no toxic side effects and therefore seems an attractive intervention for elderly patients who are more prone to develop complications due to their changed physiology and increased vulnerability (18). Compared to recorded music, live bedside music has the advantage of the possibility to interact with the patient, respond to emotions and adapt to the patient's situation. However, the effect of live bedside music on elderly patients is unknown; therefore, this prospective clinical pilot study with a control group was carried out to investigate the effect of live bedside music on pain in elderly patients after surgery.

2. MATERIALS AND METHODS

The present pilot study was conducted as a part of the Meaningful Music in Health Care project (MiMiC) between September 2016 and May 2017 at the University Medical Center Groningen, the Netherlands, in collaboration with the Prince Claus Conservatoire of Groningen, Netherlands. As per the knowledge of the authors, University Medical Center Groningen is probably the first hospital to collaborate with a conservatoire and combine these two worlds for the benefit of patients. Alteration in the pain perception was the primary endpoint of the present study and measured using a visual analog scale (VAS) after the live bedside music session. Secondary outcomes that were taken into consideration were hemodynamic parameters, oxygen saturation (SpO2), respiratory rate, and anxiety.

2.1 Participants and Setting

Patients admitted to one of the three surgical wards University Medical Center Groningen, the Netherlands took part in the study. No sample size was formally calculated since convenience sampling was done, maintaining the design of the intervention and

availability of the musicians. The inclusion criteria were patients were aged 60 years or older and had undergone surgery during this hospital admission. The exclusion criteria were patients with total deafness (perception deafness), the inability to communicate or the unwillingness or inability to provide written informed consent and those.

2.2 Music Intervention Procedure

The pilot study was carried out in six separate weeks, where live bedside music was performed by one to three professional musicians consisting of a clarinettist, flutist, violinist, contrabassist, and cellist (for changing composition). These performing musicians with comprehensive experience were all associated with the conservatoire. The intervention was planned according to a fixed structure where it was performed once daily in the morning between 11.00 a.m. to 12.15 p.m. The intervention was carried out for six or seven consecutive days, one ward at a time following the fixed structure. Each ward was allowed to participate for two separate weeks, and each day started with a joint session comprising of the musicians, a mediator, the coordinating nurse of the ward, and the researchers. During this session, patients who were present and able to participate were discussed, and the response of the previous day was evaluated. The mediator was responsible for the time schedule and served as an intermediary between the musicians, patients, and healthcare professionals. After the joint session, one of the musicians walked the hallway and played an improvisation to notify the patients that the musicians were present. The patients were visited at their bedside after the walk-around. The music consisted of genre-based improvisation, idiomatic improvisation, the repertoire of the musicians and person-centred improvisation. For person-centred improvisation, the musician asked for input from the patient in the form of a landscape, feeling or colour. Using improvisation, musicians created meaningful communication with the patient and involved the patient in the process of composing music. The music sessions took place in single, double, and quadruple rooms. The doors of individual rooms were closed and the sound for other patients outside the room was blocked. Each session lasted approximately 10 to 15 minutes. One or two pieces were played, depending on the patient's wishes or condition. The musicians performed for approximately 75 min each day, and afterward, there was a brief evaluation in which the experiences were discussed. The participation of patients was allowed until the availability of the musicians in the ward.

2.3 Data Collection

Patients were informed on the day of admission, prior to surgery or as soon as possible, by two trained research assistants. Data on the patient characteristics (age, gender, nationality) and clinical condition were obtained from the patients, which included the date and surgical category, comorbidity using the Charlson Comorbidity Index (CCI), and the patients were further classified according to the American Society of

Anesthesiologists (ASA). The degree of pain was measured 30 to 60 min before each intervention (pre-test), and 30 min after the live bedside music session (post-test) and again after three hours (follow-up test). To correct for natural changes in pain sensation over time, a control group was formed. The same research assistants collected data in the control group in which no live music was played. The data in the control group were collected during six separate weeks for five consecutive days when the musicians were absent. The same inclusion and exclusion criteria and sampling method were used in the control group.

2.4 Instruments

Pain was defined as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage' (19) and measured using the VAS (20). The VAS is also employed to measure various subjective clinical phenomena. The patient verbally rates his/her pain on a 10-cm horizontal line. The starting point (0 cm) represents no pain, while the other end (10 cm) represents the unendurable pain. VAS scores are directly proportional to the degree of pain. Hemodynamic parameters and oxygen saturation were kept as secondary outcomes and were measured using a non-invasive bedside monitor (Philips SureSigns VS2). The respiratory rate was computed for one minute. The VAS was also used to measure the degree of anxiety, and it is also directly proportional to the scores (14).

2.5 Statistical Analysis

Statistical analyses are presented using the median (range) and number (%). Data were checked for normal distribution using Q-Q plots and the Shapiro-Wilk test. The independent samples t-test was used to examine the differences in numerical data between the control and live bedside music groups. The chi-squared test was used for the categorical data. Further, if data were normally distributed, the paired samples t-test was used for the within-group analyses; if not, the Wilcoxon signed-rank test was used. To analyze the difference between the groups, the Mann-Whitney U test was used. All statistical analyses were performed using IBM SPSS Statistics version 23 (IBM Corporation, Armonk, NY). The data were considered statistically significant when P-values < 0.05 (two-sided).

2.6 Ethical Considerations

The medical ethics board concluded that this study did not fall within the scope of the Dutch law of Medical Research Involving Human Subjects Act and provided dispensation for further assessment. The study was registered on the national Netherlands Trial Register (trial ID: NTR6046). Commonly used ethical principles in clinical trials were followed. All participating patients in the study signed the written informed consent according to local regulations, and the data collection was done following the Declaration

of Helsinki. Participation in the test was solely entitled to make individual decisions about the number of days they wanted to participate, and also, they were allowed to withdraw from the study at any time without consequences for their care.

3. RESULTS

Characteristics of the patients and the clinical data of both the control group and intervention groups are detailed in Table 1. The live bedside music group consisted of 43 patients, whereas the control group comprised 35 patients. The median age group of the study population was 70 years, and approximately 60% of the participants were male. Over 50% of the patients underwent intracavitary surgery. The median time of the first participation in the intervention group was two days postoperatively (range 1–36) compared to three days in the control group (range 1–15). Most of the patients participated for once or twice in the control group (79.1%) or the intervention group (65.7%). No significant differences were found in patients and their clinical characteristic data between both the groups. Approximately 40% of the patients declined to participate in research or were not able to participate due to their medical conditions.

Table 1. Patient characteristics and clinical data

Variables		Control group (n=43)	Live bedside music group (n=35)	*p*- value
Age		70 (60-86)	70 (60-88)	.786[x]
Gender				.820[y]
	Male	26 (60.5%)	20 (57.%)	
	Female	17 (39.5%)	15 (42.9%)	
CCI		3 (0-10)	4 (0-9)	.104[z]
Location of surgery				.301[y]
	Intracavitair	23 (53.5%)	19 (54.3%)	
	Extremity	17 (39.5%)	10 (28.6%)	
	Head-neck area	3 (7%)	6 (17.1%)	
ASA - classification		2 (1-4)	2 (1-3)	.245[y]
Days POD of first measurement		3 (1-15)	2 (1-36)	.530[z]
Number of participated/ measured session		2 (1-5)	2 (1-7)	.502[z]
	1	20 (46.5%)	17 (48.6%)	
	2	14 (32.6%)	6 (17.1%)	
	3	5 (11.6%)	4 (11.4%0	
	4	3 (7%)	2 (5.7%)	
	5	1 (2.3%)	5 (11.4%)	
	6	n.a.	-	
	7	n.a.	2 (5.7%)	

Presented as median (range) or number (%). A *p*-value of < 0.05 was considered significant.
[x] Independent samples T-Test
[y] Chi-square Test
[z] Mann Whitney U test

3.1 Pain

The low pain scores measured on the VAS resulted in positively skewed distributed data and median scores of zero for the live bedside music group (see Table 2). For the sake of illustration, we presented the means of the pain scores of both groups instead of medians in Figure 1a. The p-values are based on non-parametric testing. Statistical analysis revealed that a significant diminution was noted between the pre-test and post-test score ($Z = –2.916$; $p = .004$) in the live bedside music group that continued up to the follow-up test ($Z = –4.200$; $p = .000$). The control group revealed a minimal, non-significant ($Z = –0.492$; $p = .623$) change in pain scores in the post-test, and the follow-up test scores did not differ significantly ($Z = –0.712$; $p = .476$) when compared to the pre-test. No differences were observed in the baseline pain scores between the groups ($p = .525$). However, it was evident from the analysis that differences were revealed in the post-test ($U = 2518.0$; $p = .014$) and follow-up test ($U = 2119.5$; $p = .005$), indicating live bedside group perceived less pain at the post-test and follow-up test compared to the control group. Additional analysis of patients, who underwent major surgery (intracavitair) showed a significant decrease of pain scores on post-test ($Z = -2.663$; $p = .008$) and follow-up ($Z = -3.531$; $p = .000$) in the intervention group. Patients with minor surgery (head-neck area & extremity) also showed a decline in pain scores, which was only significant at the follow-up test ($Z = -2.272$; $p = .023$). A comparison between major and minor surgery showed no significant difference.

3.2 Hemodynamic Parameters

3.2.1 Heart Rate

The results exhibited that the heart rate was significantly reduced in the post-test ($Z = –2.759$; $p = .006$) and remained lower at the follow-up test in the live bedside music group ($t = 2.757$; $df = 74$; $p = .007$). Although non-significant, a change was noted in the control group during the post-test measurement. It was observed that the heart rate increased after three hours, exceeding the pre-test (Figure 1b). No significant statistical difference was observed when analyzed by the Mann-Whitney U test between the groups at the three test points.

3.2.2 Blood Pressure

Overall, patients in the control group had higher blood pressure, resulting in a significant difference at pre-test. In both groups, values exhibited a small increase at post-test and a decrease 3 hours later at the follow-up test. In the live bedside music group, these changes were not significant. In the control group, these changes were for the diastolic blood pressure ($t = 3.132$; $df = 72$; $p = .003$) and for the MAP ($Z = -2.830$; $p = .005$).

Table 2. Results comparison in- and between groups per outcome

	Variables		Control group (median-range)	n	Live bedside Music group (median-range)	n	*p*- value
Primary	**Pain**	Pre- test	0,40 (0-8,40)	80	0,00 (0,00-10,00)	83	.525
outcome	**(VAS: 0-10)**	Post- test	0,15 (0-8,00)	78	*0,00 (0,00-10,00)* [1]	81	.014*
		Follow-up test	0,00 (0-8,00)	73	*0,00 (0,00-04,00)* [1]	75	.005*
Secondary	**Heartrate**	Pre- test	79,50 (46-133)	80	80,00 (47-126)	80	0,085
outcomes	**(bpm)**	Post- test	76,50 (45-131)	78	*79,00 (45-113)* [1]	78	0,126
		Follow-up test	80,00 (50-131)	73	*78,00 (50-111)* [2]	73	0,8
	Respiratory rate	Pre- test	16,00 (12-24)	80	18,00 (12-28)	80	0,03*
	(n per minute)	Post- test	16,00 (12-24)	77	18,00 (11-30)	77	0,027*
		Follow-up test	16,00 (12-24)	73	18,00 (10-28)	73	0,022*
	Saturation	Pre- test	96,00 (78-100)	78	97,00 (92-100)	78	0.010*
	(%)	Post- test	97,00 (81-100)	77	98,00 (87-100)	77	0,051
		Follow-up test	97,00 (87-100)	72	98,00 (89-100)	72	0,001*
	Systolic	Pre- test	132,00 (83-200)	80	124,00 (95-167)	80	0,038*
	blood pressure	Post- test	134,00 (84-192)	78	125,00 (76-182)	78	0,01*
	(mmHG)	Follow-up test	136,00 (64-172)	73	122,00 (90-180)	73	0,017*
	Diastolic	Pre- test	69,00 (42-108)	80	62,50 (28-104)	80	,002*
	blood pressure	Post- test	68,00 (39-101)	78	63,00 (36-116)	78	,004*
	(mmHg)	Follow-up test	*67,00 (42-95)* [2]	73	61,00 (29-97)	73	0,013*
	Mean aterial	Pre- test	84,00 (51-148)	78	76,00 (48-112)	78	0,001*
	blood pressure	Post- test	86,00 (55-136)	78	78,00 (54-119)	78	0,003*

Table 2. Continued.

Variables		Control group (median-range)	n	Live bedside Music group (median-range)	n	*p*- value
(mmHg)	Follow-up test	*84,00 (55-136)* [2]	73	*74,00 (45-120)*[2]	73	0,003*
Anxiety	Pre- test	0,00 (0,00-10,00)	78	0,00 (0,00-10,00)	78	0,659
(VAS: 0-10)	Post- test	*0,00 (0,00-7,00)* [1]	78	*0,00 (0,00-2,70)* [1]	78	0,734
	Follow-up test	*0,00 (0,00-8,00)* [2]	73	*0,00 (0,00-2,20)* [2]	73	0,895

* sign. *>p,005*
[1.] significance difference within the group between pre-test and posttest measurement
[2.] significance difference within the group between pre-test and follow-up test measurement

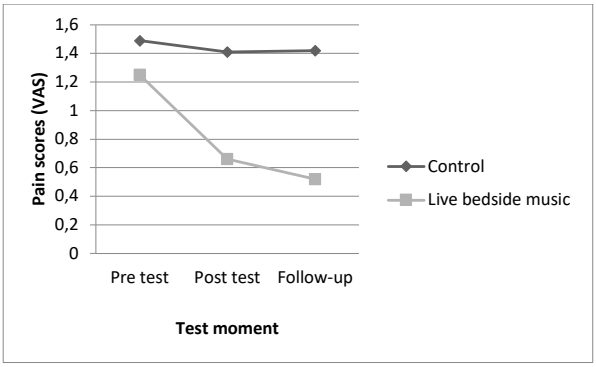

Figure 1 a. Pain (mean)scores, measured on a visual analogue scale

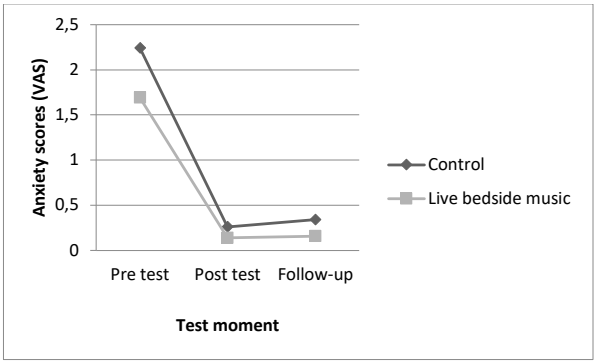

Figure 1 b. Anxiety (mean) score, measured on a visual analogue scale

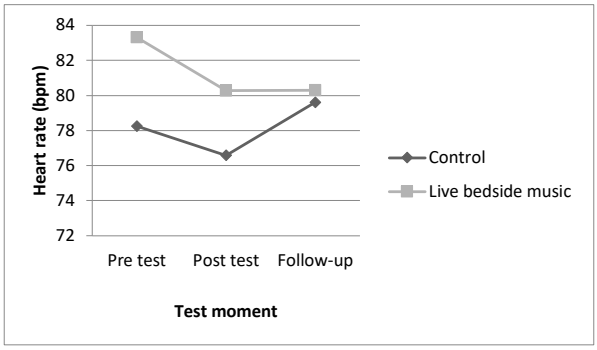

Figure 1 c. Heart rate (bpm, mean values)

Figure 1. The dark grey line represents the control group and the light grey line the live bedside music group. a: Mean pain mean scores, measured on a visual analogue scale; b: Mean anxiety scores, measured on a visual analogue scale; c: Heart rate (bpm, mean values).

3.3 Oxygen Saturation (SpO2) and Respiratory Rate

There was a significantly higher level of SpO2 at pre-test in the live bedside music group ($Z = -2.560$; $p = .010$). In this group, SpO2 rose from a mean level of 97.05 (SD 2.33) to 97.35 (SD 2.47) at post-test and 97.53 (SD 2.35) at follow-up, but not significantly. In the control group, SpO2 rose at post-test from a mean level of 95.47 (SD 5.47) to 96.44 (SD 3.18), but decreased slightly at follow-up (m 96.32; SD 2.58). The respiratory rate was higher (18 breaths per minute) among patients in the live bedside music group compared to the control group (16 times per minute). We found no differences within the groups.

3.4 Anxiety

In both groups, the median VAS score was zero at all test points, and no significant differences were found between the groups. A decrease in anxiety was noted between the pre-test and post-test or the follow-up test in both groups, as illustrated in Figure 1c. Furthermore, the level of anxiety range in the live bedside group as computed by VAS decreased considerably from 0–10 at the pre-test to 0–2.7 at the post-test, 0–2.2 at the follow-up.

4. DISCUSSION

Findings from the present investigation gathered evidence to demonstrate that live music creates a positive environment and has a positive effect on the postoperative pain in the geriatric patients that lasts for at least three hours. The same effects were not found in the control group. To our best knowledge, no previous study has examined the effect of live music on pain, specifically in the elderly surgical population. This study also distinguishes itself by the fact that a prolonged decrease in pain perception, up to three hours after intervention, was found, despite the low pain scores at baseline in both groups. The pain scores were reduced by 0.59 at post-test and 0.73 at follow-up; this is marginally greater than the results described in two meta-analyses evaluating recorded music interventions postoperatively with a standardized mean difference of 0.53/0.71 (21, 22).

In the present study, we used a VAS to measure pain, which is a commonly used instrument for this purpose in studies with similarly aged populations with recorded music (8, 10, 12, 14, 15, 17), However, it remains unclear whether these findings reflect a reduction in pain medication. Some of the earlier studies with recorded music yielded conflicting results in the reduction of pain medication (8, 12, 13, 23). It is difficult to generalize the data due to the heterogeneity of our study population. Hence, the evidence-based effect of live music on drug use among the geriatric surgical population is still obscure. Further research is needed to establish the influence of live bedside music on pain, which

is more pronounced in patients undergoing major surgery. The underlying mechanistic pathway also deserves further insight. Furthermore, it is necessary to understand and compare the effect of live music with recorded music to determine clinical implications and draw definite conclusions. The results from the present investigation indicate that live bedside music can be potentially used in pain management.

Although, due to the distribution of the data, the median score for anxiety was zero, there was a notable decrease in the range of the live bedside group, which was not present in the control group. This concords with previously conducted studies on elderly surgical patients with recorded music that found a positive effect on anxiety (8, 12, 14, 17). This is relevant because psychological aspects such as anxiety can affect the postoperative pain of an older surgical patient and adversely affect a patient's recovery (24, 25).

Based on our data, music has some effect on psychological parameters, although its clinical relevance is debatable. Non-parametric analyses of the heart rate revealed a significant decrease between pre- and post-test values and pre- and follow-up test values, which was not found in studies with recorded music (10, 12-15, 26, 27). It can be presumed that live music affects the autonomic nervous system. It is a well-acknowledged fact that the heart rate is regulated by the autonomic nervous system, where the parasympathetic nervous system pacifies the body after the action of the sympathetic nervous system. Heart rate increases when the sympathetic nervous system is activated as a response toward harmful stimuli like pain or surgery, and responses are monitored by calculating heart rate variability (HRV), which is the time difference between consecutive heartbeats (28). Earlier studies (29, 30) revealed that live music not only enhances parasympathetic activity but also causes a reduction in sympathetic activity as measured by HRV. The influence of live music on HRV in elderly patients after surgery, to our best knowledge, has not been measured and should be further explored to gain insight into the mechanism behind the effect of live music.

This study was performed with live music and conducted among a broad range of elderly patients undergoing various types of major and complex surgery. The data were collected in both groups by the same professionals, any Hawthorne effect cannot be completely ruled out due to the nature of the intervention and focus on experienced pain of patients. The limited availability of the musicians restricted the inclusion of patients who were admitted at the same time. However, baseline characteristics between the live bedside music group and the control group did not differ. In the Netherlands, music therapy is not common care in hospital wards, and certainly not in surgical wards. In a previously conducted review on the effect of live music in older patients, no specific studies using live music therapy in surgical patients were found (18). The intervention in our study was performed by professional musicians and must not be confused with

music therapy, in which selected music-based interventions are applied using both music and the therapist-patient relationship as agents of change, or with 'music medicine', an intervention in which music is delivered by healthcare professionals (31). In the analysis of pain perception, the effects of musical characteristics like volume, beats per minute, patient's choice of music, and various types of improvisations, were not taken in to account. Some studies among young adults have shown that personal preference and type of music played can be associated with the effect of music on pain perception (32, 33). However, a meta-analysis by Hole and colleagues (2015) found a positive but non-significant effect of the music choice on reduction in pain (21). Further research should be done keeping these variables into account.

The study demonstrates the applicability of live bedside music is an attractive and likely achievable option, which may create a new dimension in the working environment for professional musicians. The advantage of this intervention is that live music is multi-faceted and can be designed in various ways, which could be further explored. A larger-scale implementation and formal feasibility study can potentially bring out obstructing economic factors as attitudes of patients and healthcare professionals toward this innovative practice. Nevertheless, the results of this study indicate that live music influences pain perception in geriatric surgical patients in a positive way with no side effects.

5. CONCLUSION

Live bedside music, performed by professional musicians, has a positive effect on the perceived pain of elderly patients after surgery compared with patients who did not receive the intervention. Further research on the clinical implications, such as reduced pain medication usage, and the mechanism behind decreased pain must be conducted.

Author Contributions

All authors contributed substantial, approved the final version and are accountable for all aspects.

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Competing Interests

The authors have declared that no competing interests exist.

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CHAPTER 5

Heart rate variability in surgical patients experiencing live bedside music; an explorative study

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ABSTRACT

It's known that surgery elicits a stress response involving the autonomic nervous system (ANS) which is important in general recovery but can also have detrimental effects in older patients. Music seems to positively effect postoperative recovery, although the mechanism requires further unravelling. Our objective was to explore the response of the ANS to live bedside music in older surgical patients, by using heart rate variability (HRV) as a proxy. This explorative prospective non-randomized controlled cohort study included 101 older non-cardiac surgical patients, with a median age of 70 (range 60-88 years). HRV was measured in a cohort receiving live bedside music provided by professional musicians and in a control group that did not receive music. HRV was measured pre-intervention, during the intervention, 30 minutes after the intervention, and again after three hours. Mixed linear modelling was used to assess the effect of the intervention compared to the control group over time. A significant change in both the low and high frequency bands ($p = 0.041$) and ($p = 0.041$) respectively, was found over time in the music group compared to the control group indicating relaxation and increased parasympathetic activity in the music group. Other measures revealed a trend but no significant effect was shown. These results provide a first glance and contribute to a better understanding of the effect of music on the recovery of older surgical patients.

Keywords
Heart rate variability, stress response, surgery, music, older people, postoperative recovery

INTRODUCTION

Music is an important part of everyday life across cultures and has played a role in healing practices for centuries. In recent years, music has gained interest for its effects on post-operative recovery. Positive effects have been found on experienced pain, anxiety, stress and relaxation (1-7).

Surgery is a physical strain that activates the sympathetic branch of the autonomic nervous system (8). The autonomic nervous system consists of two interacting parts; the sympathetic and the parasympathetic. Both are vital in regulating physiological processes in normal and pathological conditions (9). The sympathetic response to surgery is important in general recovery but can cause postoperative complications, especially in older patients (10). The reduced physiological reserve, and changes associated with ageing affect an older person's ability to withstand the stress of a surgical event (11-13).

The dynamics of the autonomic nervous system can be measured by recording heart rate variability (HRV) (14). HRV is defined as the variance in time intervals between consecutive heartbeats, which is influenced by the input of the sympathetic and parasympathetic systems on the sinoatrial node of the heart (15). Both the baroreflex and respirator sinus arrhythmia (RSA) have a role in HRV modulations. The baroreceptor response to blood pressure fluctuations and sends information to the autonomic nervous system via nerve pathways. Subsequently, the parasympathetic nerve pathways send signals to the heart. Through the vagal nerve, the parasympathetic nervous system controls the speeding up and slowing down of the heart rate. Another main short term modulator of the heart rate is respiration. When inhaling, the heart rate accelerates and when exhaling, the heart rate slows down. This process is known as the RSA, which is entirely a parasympathetic process (16). Stimuli such as pain and surgery, activate the sympathetic nervous system, leading to an increased heart rate. An increased heart rate leads to a decreased time between consecutive heartbeats, resulting in reduced HRV (15). Parasympathetic activation has an inhibiting effect and therefore slows the heart rate. When the heart rate is slow, there is more time for variability to occur (17). Decreased HRV has been associated with increased morbidity and mortality in trauma patients, multiple organ dysfunction in septic patients and is considered as an early warning sign of mental stress (18,19). When a patient experiences pain, sympathetic activities increases and there is less variability in heart rate. Conversely the parasympathetic system takes over if the patient is relaxed and variability increases (17).

There is growing evidence that music may act as a medium to increase parasympathetic outflow, reduce the psychobiological stress response, inhibit sympathetic activity and increase HRV (20-25). We aimed to explore the effect of live bedside music on the

autonomic nervous system in older surgical patients using HRV as a proxy (Fig 1.).

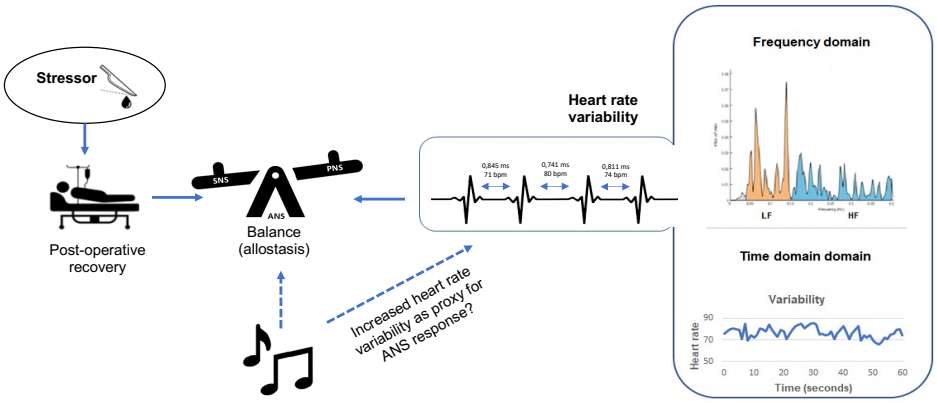

Figure 1. The aim of this study shown graphically.

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METHODS

This study was performed as part of a prospective controlled clinical trial, Meaningful Music in healthCare ('MiMiC'), conducted at a university hospital, in collaboration with the Prince Claus Conservatoire of Groningen in the Netherlands. The study aimed to investigate the effect of live bedside music on post operative pain in older patients (26). The study was registered in the Netherlands National Trial Register (trial ID: NTR6046). The medical ethical board of the University Medical Center Groningen concluded that this study did not fall within the scope of the Dutch law on medical research involving human subjects and provided dispensation for further assessment. Data collection was conducted following the Declaration of Helsinki.

Inclusion and exclusion criteria

This study included patients over the age of 60 admitted for surgical non-cardiac procedures at one of the three participating surgical wards, between September 2016 and November 2018. Convenience sampling was used to accommodate the design of the intervention and the availability of the musicians. As this was an exploratory study, no power analysis was conducted prior to data collection. Patients with total deafness (perception deafness), unable to communicate or unwilling or unable to provide written informed consent were excluded. Data were also collected in a control group in which patients were not informed about or exposed to the music intervention nor encouraged to listen to recorded music.

Music intervention

During this study, live music was performed at the bedside for six separate weeks. Each ward participated for two weeks. A team of five professional musicians were involved: a clarinettist, flutist, violinist, contrabassist and cellist. Each week the team consisted of three of these five musicians. The intervention was performed once a day according to a fixed structure (protocol previously described (26). Each session lasted approximately 10-15 minutes; one or two pieces were played at the bedside of the patient. The music consisted of genre-based improvisation, idiomatic improvisation, the repertoire of the musicians and person-centred improvisation. For person-centred improvisation, the musician sought input from the patient by asking them to describe a landscape, a feeling or a colour for example. The musicians were trained to work in a hospital ward.

Data collection

Data were obtained by two researchers in both the intervention and control group. Baseline characteristics including age, sex, type of surgery, number of days since a surgical procedure at the time of the first measurement, American Society of Anesthesiologists score (ASA-classification) and Charlson comorbidity index (CCI) were collected to explore whether the populations in the intervention group and control group were comparable. Measurements of HRV were observational, patients were not informed about their heart rate and not trained to influence their heart rate. HRV measurements were obtained at four different time points: pre-measurement (30 minutes before the intervention), peri-measurement (during the music intervention), post-measurement (30 minutes after the intervention) and follow-up measurement (three hours after intervention The same schedule was followed in the control group (see Fig. 2). Each HRV measurement consisted of a five -minute segment recording according to guidelines of the Taskforce of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Due to the duration of the music intervention, approximately 10-15 minutes, a five minute recording was realistic and in line with the guidelines. HRV recordings were performed with an Em-Wave Pro device from HeartMath (Boulder Creek, CA) using an ear lobe pulse sensor to minimize the burden and distraction for the patient. In a previous study, this method was not experienced as disturbing (27).

The data in the control group were collected during six separate weeks for five consecutive days when the musicians were absent. None of the patients in the control group were aware of the music intervention. HRV was measured while the patients was in his/her hospital bed and we did not talk to the patient during the measurements. The same inclusion and exclusion criteria and sampling method were used in the control group.

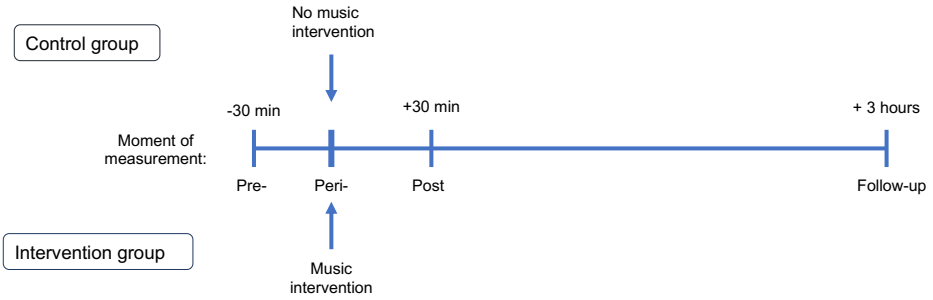

Figure 2. Timeline HRV measurements

HRV

Frequency, time, coherence and achievement are the main domains of the HRV analysis.

Frequency domain

Frequency domain statistics, based on spectral analysis of cardiac interbeat intervals (IBIs), were calculated from fast Fourier transformations. We computed high frequency (0.15-0.4 Hz, HF) and low frequency (0.04-0.15 Hz, LF) (28).

The LF band reflects the parasympathetic and baroreceptor activity and is comprised of rhythms with periods between 7 and 25 seconds. It is affected by breathing from ~3 to 9 breaths per minute (bpm) (15,28). The HF band reflects vagal or parasympathetic activity and also corresponds to respiratory arrhythmia (15). This band is influenced by breathing from 9 to 24 breaths per minute (bpm) (15,28). More activity in the LF or HF band results in higher power spectral density (ms^2/Hz), which is the amplitude of a signal in each frequency band.

Time domain

The time domain analyses are based on linear statistics calculated from intervals between normal heartbeats, the normal to normal (NN) interval or IBI. SDNN is the standard deviation of the normal-to-normal interval. The SDNN is highly correlated with LF and VLF band power (28). The most commonly used time domain variable used to measure parasympathetically mediated changes, is the Root Mean Square of the Successive Differences of normal intervals between heartbeats (RMSSD). This shows the variance per heartbeat and is the most important variable used for estimating vagally mediated changes (29). The RMSSD is a good measure of RSA because it reflects the most fast-moving intervals in the HRV spectrum, and hence reflects vagal (parasympathetic) activity, which tends to be elevated in states of relaxation (15). The short-term norms in healthy subject means (standard deviation) for SDNN and RMSSD are 50 (16) and 42 (15) milliseconds (28).

Coherence and achievement
The level of coherence is a particular pattern in which the heart rate changes in sync with breathing and is determined every 5 seconds. A higher score indicates more coherence, reflecting a better internal physiological state (30). The achievement score is the sum of the individuals coherence sores during the whole HRV measurement. These outcomes were obtained using the EmWave Pro device from HeartMath and both terms are used exclusively by the HeartMath institute (Boulder Creek, CA).

In this study HF and LF (frequency domain); SDNN and RMSSD (time domain) and level of coherence and achievement were measured.

Data analysis and statistics
Descriptive statistics are presented in percentages, medians and ranges. For normally distributed data, unpaired t-tests were used to compare groups and the Mann Whitney U test were used for data that were not normally distributed. Categorical variables were compared using the Chi-square test.

Kubios HRV Premium software (version 3.1 HRV analysis, University of Eastern Finland) were used to apply automatic correction to the measurements to remove artefacts. Data were then exported to an SPSS database (IBM Corporation, Armonk, NY). All measurements of 5 minutes, of the first day a patient participated, were taken in account, shorter measurements were excluded. Logarithmic transformation were applied on the SDNN and RMSSD to reduce skewness to the right and approach a normal distribution.
Mixed linear modelling were used to assess the effect of the intervention on the outcomes, taking into account changes in outcome values over time. The models were adjusted for the following potential confounders: age, gender, location of surgery, and ASA-classification. P-values < 0.05 were considered to be statistically significant.

RESULTS

Of the 101 patients included in this study, 57 patients participated in the intervention group. No significant differences were found in patient and surgical characteristics between the groups (Table 1). The median age was 70 years. In both groups the majority of the patients underwent intracavitary surgery and had an ASA classification of 2 or 3. The median number of days since surgery at the first participation in the intervention group was two days (range 1-36) compared to three days in the control group (range 1-15).

Table 1. Patient characteristics and surgical characteristics

Variables		Control group (n=44)	Intervention group (n=57)	*p*- value
Age (years)		70 (60-86)	70 (60-88)	.371[x]
Gender				.818[y]
	Male	28 (63.6%)	35 (61.4.%)	
	Female	16 (36.4%)	22 (38.6%)	
CCI		3 (0-10)	3 (0-10)	.105[z]
Type of surgery				.654[y]
	Intracavitary	26 (53.5%)	31 (54.4%)	
	Extremity	15 (34.1%)	19 (33.3%)	
	Head-neck area	3 (6.8%)	7 (12.3%)	
ASA – classification		2 (1-4)	2 (1-4)	. 297[y]
	I	5 (11.4%)	5 (8.8%)	
	II	22 (50.0%)	28 (49.1%)	
	III	13 (29.5%)	23 (40.4 %)	
	IV	4 (9.1%)	1 (1.8%)	
POD of first measurement		3 (1-130)	3 (0-36)	.388[z]

Presented as median (range) or number (%). A p-value of < 0.05 was considered significant.
X Independent samples T-Test; y Chi-square Test; z Mann Whitney U test
CCI= Charlson co-morbidity index; ASA= American Society of Anesthesiologists score; POD= Post-Operative Days

Heart rate variability

Outcomes of HRV parameters at different time points are presented in Table 2 and Figure 3. Baseline measurements for both groups on the LF band were comparable. At peri-measurement, there was an increase in both cohorts, but there was a higher increase in the intervention group (peri-measurement 48.58 vs 53.30) and afterwards (post- measurement 46.20 vs 49.33) compared to the control group. Outcomes on the HF band were also similar at baseline in both groups. In contrast to the LF band, the HF band in the intervention group, when displayed graphically, create a U-shape. The peri-measurement in the intervention group is the lowest point (peri measurement 51.18 vs. 46.40). The results in the control group also show a decrease in the peri-measurement but no increase in the HF band after the post-measurement (follow-up measurement 53.30 vs 58.77).

In the intervention group there is a decrease in the time domain visible parameters SDNN and RMSSD until the post-measurement. Three hours after the live bedside music intervention we see that the SDNN nearly returned to baseline and that the RMSSD increased above baseline (43.82 vs 45.04). This trend is not visible in the control group.

The mixed-effect regression model, was used to assess changes in outcome values over time. Results shows a significant difference (95%CI [-9.41- -.19], $p = 0.041$) on the LF and HF band (95%CI [.21-9.37], $p = 0.041$) between the intervention and control groups (see Table 3).

Table 2. Description of HRV parameters in subgroups

Parameter		Moment	Control group (mean – sd)	n	Intervention group (mean – sd)	N
Frequency domain	**LF (power ms²)**	Pre	43.06 (16.59)	34	43.69 (18.64)	44
		Peri	48.58 (19.05)	34	53.30 (19.18)	33
		Post	46.20 (17.29)	31	49.33 (19.00)	35
		Follow-up	46.42 (18.20)	28	40.85 (18.90)	29
	HF (power ms²)	Pre	56.65 (16.48)	34	55.96 (18.46)	44
		Peri	51.18 (18.91)	34	46.40 (19.02)	33
		Post	53.53 (17.18)	31	50.36 (18.87)	35
		Follow-up	53.30 (18.09)	28	58.77 (18.76)	29
Time domain	**SDNN (ms)**	Pre	31.84 (15.52)	34	35.50 (21.96)	44
		Peri	28.56 (14.16)	34	32.34 (21.81)	33
		Post	31.85 (16.26)	31	28.43 (18.25)	35
		Follow-up	31.43 (16.02)	28	34.58 (24.26)	29
	RMSSD (ms)	Pre	40.04 (22.86)	34	43.82 (33.89)	44
		Peri	32.49 (20.18)	34	37.16 (30.45)	33
		Post	38.67 (23.75)	31	34.53 (28.75)	35
		Follow-up	37.76 (22.38)	28	45.04 (37.36)	29
Coherence		Pre	.46 (.23)	41	.43 (.19)	35
		Peri	.45 (.24)	41	.52 (.23)	34
		Post	.44 (.19)	38	.46 (.21)	34
		Follow-up	.47 (.20)	38	.48 (.27)	31
Achievement		Pre	33.56 (18.78)	41	31.29 (13.95)	35
		Peri	37.22 (21.35)	41	41.12 (23.34)	34
		Post	31.13 (14.95)	38	31.44 (17.49)	34
		Follow-up	34.29 (14.58)	38	34.55 (21.46)	31

LF= Low Frequency, HF= High Frequency, SDNN=Standard Deviation of the N-N interval, RMSSD= Root Mean Square of the Successive Differences, Ms= milliseconds

No significant differences were found between the groups in the time domain (SDNN (p = 0.610), RMSSD (p=0.840) nor in coherence (p = 0.278) or achievement (p = 0.530). However, in coherence a trend was visible in the peri-measurement results of the intervention group compared to the control group, indicating that during the intervention, patients had a more coherent HRV. This also resulted in achievement scores which increased by more than 31.4% in the live bedside music group during the intervention, compared to the control group which increased by 10.9% compared to baseline. Assumedly due to the large standard deviation, no significant difference was be demonstrated.

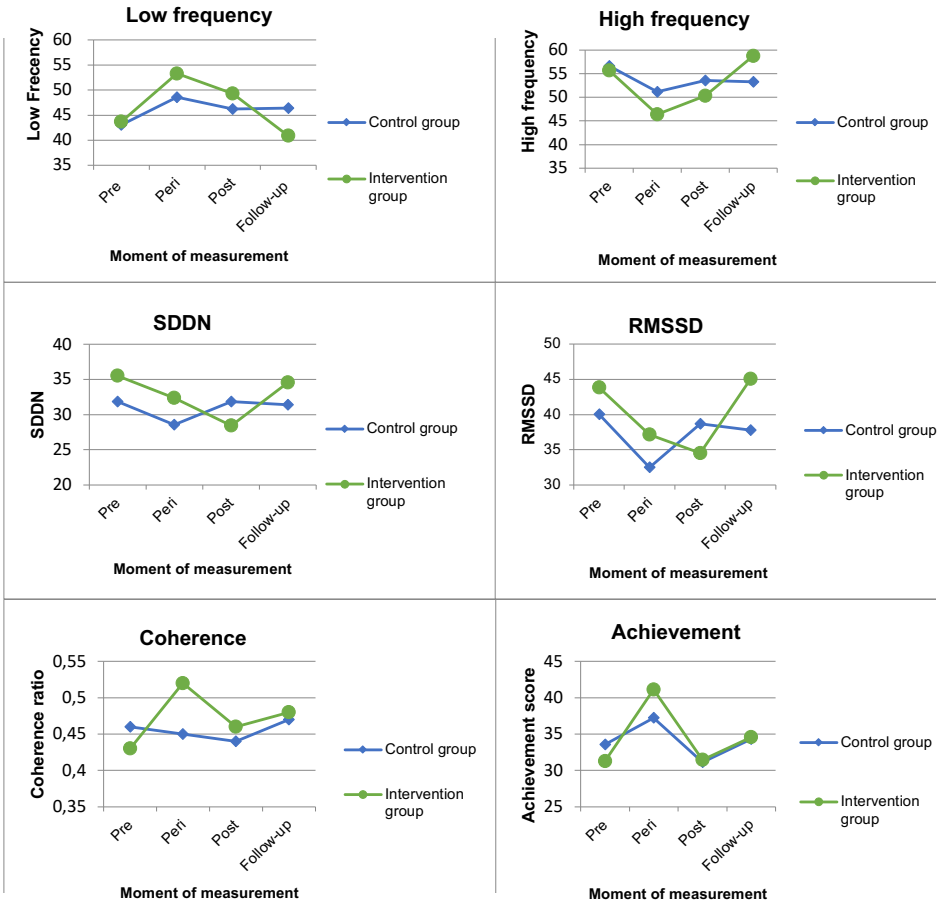

Figure 3. Graphical representation of the mean changes in HRV parameters in both groups.

Table 3. Variables HRV between both groups on mixed-effects linear regression

	Crude model		Adjusted model	
HRV domain	**Coefficient (95% CI)**	***P*-Value**	**Coefficient (95% CI)**	***P*-Value**
Low frequency	-4.59 (-9.18 - -.00)	.050	-4.80 (-9.41 - -.19)	**.041***
High frequency	4.58 (.23 – 9.14)	**.049***	4.79 (.21 – 9.37)	**.041***
SDNN	-.05 (-.18 - .09)	.515	-.36 (-.17 - .10)	.610
RMSSD	-.17 (-.18 - .15)	.840	-6.32 (-6.76 - 5.49)	.840
Coherence	-.33 (-.09 - .28)	.287	-.33 (-.093 - .028)	.288
Achievement	-1.76 (-7.24 – 3.73)	.530	-1.67 (-7.18 - 3.84)	.553

CI = confidence interval, *=significant

DISCUSSION

This study aimed to explore the effect of live bedside music on different HRV parameters in older surgical patients, as a proxy for the effect of live bedside music on the autonomic nervous system. This effect of live beside music were limited to the time the music was played, no lasting effects could be established. Data shows, specific in the frequency band, that is was positively influenced by live bedside music, compared to patients in the control group, indicating parasympathetic activity was increased and patients were more relaxed. The level of coherence increased during the live bedside music intervention. However, this effect on the level of coherence did not continue after the music stopped. In recent decades, growing evidence of the contribution of music to the recovery of surgical patients has shown promising psychophysiological effects. Several systematic reviews and meta-analyses have described the positive effects of music on pain perception and anxiety (31-34). Despite conflicting results, there are indications that music also influences physiologic parameters such as blood pressure and heart rate (3,5,6,35). Several studies have examined the impact of music interventions on surgical stress by measuring cortisol levels and found a significantly decrease compared to the control group (5,36-38).

Although the results of this explorative study are statistically significant, their clinical relevance is limited for surgical interventions at this point. The literature on the effects of (live) music intervention on HRV in older surgical patients is scarce, limiting the comparison of our results to previous studies. It is known that music promotes relaxation and a slower breathing pattern with more power in the HF band could be expected when the breathing rates between were between 9-24 bpm (25,39,40).Once the breathing rates are slower, it is likely that there is a decrease in HF band and an increase LF band. In this exploratory study, we did not monitor respiratory rates. Because the HF band is related to variations in the heart rate with the respiratory cycle (RSA), an increase of the HF band was expected during the intervention (peri-measurement) compared to pre-measurement. Results indicate a shift during the live bedside music intervention from the HF band towards the LF band (fig. 3) which might have been caused by a lower breathing pattern of the participants during the music which created the U-shape. However, results did show an increased HF band in the intervention group over time ($p = 0.41$), even higher than the baseline measurements. This indicates more parasympathetic activity related to the music intervention based on the frequency domain, however, this was not confirmed by the results of the time domain analyses for the SDNN and RMSSD. Based on the decreases in the SDNN and RMSSD, is it could be stated that the music was arousing for patients. However, in the absence of adequate data on respiratory rates and frequency peaks in this explorative study, we cannot fully support this finding. Our results do not align with results from a study of 49 older patients after knee-replacement surgery. They

found an increased HF band in patients listening to music during training of their knee (41). A possible explanation for this difference is that in our study, patients were lying in their beds during the intervention and not physically active and thus no respiratory effort was required, which makes a decrease in breathing rate likely and therefore a decrease in HF band (and increase in LF band). Another explanation could be that patients were cardiovascular deconditioned due to hospitalization which may have led to a disturbed baroreflex, affecting the HRV (42). In future research days of bedrest could be taken into account to determine this. It is also plausible that patients felt more at ease during our live bedside music intervention, resulting in slower breathing, which is associated with an increased RSA in the LF band. A study of older patients who had undergone abdominal surgery found similar results regarding lower respiratory rates after music intervention (35). The evidence regarding slow breathing and inflammation is still limited, there are some interesting possibilities presented in a study among non-surgical patients (age 18-75) with asthma on HRV biofeedback with relaxing music indicating that HRV biofeedback had beneficial effects (43). In our study, no inflammatory markers were measured, but it is known that surgical tissue damage initially triggers an inflammatory response to limit the expansion of the injury and promote wound healing (44). The autonomic nervous system regulates this inflammatory reflex (45). However, an excessive inflammatory response can cause collateral tissue damage and pathology and may account partially for the increased morbidity and mortality seen in older surgical patients (46,47). Although the level of evidence is still low, there is a potential role for music listening in alleviating inflammation (48). Previous studies have shown a negative association between indices of HRV and markers of inflammation (45). Further exploration of the effect of music on the inflammatory response through analyzing the plasma levels of inflammatory markers and measuring HRV at multiple time points around music interventions is necessary.

Several study limitations and improvements should be addressed. It is known that live music compared to recorded music elicits a greater emotional and physical response and, therefore, may positively influence HRV parameters (49). However, in further research a recorded music arm could be included in the design for comparison. In addition, the timing of HRV measurements is debatable because HRV can be influenced by environmental circumstances beyond the control of the researchers. Extra measurements directly after the live bedside music intervention could provide more information on HRV parameters. Furthermore, the sample size of this study is limited due to the design and shaping of the intervention and the study population is heterogeneous. Further research should consider surgical prognosis-related factors, various drugs and specific cardiovascular medications. Applying randomization should also be considered in follow-up research to distribute the effect of known and unknown factors between both arms.

CONCLUSION

This study aimed to explore the response of the autonomic nervous system to live bedside music in older surgical patients by using HRV as a proxy measurement. Our data show that HRV parameters, specifically the frequency band, are small but positively influenced by live bedside music compared to the control group. This indicates relaxation and increased parasympathetic activity in time, but due to the absence of data on breathing patterns this should be carefully interpreted. Future research should examine interfering (physiological) factors of the ANS to gain more insight into the underlying mechanism. Although the clinical relevance is limited these results contribute to a better understanding of the effect of music on the recovery of older surgical patients.

STATEMENTS AND DECLARATIONS

Competing interests

Funding
The authors did not received no funding for conducting this study.

Financial interests
The authors declare they have no financial interests.

Non-financial interests
None.

Data availability statement
The data that support the findings of this study are available from the corresponding author upon request.

Compliance with Ethical Standards

Conflicts of interest
The authors declare that they have no conflicts of interest.

Consent to participate
The medical ethical board of the University Medical Center Groningen concluded that this study did not fall within the scope of the Dutch law of medical research involving human subjects act and provided dispensation for further assessment (registration number: 201600541). Informed consent was obtained from all participating patients. All procedures followed were in accordance with the ethical standards and in line with the principles of the Declaration of Helsinki.

Consent to publish

Patients singed informed consent regarding publishing data.

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CHAPTER 6

Live bedside music for hospitalized older adults: a qualitative descriptive interview study

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ABSTRACT

Introduction

Hospitalization may have a major impact on older patients as it is often a period of psychosocial vulnerability. Music is one of the most described art forms used in healthcare. Applied in clinical settings, it can affect a patients' emotional and psychosocial wellbeing. Incorporating a wider perspective of health promotion that aims to advance not only physical health, but a patients' overall wellbeing, is part of a person-centred approach to care. We developed an innovative participatory music practice in which professional musicians and music therapists visited patients at their bedside for 10-15 minutes in a Dutch and Austrian hospital. This qualitative study explores the added value of live bedside music practice for older hospitalized patients in Austria and the Netherlands.

Methods

Semi-structured interviews were conducted between October 2020 and February 2022 with 23 hospitalized patients aged ≥60 years. Due to the COVID-19 pandemic, the music sessions in Austria were facilitated by establishing a live connection between musicians and patients using a tablet. Data was transcribed verbatim and performed qualitative content analysis following the steps of thematic analysis. The COnsolidated criteria for REporting Qualitative research (COREQ) checklist was applied to report data collection, analysis and results.

Results

Four themes emerged from the data analysis. Participants described the perceived influences of live bedside music in terms of (1) emotional release, (2) positive distraction, (3) alterations in contact and (4) shared humanity. Overall, participants positively valued the live bedside music practice and expressed a desire for its' continuation.

Conclusion

This study explores the experiences and the added value of live bedside music for older hospitalized patients. By facilitating distraction and emotional release and enhancing nurse-patient interactions, live bedside music can significantly improve hospital experiences for older patients. Results reveal that live bedside music provides a positive patient experience and can be part of integrative and holistic care for hospitalized older patients. Live bedside music can attend to the emotional needs of older patients which are often under addressed in clinical settings but are crucial for enhancing their wellbeing.

Keywords

Nursing, older patients, surgery, live bedside music, perceived value.

1. INTRODUCTION

The growing interest in the role of music in healthcare has provided substantial knowledge on the beneficial outcomes of music in improving wellbeing (1). Integrative approaches to hospital care, aiming to advance both a patient's somatic as well as their emotional wellbeing, are particularly relevant for older patients as they demonstrate greater vulnerability to stress. Older patients, those over the age of 60, increasingly represent a large proportion of hospitalized patients due to population ageing (2). Hospitalization is a major event that often marks the transition from health to frailty. Little to no distraction, loss of autonomy and privacy, and increased levels of anxiety and discomfort add to older patients' psychological vulnerability. Incorporating music into hospital care for older patients might contribute to enhanced positive experiences. Positive experiences with hospital care increase quality of life for older patients not only during hospitalization, but also afterwards (3).

Rather than exclusively focussing on the somatic needs of patients, a person-centred approach to care involves recognizing a patient's psychosocial circumstances and how these might affect their health and wellbeing. It acknowledges the urgency to incorporate a broader view of health and wellbeing, paying significant attention to a patients' unique needs and wishes concerning their somatic and emotional needs. In the coming decades, person -centred approaches in healthcare will gain relevance, as populations worldwide age and problems associated with comorbidity and frailty increase (4,5).

Providing music can be a way to facilitate and promote person-centred care for older patients (6). Several programmes have been developed as adjunct forms of support for patients, which promote a healing environment (7). Live bedside music is a form of participatory art. Patients are accompanied by a nurse while musicians play for them at the bedside of the patient. Both the patient and the nurse share their musical preferences with the musicians, who then, according to these preferences, play from their repertoire or create an improvisation on the spot (8). The current literature mainly uses recorded music and reports its influence on physiological effects, clinical patient outcomes, pain, and physiological parameters such as heart rate and blood pressure (1,9). Little is known about the perceived added value of live bedside music from the personal perspective of older patients.

The purpose of this qualitative study is to gain insight into the experiences of older patients with live bedside music during their hospital admission and to understand whether they perceive it as having added value.

2. BACKGROUND

Music is one of the most widely described art forms used in healthcare and, in addition, is a part of many people's lives (1). It is widely acknowledged that music contributes to physical and mental health and is often a meaningful attribution to special and important life events (9). Hospitalization is considered a major life event. Therefore, it is plausible that music can also fulfil a meaningful role during hospital admission. Offering music can be shaped in various ways and can have several goals.

Although research on live bedside music for older hospitalized adults is scarce, the results of a systematic review shows that music as an intervention for older surgical patients has a positive effect on a broad range of clinical outcomes, of which pain and anxiety were most frequently examined. These outcomes also include physiological parameters such as heart rate and blood pressure (10). While most studies used recorded music, studies using live, participatory music practice in older patients show similar results (11,12). However, the effect of music intervention on clinical outcomes is mostly described, while the arts can also be used to facilitate care and promote general wellbeing. Participatory music engagement supports wellbeing by creating both a connection and a shared experience between the participants and should not be confused with music therapy or music as medicine (13). Unlike participatory music engagement, music therapy uses music-based interventions in which both the music and the therapist-patient relationship are agents of change, and music as medicine contains an intervention were music is delivered by healthcare professionals (14).

The live bedside music intervention is performed by professional musicians and is a participatory music practice. Participatory music making is characterized by activities that take place when people actively engage in the music interaction (15). This engagement can commonly be seen as making music using an instrument or singing as well as physical movements like toe-tapping or nodding one's head to the beat (16). The nature of it is interactive and requires no skills from the participants (16).

While several studies have investigated the (positive) effects of music listening in older hospitalized patients, the patient experience of participatory music practices performed during hospitalization, has not yet been studied (10,17).

This is also relevant considering the current era of healthcare we are entering, which is value-driven instead of disease-driven (18). In this transition, the focus is no longer solely on the body and its physical needs: healthcare is being placed in a broader holistic perspective, in which the body and mind are both considered in care (19). As such, more focus on a broader holistic perspective can tie in well with the care provided by nurses and live bedside music as a participatory form of art. A greater understanding of the perceived value of live bedside music as a participatory form of art can contribute to the

optimization of person-centred care for older hospitalized patients.

3. MATERIALS AND METHODS

3.1 Design

The aim was to study the added value of a live bedside music practice for older hospitalized patients in Austria and the Netherlands. A qualitative descriptive design was used, based on the principles of reflexive thematic analysis. This study was conducted during the Meaningful Music in healthCare (MiMiC) study (trail ID: NL5874) and Professional excellence in Meaningful Music in healthCare (ProMiMiC) study (trail ID: NL9653) in which the live bedside music intervention was investigated in relation to interprofessional collaboration between musicians and nurses, and compassion at the participating hospital wards. Semi-structured interviews, directed by an interview guide, were carried out with individual patients. Semi-structured interviews were selected for their capacity to facilitate dialogue and enable the interviewer to probe deeper based on the interviewee's responses (20). The consolidated criteria for reporting qualitative research (COREQ) were adhered to throughout this study (21).

3.2 Live bedside music intervention

The live bedside music intervention called MiMiC, was developed in collaboration with the Prince Claus Conservatoire Groningen, the Netherlands. Guidelines for reporting music-based interventions were used to describe the intervention (22).

In this practice, live bedside music is performed by professional and multi-faceted musicians of which three musicians played for four or five consecutive days at a row at the ward. The conservatoire selected the musicians: a violinist, a cellist, a clarinettist, a flautist, a bassoonist and an accordionist. All these musicians were accomplished chamber musicians who can play solo, improvise and arrange music and have adequate social awareness. The musicians played both repertoire and person-centred improvisations. The genres of repertoire played at the patients' bedside varied from light classical music to contemporary pop music. For the person-centred improvisations musicians elicited input from patients (for example a landscape, theme or colour). If a patient preferred a piece of the repertoire, then this was tailored to the patient's preference or need. Music was then made in the moment in which the musicians responded in their practice to the patient reaction on the music (8,23). Each session lasted 10-15 minutes which is approximately one or two pieces, depending on the patient's wishes or condition and was carried out according to a fixed structure (fig 1. for an impression). Musicians visited the rooms of patients who wished to receive live bedside music. Patients who did not wish to receive live bedside music were excluded from visits. Monitoring patients who

wished to receive live bedside music and those who didn't was done in consultation with nurses. Before the musicians entered the room, it was always double checked to confirm the patients' wish and whether it was a convenient time. The musicians visited approximately 10 to 15 patients each day.

Live bedside music was provided to all willing patients, whether or not they agreed to participate in the study (8,23).

Figure 1. Photograph of a live beside music performance in a patient's room.

3.2.1 Adaptation of the live bedside music during the COVID-19 pandemic

The COVID-19 pandemic significantly impacted the healthcare sector, prompting healthcare workers, policymakers and researchers worldwide to find alternative methods of facilitating human-to-human interaction in practice.

After extensive discussion among members of the research team and in close collaboration with the department of infection prevention, a setup was established that facilitated a high-quality, live connection between musicians and patients via a tablet. The musicians, stationed in another room, did not pre-record the music. Instead, they engaged with the patient through a real-time, live connection and actively involved the

patient in the practice. The live bedside music was then performed specifically for that patient, who held the tablet while sitting or lying in bed. A researcher was present in the room with the patient to guide and explain the intervention and to facilitate the process in order to relieve the patient any burden.

During the COVID-19 pandemic, regulations were constantly changing and differed per country to country. In Austria, the live bedside music continued to be conducted in the manner described above. However, in the Netherlands, the musicians were permitted to return to the hospital during the period the data was collected.

3.3 Setting

Participants were recruited from two university hospitals in which the live bedside music intervention took place. Patients were admitted to one of four participating surgical wards in a Dutch hospital or a radiotherapy ward in the Austrian hospital. During the COVID-19 pandemic, the music sessions in Austria were conducted virtually, with a tablet with a live internet connection linking the musicians to the patient.

3.4 Participants

Patients were purposively sampled to include those patients that received live bedside music during their hospital admission for treatment. Patients were eligible to participate in this study if they met all of the following inclusion criteria: age ≥60 years, surgical or radiation treatment prior to the live bedside music intervention, and being capable of providing informed consent. Out of the 35 patients approached for participation, between October 2020 and February 2022, 23 provided informed consent (figure 2).

3.5 Data collection

In the Netherlands, all individual interviews were conducted at the patients' bedside. Due to the COVID-19 pandemic and related hospital regulations, the data collection in Austria needed to be altered and was carries out via by telephone. The interviews were performed by three experienced interviewers of which three (HWH, NvdB, LB) were involved in the data collection, all working in the field of healthcare or music therapy. An interview guide was developed through discussions with the research team and was informed by their expertise, the current literature and the aim of this study. The interview guide contains three topics (see Appendix A). The first topic related to the live bedside intervention and contained questions about the upfront expectations and considerations of the intervention. Follow-up questions were asked including whether it had affected the patient emotionally or physically, how they experienced the live bedside music practice and whether the music was repertoire and/or person-centred improvisation. The second topic concerned the contact and presence of the nurse during the intervention and afterwards. The third topic concerned experiences with music in daily life. A brief verbal summary of the conversation was given at the end of the interview.

All interviews were audiotaped, and situational field notes were made. Prior to the start, the interviewers conducted a test interview with an older person who was familiar with the live bedside music intervention. Demographics were collected from the electronic medical records.

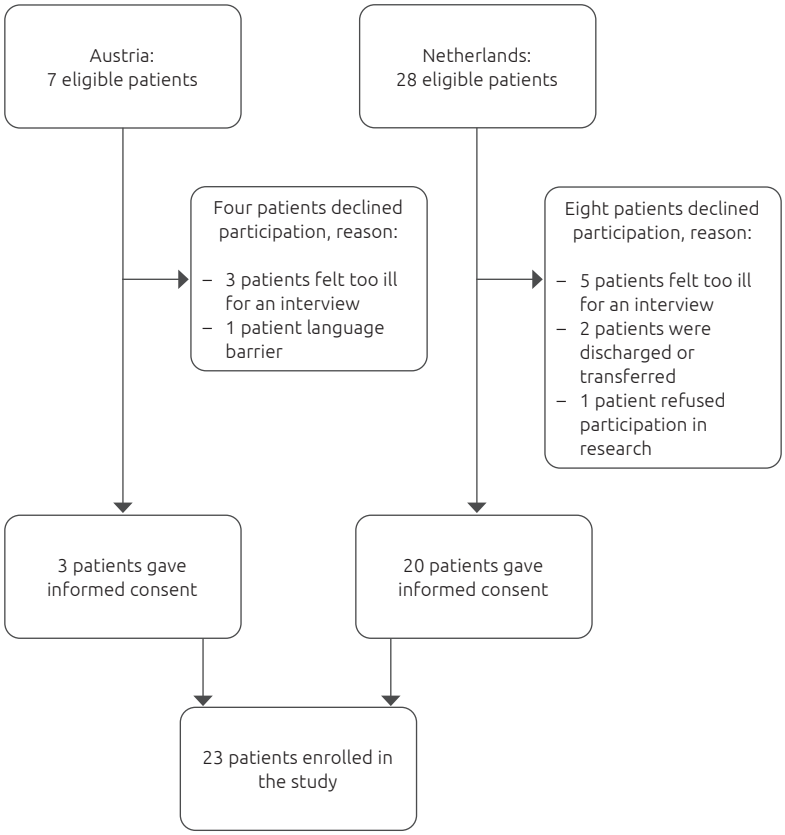

Figure 2. Participating patients

3.6 Analysis

A thematic qualitative content analysis was performed. This approach allows for unexpected themes to be identified, including the analysis and reporting of patterns (or themes) within the collected data (24). Within this process, the following six steps of reflexive, inductive thematic analysis were performed as described by (25). These steps include the following; (1) familiarization with the data; (2) generation of initial codes; (3) search for categories and themes; (4) review of categories and themes; (5) definition

and naming of categories and themes; and (6) reporting. Initially, all interviews were transcribed verbatim. The transcribed text of the interviews conducted in Austria were translated from German into Dutch by a professional translator with a medical background. All data were pseudonymized and data that could identify the patients' identities were removed from the transcripts. Three researchers (HWH, NvdB, LB) conducted the interviews and transcribed the data. Two additional researchers (PdG, WP) cross checked and open coded the data to ensure rigour. The researchers (HWH, NvdB, LB) transcribed the data and familiarised themselves with it by reading. In the second phase, two other researchers (PdG, WP) open-coded interviews to check whether the authors' individual interpretations were similar, which was the case, thus increasing the trustworthiness (26). Any differences that arose were resolved by discussion, and data saturation was reached. Additionally, during steps three to six, consensus meetings were held with the researchers (HWH, NvdB, PdG, WP) to discuss the inductively open and axially coded data, derive and name the themes, and produce the report. In the process of analysis, the four criteria for trustworthiness were taken into account as follows: credibility (1) was improved by using investigator triangulation, which allowed for an independent analysis of interview transcripts and joint consensus discussions. Furthermore, peer debriefing with the researchers took place. Generalizability (2) was considered by providing patient characteristics. This supports those interested in exploiting the findings to adjudge the transferability of the results to their own (research) context. The reliability (3) of our study was increased by following the COREQ checklist for the 'Standards for Reporting Qualitative Research' (21) where the processes of coding and analysis were detailed. To ascertain confirmability (4), the interpretations and conclusions of the researchers can be traced back to the transcribed texts. This was facilitated by archiving all analysis steps in the ATLAS-ti programme (version 22). Literal quotes have also been used in the results section. The representation if figure 3 shows the outcome of this process.

3.7 Ethical considerations

The medical ethics board of University Medical Center Groningen, the Netherlands, concluded that this study did not fall within the scope of the Dutch law of Medical Research Involving Human Subjects Act and provided dispensation for further assessment (research register number: 202000659). The study was subsequently submitted to the ethical board in Austria and approved (EK Nr. 1525/2021). Common ethical principles in clinical research were followed. Written informed consent was obtained from all participating patients according to local regulations, and the data collection was conducted following the Declaration of Helsinki.

4. RESULTS

Twenty-three older patients with a median age of 73 years (SD 8.01) were included in the study. The majority of the patients were admitted for surgery (20 patients, 60% male) and three patients (66.7% male) were admitted for radiotherapy treatment. An overview of the participants is presented in Table 1.

Table 1. Overview of participating patients

Participants	Gender	Age (years)	Ward
P. 01	Male	61	Surgical oncology
P. 02	Male	63	Radiotherapy
P. 03	Female	63	Orthopaedic surgery
P. 04	Male	65	Abdominal surgery
P. 05	Male	66	Orthopaedic surgery
P. 06	Male	67	Surgical urology
P. 07	Female	67	Surgical gynaecology
P. 08	Male	69	Surgical oncology
P. 09	Male	69	Endocrine surgery
P. 10	Male	69	Surgical oncology
P. 11	Male	71	Radiotherapy
P. 12	Male	73	Hepatobiliary surgery
P. 13	Male	73	Surgical oncology
P. 14	Female	73	Surgical oncology
P. 15	Female	74	Surgical gynaecology
P. 16	Female	76	Hepatobiliary surgery
P. 17	Male	76	Abdominal surgery
P. 18	Female	78	Radiotherapy
P. 19	Male	78	Surgical urology
P. 20	Female	80	Orthopaedic surgery
P. 21	Female	86	Orthopaedic surgery
P. 22	Female	89	Surgical oncology
P. 23	Male	90	Vascular surgery

The data revealed four overarching themes: emotional release, positive distraction, alterations in contact and shared humanity. An overview of the codes, categories and themes derived from the data is presented in Figure 3.

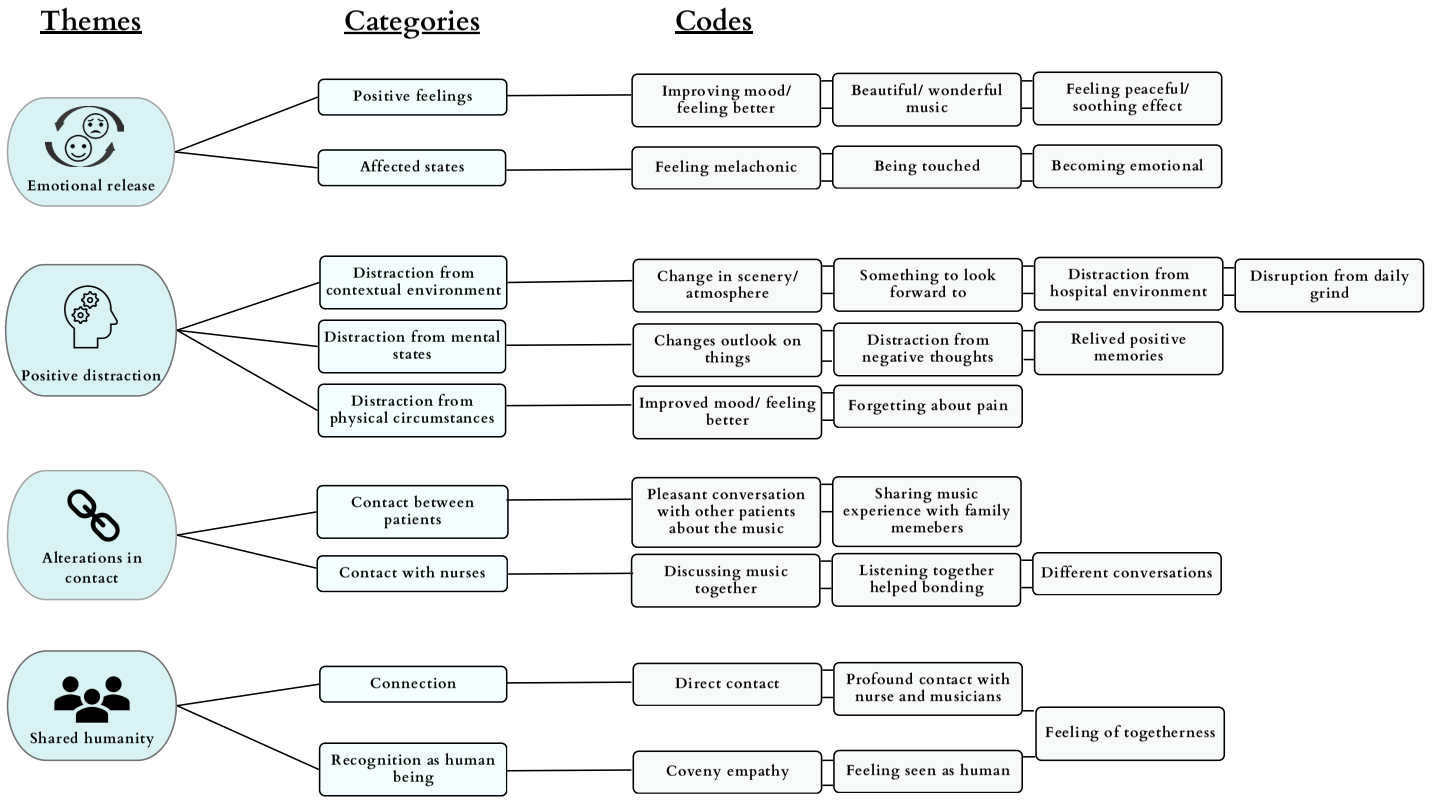

Figure 3. Overview of themes, categories and codes derived from the data

4.1 Emotional release

All participants in this study spoke of multiple perceived effects relating to the emergence of emotions and feelings as a result of the live bedside music performances. Nine participants mentioned that perceiving live bedside music could release compiled emotions, enable temporary surrender to certain feelings, or that it could trigger specific affects or emotional states. In this context, these participants furthermore spoke of listening to music as a "relief" or as a moment of being able to let go of emotions. *"It is a moment of letting go... a moment that brings happiness. I could both laugh and cry*" P. 05, male, 66 years.

Two categories emerged relating to emotional release. Participants spoke of experiencing positive emotions and of becoming emotionally affected.

4.1.1 Positive feelings

Among the perceived influences in this study, the experience of positive emotions as a result of receiving a live bedside music performance was mentioned by all participants. Multiple words and expressions were used to describe these emotions. Some of these words related to the appreciation of the quality of the music, such as the music being "delightful" "valuable" or "special". As one participant mentioned: "*I was so engaged in listening… it was truly beautiful*" P. 10, male, 69 years. Others referred to specific states that the music generated, such as states of "enjoyment", "bliss" "happiness", "satisfaction" or "contentment". Participants also mentioned that the music improved their mood, cheered them up, amused them or made them feel good.

Other words that participants used to describe the mood they were in after the music was played were "funny", "romantic", "cosy" and "happy". One participant said: *"I feel so much emotion inside me, and so much happiness…"* P. 05, male, 66 years. Nine participants described feelings of relaxation and calmness. As one participant mentioned: "*You just really become more peaceful, because you're focused on the music*" P. 16, female, 76 years. Participants stated that different durations of these states. Three mentioned the perceived influences lasted only as long as the musicians were in the hospital room, or several moments thereafter. Eight participants stated that the perceived effect lasted between an hour and a few hours.

4.1.2 Affected states

Ten participants mentioned that they were emotionally moved by the music in terms of feeling sadness, sorrow or melancholy. They spoke of "becoming emotional", "being touched" and of the music going "directly to your feelings". While pointing at the heart, one participant said: "*It touches you right here*" (P. 06, male, 67 years). Five participants mentioned that they experienced physical symptoms such as getting goosebumps or crying. Some of them reexperienced these while talking to the interviewer about the

performances: "*Even thinking about it can make me cry (…) music is a superpower. It's in the tones, they convey feelings of empathy, hope, love*" P. 05, 66 years. One participant negatively valued becoming affected by the music, stating that it was a reminder of painful events: "*I shouldn't think about emotions too much… my husband died recently. And if I think of certain music, it makes me really, really sad (…) the feelings of loss, that he's not here anymore. And that we enjoyed music so much together*" P. 20, female, 80 years. Four participants spoke of how the music sessions in the hospital created new memories for them: "*If I ever hear this composition again… I'll think of my stay in the hospital*" P. 06, male, 67 years.

4.2 Positive distraction

All participants mentioned distraction as a perceived effect of the live bedside music performances. They spoke of distraction from the contextual environment, distraction from inner mental states or from physical circumstances. Moreover, as a result of these diversions in the inner and outer environment, ten participants mentioned changes in the contact they had with nurses, families and others.

4.2.1 Distraction from contextual environment

Fourteen participants mentioned how the music performances caused a change in scenery that (temporarily) distracted them from the general ambiance and environment of the hospital: "*Already just the ambience they bring… doesn't matter what kind of music they are playing. I really, really like that"* P. 16, Female, 76 years. The music performances were a pleasant surprise that caused a welcome alteration of the hospital's atmosphere: "*It is not so monotonous here when there is music frolicking around*" P. 21, female, 86 years.

Participants furthermore spoke of the live bedside music as a "pleasant break from the daily grind" or as a "nice interruption of the day". They mentioned how it helped them "pass the time" or that it made their day "less inert": *"it's a very welcome disruption. You're just all cooped up here/You're just lying around here"* P. 12, male, 73 years.

Most patients did not expect live music at the hospital and were pleasantly surprised and curious. One participant hesitated but decided to participate because music offered a different sound and one because of the type of musical instrument.

Seven participants expressed explicit admiration for the musicians' musical qualities, in terms of the musicians' technical performance, the ability to improvise, and the degree of being musically attuned with one another.

Four participants expressed their appreciation for the musicians' social skills: "*It's not easy, a hospital environment. It takes bravery from those young people to come here, I admire that*" P. 23, male, 90 years.

4.2.2 Distraction from mental states

Ten participants spoke of how, while receiving a live music performance at their bedside, their attention was diverted from their ongoing thoughts. They mentioned that the added value of music during hospitalization was that it either altered their thought patterns or completely removed them during the sessions. "*I became a little calmer. (…) it was chaos in my head. Afterwards I wasn't fretting that much anymore*" P. 21, female, 86 years.

Moreover, participants spoke of how they enjoyed the music as a welcome distraction from their current circumstances, saying that "experiencing something different" helped them to cope with their mental states, whether this included having negative thoughts, being preoccupied with oneself or having fearful thoughts about upcoming procedures: "*I was going for treatment the next day, and it mainly distracted my thoughts from that... I wasn't thinking "how will it be, how will it be after?", no, it diverted my attention from it, those thoughts weren't there for a change*" P. 12, male, 73 years.

Furthermore, music appears to be an accessible type of distraction as it requires no specific capabilities from the listener. One patient mentioned: "*Music is something easier, I cannot concentrate, and music is more distracting than literature"* P. 19, male 78 years.

Nine participants spoke of how listening to live music could evoke memories. For example, some songs played by the musicians had a nostalgic or melancholic meaning for the participants, reminding them of specific events in the past, such as weddings, vacations or funerals, or of people, such as family members. One participant mentioned: "*my grandpa used to play the violin…. And my son is very musical as well, so yeah... that's what you're thinking about"* P. 03, female, 63 years.

Live bedside music also provoked visualizations in participants when patient-centred improvisations were played. Seven participants spoke of what they visualized while they listened, such as a specific landscape or country they had previously mentioned as inspiration. One participant became emotional while reminiscing: "*I asked for Greece… why? Because of the warmheartedness… the people are so hospitable there… and then they played a song tailored to that. And I could feel it too! I felt the warmth in what they were playing!"* P. 06, male, 67 years.

Five participants mentioned that the music performances did not have any discernible impact on their state of mind: "No, I did not really feel a difference. I listened with interest, and it was nice, beautiful. But it didn't teach me anything new about life, or about my future" P.01, male, 61 years.

4.2.3 Distraction from physical discomfort

Five participants in this study stated that the live bedside music performances did not alter their physical circumstances for example pain, or that they did not know whether they felt different as a result. Four participants mentioned that they experienced distraction from physical discomfort during the music performances. For example, described "temporarily forgetting", or "being distracted" from their pain. One patient highlighted the importance of the performance being live in this context, as opposed to recorded music. According to the patient, live bedside music requires you to "stay there", contributing to the level of distraction. Other patients spoke of "feeling good" or "feeling better" as a result. One patient referred to the performance as "a pearl" on a bad day: "*I'm having a bad day today, however, that little pearl this morning… I instantly felt better, I really experienced that. Now it's a bit less, but in that moment I didn't suffer. I didn't feel any pain at all. It's miraculous, but it is true. I speak from experience. It really did me good*" P. 06, male, 67 years.

4.3 Alterations in contact

The majority of the patients said that live bedside music altered the contact they had with others, for example with nurses. Ten participants spoke of having different conversations or noticing a change in contact with nurses. Patients said they spoke about the musicians' visit with other patients with whom they shared a room, evaluating the performance or expressing appreciation. Others mentioned discussing the music with family members. Moreover, twelve participants expressed appreciation for the presence of a nurse during the music performances. One participant mentioned: "*Nurse X stood there and listened together with us… then you get this feeling like, we're all together in this room here, and the nurse is also there… I really liked that*" P. 16, female, 76 years. Others appreciated the nurses' presence during the performances because "nurses are part of it", "it's also for them" or because "it's nice to see them enjoy the music" or to "see their reaction to the music". Seven participants mentioned that the interactions between them and their nurse changed as a result. Some said it "enabled bonding" or that "they got more involved" with one another: "*It's nice to share something more than just wound care and pills*" P. 10, male, 69 years. Another patient said: *"It brings you more together… experiencing something together like that. There isn't always time for that. But you can talk about it*" P. 20, male, 80 years.

Other participants mentioned they enjoyed delivering input for person-centred performances together with their nurse. Fifteen participants did not think it would have been of "added value" whether their nurse was present, or that it would have "made any changes" "*Nurses don't play instruments, so they are not part of it. And I can talk for myself. I don't need a nurse*" P. 22, female, 89 years. One participant noticed only a slight difference in their contact with nurses as a result of the music, stating they did not have "in-depth" or "thought provoking" conversations about it together. Three participants mentioned that

they did not discuss the music performances with the nurses. Two other participants said they failed to notice or "didn't pay attention" to the nurses' presence during the musicians' visit, because they were "enjoying the music" or were "too involved with the musicians".

4.4 Shared humanity

Eleven participants spoke of how receiving a live bedside music performance enhanced and promoted feelings of shared humanity.

Participants appreciated the connection that was made with them during the live bedside music session and experienced it as intimate and personal. They felt they were being seen as human beings. Participants appreciated the "direct" and "profound" contact between them, the healthcare professionals and the musicians, that arose from the performances.

Participants used multiple words to describe the nature of the interaction with the musicians, such as "sincere" "genuine" and "heartfelt". Others spoke of the importance of being seen "as a human being". One participant said: "*the music conveys feelings of empathy, hope and love*", P 05, male, 66 years old. Others mentioned how the music "pulled their heartstrings" or referred to music as "a universal language" or a "gift". Participants also spoke of music as "healing" as "comforting" and as promoting a "feeling of togetherness". Participants further said that they appreciated that musicians "made time" for them, and felt that the musicians were there to help them heal. Six participants said that having a sincere, human connection with others was the most valuable aspect of the performances: *"Of course, when somebody gives you attention, because that's what it is… it helps you in your healing process. (…) I really had the feeling: they are here, now, to help me get better. That's the feeling I had"* P. 06, male, 67 years.

Eight participants spoke of how they appreciated the live bedside performance practice and wished its structural embedding in the hospital structure. Seven participants spoke of how they would recommend a live bedside music session to other patients: "*Whether you're musical or not, doesn't matter, just do it!"* P. 13, male, 73 years.

5. DISCUSSION

A study conducted in two hospitals provides insight into the perceived value of live bedside music for older hospitalized patients. The results of this study describe the perceived value and impact of live music on hospitalized older patients, adding to the existing research on the effects on recorded music in such a setting.

Four main themes were derived from the interviews with older hospitalized patients: emotional release, positive distraction, altered contact and shared humanity (fig. 4). Two of the themes, altered contact and shared humanity, outline the perceived value of live bedside music between patients and nurses.

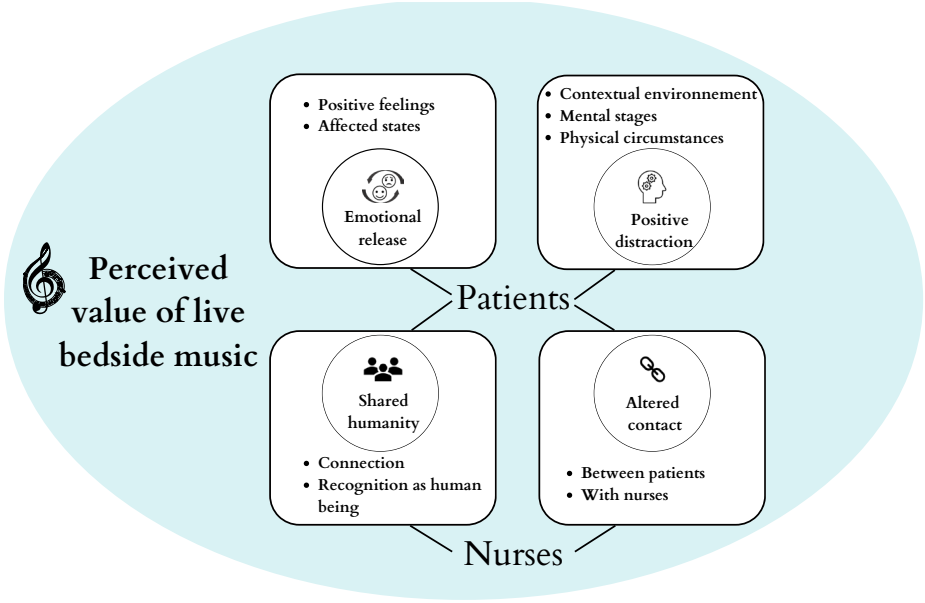

Figure 4. The perceived value of live bedside music for older patients during their hospital admission.

For all participants, receiving live bedside music induced a release of emotions. Whether the emotions were joyful, melancholic, or a combination of both, the ability to let them flow freely was marked as a form of relief. Hospitalized patients experience a range of emotions. Music performance is meaningful in such a setting because the aesthetic and emotional components of music facilitate non-verbal expressions of inner feelings and offer the opportunity for emotional expression, emotion regulation and stress reduction (27,28).

Live bedside music further facilitates distraction, both from the outer environment as well as from inner mental states. This is relevant because hospitalization introduces a unique period of psychosocial vulnerability due to high levels of anxiety and stress. Little or no distraction in the care environment contributes to that vulnerability (3). Live music is known to have a positive impact on reducing anxiety in hospital settings (29). As such, it is an effective form of distraction that is accessible to almost all patients. Distraction

from the hospital environment had multiple beneficial side effects for patients, such as the experience of a change in thought patterns, distraction from physical discomfort or a new stimulus for interaction with others.

Furthermore, participants mentioned that feelings of shared humanity were enhanced by live bedside music practice. Music is known to enhance social bonding and support the development of prosocial emotions such as empathy and compassion (30). Participants spoke of sincere human connection through engagement in the live bedside music performances, both with the musicians and with their caregivers. Being able to share a meaningful moment with others during times of distress had a positive impact on their wellbeing and enhanced feelings of togetherness.

Within person-centred approaches to care, advancing somatic wellbeing is combined with addressing the patients' emotional and psychosocial needs (31).

In a therapeutic culture that departs from a more holistic understanding of health, wellbeing is improved when both the patients' physical and emotional needs are cared for (32). Moreover, patients feel valued when feelings of wellbeing and satisfaction are engendered by positive experiences, such as experiencing positive emotions, bonding with others, and sharing meaningful moments together. These experiences can be brought about by a range of care activities and innovative practices within the context of person-centred approaches to care (31). While a singular definition of person-centred care is lacking, it is a term that is being used to describe a standard of care that ensures that the patient is at the centre of care delivery (33). Person-centred care improves patients' satisfaction because interactions are tailored to their unique needs. In a narrative review, Kitson et al. identified three core themes related to person-centred care: patient participation and involvement, the relationship between patients and healthcare professionals, and the context in which care takes place (32). One of the subthemes addresses the patients' physical and emotional needs and values (32). Similarly, in McCormack's person-centred nursing framework, central elements include: working with the patient's beliefs and values, providing for physical needs, promoting shared decision-making, providing a sympathetic presence and patient engagement (31). These constructs contribute to person-centred outcomes such as patient satisfaction, involvement, feelings of wellbeing and a therapeutic culture (31). A live bedside music practice for hospitalized patients fits within these approaches as it incorporates the unique properties of a patient's beliefs and values. The results of this study indicate that a live music practice can add to older patients' wellbeing in terms of positive experiences and meaningful moments shared with others. The primary aim of the live music practice is to attribute to the quality of the hospital experience for older hospitalized patients and to increase their affective and eudaimonic wellbeing. McCormack's framework of person-centred care includes the promotion of these values as an important aspect

of person-centred care, as well as the sympathetic presence and engagement of healthcare professionals(31). As such, nurses play an important role in advancing person-centred approaches to care. The results of this study suggest that live-bedside music performances could also stimulate the demonstration of sympathetic presence by nurses, which is defined as appropriately responding to cues by showing concern and providing reassurance to patients (31). Additionally, participation in music is linked to higher resilience and lower stress and burnout in caregivers (34).

Therefore, in the light of advancing work pleasure for nurses and increasing patient satisfaction, further research should focus on the impact of live-music performances on the caring relationship between patients and nurses, and whether it stimulates sympathetic presence and bonding between them.

While the results of this study indicate a connection between live bedside music and enhanced patient wellbeing, further research, such as an efficacy study, should be conducted to determine the effectiveness of live bedside music in increasing the quality of life for older patients during and after hospitalization and should consider the costs of this practice. Since this intervention did not seek a therapeutic relationship or investigate music as medicine, the results of this study specifically refer to live bedside music as a participatory practice specifically.

Some limitations of this study should be mentioned. First, due to the COVID-19 policies in place at the time in Austria, the preconceived execution of this study had to be altered and the number of participants was limited. Furthermore, in Austria, the practice was virtual with a live internet connection. The musicians were not in the same room as the patient which may have been a limitation to interpersonal contact and influenced the patient's response. Although it is known that live music has a social aspect, as it can create shared experiences and engagement, the Austrian participants stated that the quality of the live video connection was so good that they experienced it as the musicians were there with them in the room (35,36). Since no major differences were noted by participants, and by using an inductive approach in data-analysis, we believe that thematic saturation was reached (37). In addition, all interviewers were involved in the data analyses, thereby enhancing trustworthiness.

6. CONCLUSION

The results of this study highlight the added perceived value of a participatory live bedside music practice for older hospitalized patients. By facilitating distraction, emotional release, and enhancing nurse-patient contact, live bedside music significantly improves hospital experiences for older patients. Four overarching themes emerged: emotional release, positive distraction, alterations in contact and shared humanity. The latter

two themes pertain to the impact of live bedside music on nurse-patient interaction. These results suggest that live bedside music enhances patient experiences and can be a valuable component of integrative and holistic care for hospitalised older patients.

In addition to enhancing the hospital experience, live music practice aligns well with the wider shift towards person-centred approaches in healthcare. Older patients are often interested not only in longevity, but also have an interest in improved quality of life, which is promoted by a person-centred approach to care (38). This approach prioritises patients' unique physical and emotional health needs and desires in the pursuit of overall wellbeing. This study provides insight into the role live bedside music can play in the integrated care of older patients during hospitalization.

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APPENDIX A.

Structure of questions for patient interviews (semi structured)- guide

Topics

- Consideration regarding consent to mimic session
- Expectations regarding mimic session/ considerations in participation
- First impression
- Experiences overall
- Experiences specific on person centred improvisation
- How does it affect the patient
- Current contact with nurse
- Preferences of nurse in the room being present
- Changes in contact with nurse due to presence or absence during the mimic session

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Introduction (example)

I am ... and I work as ..

I am doing research on the effects of live music on patients and the influence of the presence of a nurse on this. This week you have experienced live music being played especially for you. I will be asking questions about how you experienced this and what it meant to you. Do you have any questions before we start?

General opening questions (for example to start the interview going)

- Could you (briefly) tell us how you are doing? (Ask about experienced health, state of mind, boredom, since when you have been here)
- Can you tell us what your stay here is like? (If necessary, ask more about: experience, perception, attention)
- Is it important for you to speak to other people besides doctors and nurses? (Continue to ask why yes, why no)

Live bedside music

I would like to ask you a number of questions about your experience and expectations of the music project.

- In what way were you informed about the fact that musicians were visiting the ward?
- What were your thoughts and/or feelings when you heard that?
- What was the consideration for you in agreeing to the musicians playing for you? (ask about barriers- example: pain, fear, health, boredom, roommates)
- Can you tell what you expected when the musicians started playing for you?
- Can you describe how you experienced the musicians playing for you? (go back to the moment, possibly referring to the first piece that was played. If there

is little response, ask more about the following: emotions, bustle, choice of music, choice of instrument)

- Did the fact that the musicians played for you do anything to you? Can you describe in what way this has affected you? (Further questions, emotional, pain, boredom, crowds, difference between 1st and 2nd session and yes/no personal improvisation)
- Did the expectations you had come true? Why or why not?

Nurse related

Now I am going to ask some questions about your experiences with your nurse.

- Can you describe your contact with the nurses? (If necessary, ask: individual differences, do they pay attention to differences) Was there a nurse in the room when the musicians played music for you?
- Did you also have a preference whether or not there was a nurse in the room when the musicians came to play? Can you tell us why you have this preference?
- Has your contact with the nurse changed as a result of listening to music together? (If so: examples?)
- In your opinion, is there any added value in having a nurse present when music is played for you? (if so, examples?)?

Then I would like to thank you very much for participating in this survey. Then I will stop recording.

PART III

General discussion

CHAPTER 7

Het zorglandschap verandert: zit er muziek in?

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INTRODUCTIE

Muziek wordt al eeuwen gebruikt om het welzijn van de mens te bevorderen. Het heeft een prominente plek bij bijzondere en belangrijke gebeurtenissen en is universeel een belangrijk onderdeel van het dagelijks leven (1). Ook bij verstorende gebeurtenissen in het leven kan muziek een belangrijke positieve en ondersteunende factor zijn.

Een ziekenhuisopname leidt tot verstoring van het dagelijks leven en is veelal stressvol (2). Patiënten voelen zich vaak niet op hun gemak vanwege een verlies van autonomie en ervaren daarnaast angst, onzekerheid of pijn (3). Deze factoren kunnen nadelig zijn voor het herstel en zijn vaak lastig te bestrijden. Het is dan ook niet verwonderlijk dat er naar manieren wordt gezocht om het welzijn van de patiënt tijdens een ziekenhuisopname te verbeteren. De inzet van muziek kan gezien worden als een interessante optie om dit doel te bereiken. Muziek kan bijdragen aan het welzijn van de patiënt en voorzien in individuele behoeften van zowel patiënten als hun zorgverleners. De World Health Organization stelt dat het onderkennen van de rol die muziek in de gezondheidszorg kan spelen, van belang is (4).

Hoewel niet-invasieve interventies onderdeel zijn van verpleegkundig handelen, is muziek hier geen structureel onderdeel van. Gezien de rol van muziek in het leven buiten het ziekenhuis en de psychologische en fysiologische helende effecten ervan, lijkt het implementeren van muziek-gerelateerde interventies in de zorg een voor de hand liggende keuze.

In dit artikel bespreken we waarom muziek van toegevoegde waarde is in een veranderend zorglandschap, wat de rol kan zijn van muziek voor patiënten en zorgverleners en wat nodig is in beleid, scholing en financiering om muziek structureel in te bedden in de verpleegkundige zorgverlening.

HET VERANDERENDE ZORGLANDSCHAP

Sinds het begin van deze eeuw is het perspectief op gezondheid aan het veranderen (5,6). In de afgelopen decennia was er sprake van snelle technologische ontwikkelingen, waardoor de groei van de gezondheidszorg werd bevorderd en nieuwe behandelmogelijkheden beschikbaar kwamen. Echter, de zorg is niet uitsluitend gericht op het genezen van een ziekte en het herstellen van lichamelijke defecten door middel van het uitbreiden van medisch-technologische behandelmogelijkheden. Er is een groeiend besef dat de menselijke geest en het menselijke lichaam nauw verbonden zijn, in plaats van de reductionistische, traditioneel medische opvatting dat het twee afzonderlijk te benaderen componenten zouden zijn (7). Dit holistische besef is passend bij het moderne denken over verpleegkundige zorgverlening. Hoewel er verschillende verpleegkundige

modellen zijn, zijn er twee basale onderleggers: verpleegkunde is interpersoonlijk van aard en de hedendaagse visie van verpleegkundigen op patiëntenzorg is holistisch gedreven; het verwerpt 'lichaam-en-geest-dualisme' (8).

In het najaar van 2022 is het Integraal Zorg Akkoord (IZA) gepresenteerd waarin passende zorg centraal staat (9). Passende zorg moet leiden tot uitkomsten die van waarde zijn voor de patiënt. Klinische uitkomsten, zoals complicaties en mortaliteit, zijn historisch primaire klassieke eindmaten voor zowel klinische richtlijnen als wetenschappelijk onderzoek en nog steeds relevant als objectieve maatstaf. Maar wat werkelijk voor een individuele patiënt van waarde is, blijft nog vaak de vraag. Mede door de introductie van de set generieke 'patient reported outcome measures' (PROM's), die gericht zijn op klachten of beperkingen in het algemeen, en niet op een specifieke ziekte of aandoening, is een verschuiving in de zorg naar uitkomsten die van waarde zijn voor een individuele patiënt ingezet (5,10). Muziek kent een intrinsieke waarde en in al zijn verschillende vormen lijkt muziek daarmee het toonbeeld van een (holistische) interventie die past in de transformatie van gezondheidszorg van ziektegedreven naar passende zorg.

MUZIEK VOOR PATIËNTEN

Muziek is geschikt voor veel patiënten, te meer omdat het ongeacht de ziekte of hulpvraag waarmee de patiënt in het ziekenhuis komt, kan worden ingezet en, mits met zorgvuldigheid toegepast, geen bijwerkingen kent. Er is toenemend bewijs dat muziek gezondheid en welzijn verbetert. Verschillende reviews hebben het (positieve) effect aangetoond op patiëntgerelateerde uitkomsten in verschillende populaties (11-16). Patiënten ervaren minder pijn na een chirurgische ingreep of (invasief) onderzoek (11,13). De mate van angst en stress kan door muziek verminderd worden en patiënten ervaren meer ontspanning (12). Muziekinterventies lijken ook korte termijn effecten te hebben op uitkomsten als bloeddruk, hartslag, hartslagvariabiliteit en ademhalingsfrequentie (11,14). Ook zijn er aanwijzingen dat muziekinterventies een positief effect hebben op delier, depressie en slaap (11,15,16). Naast klinische uitkomsten heeft muziek positieve effecten op het welzijn van patiënten en hun naasten en de tevredenheid van patiënten (11). Het kan helpen de patiënt zijn emoties te uiten en op een positieve wijze afleiding te bieden.

Muziekinterventies zijn adaptief en kunnen worden toegepast in de wachtkamer, operatiekamer, intensive care, verpleegafdeling en de polikliniek. Daarbij zijn deze interventies bij zowel bewuste als gesedeerde volwassenen en neonaten toepasbaar. Naast de setting waarin muziek kan worden toegepast is ook de vorm variabel. Muziektherapeuten focussen zich op een specifieke hulpvraag waarbij gebruik gemaakt wordt van improvisatie, het spelen van of luisteren naar muziek. Muziek kan ook

gespeeld worden door professionele musici die geschoold zijn om in de zorg te werken. Het bereiken van een therapeutisch effect is dan geen beoogd doel, maar kan wel plaatsvinden (17). Daarnaast kan gebruik gemaakt worden van opgenomen muziek. Het voordeel hiervan is dat het relatief eenvoudig in te zetten is, en makkelijk kan worden afgestemd op de wensen en behoeften van de luisteraar.

MUZIEK VOOR ZORGVERLENERS

Naast de betekenis van muziek voor patiënten, kan muziek ook van betekenis zijn voor zorgverleners. Muziek lijkt een positieve bijdrage te leven aan het leveren van compassievolle zorg (18). Zorgen met meer compassie, het handelen uit medemenselijkheid, leidt tot betere relatie tussen patiënt en verpleegkundige en arbeidstevredenheid (19,20). Dit is relevant, enerzijds vanwege het oplopende tekort aan zorgprofessionals, en anderzijds vanwege de toenemende zorgvraag door de verouderende populatie en het groeiende percentage van professionals met burn-out klachten. In het werk worden zorgverleners geconfronteerd met stressvolle omstandigheden en met het lijden van patiënten en naasten. In combinatie met een hoge werkdruk, kan hierdoor verlies van compassie en compassiemoeheid optreden. Dit heeft gevolgen voor het professionele almede het persoonlijke leven van de zorgverlener (21). Hoe meer compassie iemand kan behouden, des te meer veerkracht er is om de stress van de dagelijkse praktijk aan te kunnen (22). Een vertrouwde, empathische relatie tussen verpleegkundige en patiënt zorgt voor meer zelfvertrouwen bij patiënten tijdens het ziekteproces en wordt door patiënten aangeduid als één van de belangrijkste factoren die een verblijf in het ziekenhuis dragelijk maakt (23). Ook kan een compassievolle behandeling bijdragen aan betere en snellere diagnoses omdat patiënten zich gehoord en emotioneel veilig voelen en zorgt het voor een toename in patiënttevredenheid. Dit heeft positieve gevolgen voor de kwaliteit van zorg.

TOEKOMSTPERSPECTIEF

Ook in de wereld van de muziek vindt een transitie plaats. Musici zoeken naar mogelijkheden zodat hun professie ook van betekenis kan zijn buiten de concertzaal. Dit heeft geresulteerd in de ontwikkeling van verschillende participatieve muziekpraktijken. Verschillende conservatoria in Nederland, waaronder Groningen, Utrecht en Den Haag, hebben een onderwijsprogramma speciaal voor het werken als musicus in een zorgcontext ontwikkeld. Daarnaast zijn er verschillende hogescholen waar muziektherapeuten worden opgeleid.

Waar bij musici 'optimaal performen in het moment' centraal staat, staat in de gezondheidszorg de patiënt centraal en speelt de zorgverlener vaak de tweede viool. Anderzijds zijn zorgverleners in staat continu te acteren op de steeds veranderende omstandigheden en zich hieraan aan te passen. Transprofessioneel opleiden van musici en zorgverleners, al dan niet gecombineerd met actieve patiëntparticipatie, zou kunnen ondersteunen bij het uitwisselen van kennis over vaardigheden die zowel musici als zorgverleners nodig hebben in hun vak. Hierbij valt te denken aan communicatieve vaardigheden, observatietechnieken alsmede presteren onder druk.

Er is een brede range van studies met verschillende vormen van muziekinterventies en verschillende uitkomstmaten. Door deze variatie is generalisatie moeizaam. Veel studies zijn kwantitatief waarbij de focus enkel ligt op (klassieke) klinische uitkomstmaten. Het gebruik van mixed methods zou kunnen helpen de waarde van muziek in woorden te vatten. Longitudinale studies, zinvolle controlegroepen en hoge kwaliteit van gekozen uitkomstmaten kunnen inzicht geven in de duurzaamheid van de resultaten van muziekinterventies over tijd. Verder onderzoek naar het effect van muziek op verpleegsensitieve uitkomstmaten zal eveneens kunnen bijdragen aan het verbeteren van de kwaliteit van zorg. Evenzo verdient de relatie tussen muziek, compassievolle zorg in relatie tot professionele veerkracht verder onderzoek.

Zowel voor live muziek als voor muziek therapeuten geldt dat financiering geborgd dient te worden. Muziektherapie vindt voornamelijk plaats in de geestelijke gezondheidszorg en verpleeghuizen en thuiszorginstellingen en nog in mindere mate in ziekenhuissettingen. Vergoeding hiervoor vindt veelal plaats vanuit de aanvullende zorgverzekering, onder de noemer alternatieve of complementaire geneeswijze. Voor ziekenhuizen is er echter nog geen diagnose-behandel-code. Initiatieven ten aanzien van livemuziek door professionele musici en de inzet van muziektherapeuten worden nu voornamelijk gefinancierd vanuit tijdelijke fondsen en subsidies. Voor een structurele borging van muziek in de ziekenhuiszorg is samenwerking tussen beleidsmakers van zorginstellingen en zorgverzekeraars gericht op inzicht in kosten en bekostiging noodzakelijk.

TOT SLOT

Passende zorg is meer dan het genezen van een aandoening en biedt de mogelijkheid interventies te integreren die passen bij de onderliggende principes van het verpleegkundige vak. Muziek verdient daarin een prominentere rol.

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CHAPTER 8

Summary

The aim of this thesis was to gain insight in the practice, the underlying mechanism, the effect and the added value of live bedside music for older hospitalized patients, with primary focus on the surgical patient.

To gain insight into what is already known about the effect of music on postoperative recovery in older hospitalized patients and the underlying theoretical models, a systematic review was performed (**Chapter 2**). In total, 17 studies were included. All music interventions were performed with recorded music, except one study in which an acoustic guitar was used. The shaping of the music intervention and type of surgery varied strongly between studies. As a result, the most effective way of performing the music in the postoperative period remains unclear. Results on clinical outcomes of the included studies show that music as an intervention for older surgical patients has a positive effect on a broad range of outcomes, of which pain and anxiety were most frequently examined. No negative side effects of music as an intervention were described in these studies. Four different underlying theoretical models were found explaining these effects: (1) the Cognitive-behavioural framework model (reducing stress via distraction), (2) the Gate Control Theory (music may deviate sensory input from the brainstem, closing the gating mechanism resulting in a reduction of pain), (3) music causes release of endorphins and changes catecholamine levels (which facilitate pain relief) and (4) influence of music on activation of the autonomic sympathetic nervous system (resulting in an increased heart rate, blood pressure, and higher oxygen demand).

To gain further insight into the operationalisation and implementation of music as an intervention to improve postoperative recovery, contact was initiated with the Prince Claus Conservatoire Groningen, the Netherlands. A partnership was established with the research group of the Prince Claus Conservatoire that focused on exploring the meaning of musical practice for both musicians and health care professionals and the development of the practice of live music for hospital patients. An innovative music practice was developed, called Meaningful Music in healthCare (MiMiC) in which professional musicians played at the patients' bedside. In **Chapter 3** this practice is described, including an evaluation if live bedside music could be applied in daily practice of a hospital ward, and the design of a non-randomized controlled trial aiming to determine whether this practice could improve postoperative outcomes in patients aged ≥60 years. In the MiMiC practice, the musicians played for six or seven consecutive days at one of the three participating surgical wards. Each live bedside music session lasted approximately 10-15 minutes and one or two pieces were played, depending on the patient's wishes or clinical condition and in close collaboration with the nurses. The music consisted of repertoire of the musicians, genre-based improvisation, idiomatic improvisation and person-centred improvisation. For person-centred improvisation, the musician sought input from the patient by asking them to describe a landscape, a feeling

or a colour. By using improvisation, the musician could meaningfully communicate with the patient and involve the patient in the music creation process (participatory practice). The primary endpoint to determine the influence of this practice was a change in the level of experienced pain. Secondary endpoints were anxiety, physical parameters, relaxation and satisfaction. The data collection consisted of four timepoints: 30 minutes before the live bedside music, during the music, 30 minutes after and three hours afterwards. Similar measurements, at similar timepoints, were designed for older surgical patients that were not exposed to the live bedside music intervention.

The different phases of embedding the live bedside music practice into the surgical ward were described along with the first experiences, hindering and facilitating factors. The live bedside music practice fitted in daily clinical practice and did not disrupt the daily routine. Almost all patients and healthcare professionals responded positively to the live bedside music practice. Perceived facilitating factors were that the live bedside music did not interfere with the medical treatment, and that the professionalism of the musicians enabled them to respond to the patients' needs concerning the music genre, volume and interaction. A disadvantage of this flexibility was the lack of standardisation of the live bedside music intervention and the availability of the musicians that are capable performing this intervention. The support of the head nurses was crucial during the process of implementation.

The results of the trial as described in chapter three and the underlying mechanism were described in chapter 4 & 5. In **Chapter 4** the influence of live bedside music on perceived postoperative pain was measured in 83 music sessions among 35 older patients. Patients rated their pain on a visual analogue scale (VAS) from no pain to unendurable pain. Similar measurements were performed in a control group of 43 older patients. Median age in both groups was 70 years and the groups did not significantly differ with respect to clinical characteristics. Our results showed that although the mean rates on the VAS were low in both groups at baseline, the pain ratings decreased significantly after the live bedside music intervention and continued to be so for up to three hours after the intervention. This decrease was not observed in the control group. Furthermore, our results showed a decrease in anxiety among the intervention group compared to pre-measurement and the music seemed to have some effect on heart rate presuming that it could affect the autonomic nervous system.

To gain more insight in the possible underlying mechanism and explore the role of the autonomic nervous system, which is important in general recovery after surgery, the heart rate variability (HRV) was measured as a proxy for the influence of live bedside music on the autonomic nervous system (**Chapter 5).** In 101 older surgical patients, five-minute measurements of HRV were conducted of whom 57 received live beside music. HRV was

analysed on the frequency and time domain as well as the coherence and achievement score. Results show that the HRV parameters, specifically the frequency band, are small but positively influenced by live bedside music compared to the control group. This indicates relaxation and parasympathetic activity in time which could contribute to achieving homeostasis. This is relevant because the autonomic nerve system can play a role in developing complication. These results provide a first glance and contribute to a better understanding of the effect of music on the recovery of older surgical patients.

Integrative approaches to hospital care that seek to advance both a patients' somatic as well as their emotional wellbeing, are particularly relevant for older patients as they demonstrate greater vulnerability to stress. Providing music can also be a way to facilitate and promote person centred care. In **Chapter 6** the added value of the live bedside music practice for older hospitalized patients in Austria and the Netherlands was examined. Semi-structured interviews were conducted among 23 hospitalized patients (median age of 73 years) that were admitted to a surgical ward of an university hospital in Groningen, the Netherlands, and a radiotherapy ward in Vienna, Austria. Due to the COVID-19 pandemic, the music sessions in Austria were conducted through a live internet connection using a tablet. Four themes emerged from the thematic qualitative content analysis. Participants referred to perceived influences of live bedside music in terms of (1) emotional release, (2) positive distraction, (3) alterations in contact and (4) shared humanity. The participants positively valued the live bedside music practice and wished for its' continuance. Live bedside music can positively contribute to older patients' hospital experience by facilitating distraction and emotional release. Furthermore, the themes alteration in contact and shared humanity are also related to the influence of this practice on nurse – patient interaction. Results reveal that live bedside music provides a positive patient experience and can be part of integrative and holistic care for hospitalized older patients, adding to existing research on music in hospital care which is mostly clinically orientated.

The evidence of the added value of music in healthcare is growing, however not structurally embedded yet. **Chapter 7** discusses future perspectives, why music should be structurally embedded in healthcare and what's needed to reach that goal. Healthcare faces major challenges with an ageing society, rising healthcare costs and staff retention. Music has evident positive effects on both patients and healthcare staff and can be applied to a growing (vulnerable) patient population. It fits the transition of care towards tailored care, in which human values are central. Tailoring care is more than curing a disease and offers the opportunity to integrate interventions that fit the underlying principles of nursing. In addition to the aforementioned developments in healthcare, musicians increasingly want their profession to be meaningful, which has resulted in the development of participatory practices. For music to be complementary and contribute

to the transition to tailored care, it is necessary to initiate (national) changes in education and training, research and funding. This requires interprofessional education and training between healthcare providers and musicians in order to exchange knowledge and skills from both disciplines. Longitudinal studies focusing on both clinical outcomes, as well as more patient oriented outcomes, including nurse sensitive outcomes, can contribute to the quality of care. For structural implementation of music in hospital care, cooperation between policy makers of health care institutions and health insurers is necessary. This will allow structural investment in the collaboration between healthcare and music, resulting in better patient outcomes.

CHAPTER 9

Nederlandse samenvatting

Het doel van dit proefschrift was inzicht te krijgen in de praktijk, het effect en de meerwaarde van livemuziek aan het bed voor oudere opgenomen patiënten, met primaire focus op de chirurgische patiënt.

Om de bestaande kennis over het effect van muziek op postoperatief herstel bij oudere opgenomen patiënten en de onderliggende theoretische modellen te evalueren, werd een systematische review uitgevoerd **(hoofdstuk 2)**. In totaal werden 17 studies geïncludeerd. Alle muziekinterventies werden uitgevoerd met opgenomen muziek, behalve één studie waarbij een akoestische gitaar werd gebruikt. De invulling van de muziekinterventie en het type operatie varieerde sterk tussen de studies. Daardoor bleef onduidelijk wat de meest effectieve manier is om muziek in de postoperatieve periode uit te voeren. Klinische uitkomsten van de geïncludeerde studies laten zien dat muziek voor oudere chirurgische patiënten een positief effect heeft op een breed scala aan uitkomsten, waarvan pijn en angst het meest werden onderzocht. In deze studies werden geen negatieve bijwerkingen van muziek als interventie beschreven. Er werden vier verschillende onderliggende theoretische modellen gevonden die deze effecten verklaren: (1 vermindering van stress door afleiding (het cognitief-gedragskadermodel), (2); beïnvloeding van de sensorische input van de hersenstam , resulterend in vermindering van pijn (de Gate Control Theorie), (3) vermindering van pijnklachten door afgifte van endorfine en verandering van catecholamine spiegels en (4) beïnvloeding van het autonome sympathisch zenuwstelsel (lagere hartslag, bloeddruk en zuurstofbehoefte).

Om meer inzicht te krijgen in de implementatie van muziek als interventie ter verbetering van postoperatief herstel, werd contact gelegd met het Prins Claus Conservatorium Groningen, Nederland. Met de onderzoeksgroep van dit conservatorium werd een samenwerkingsverband opgezet dat zich richtte op het verkennen van de betekenis van een muziekpraktijk voor zowel musici als zorgprofessionals. Een innovatieve praktijk van livemuziek voor ziekenhuispatiënten, genaamd Meaningful Music in healthCare (MiMiC), werd ontwikkeld waarbij professionele musici aan het bed van de patiënt speelden. In **hoofdstuk 3** werd deze praktijk beschreven, inclusief een evaluatie van de toepassing in de dagelijkse praktijk van ziekenhuisafdelingen. Dit laatste gebeurde in het kader van een niet-gerandomiseerd gecontroleerd onderzoek met als doel te bepalen of deze praktijk de postoperatieve uitkomsten bij patiënten van ≥60 jaar kan verbeteren. In de MiMiC-praktijk speelden de musici gedurende zes of zeven opeenvolgende dagen op een van de drie deelnemende chirurgische afdelingen. Elke sessie livemuziek aan het bed duurde ongeveer 10-15 minuten en er werden één of twee stukken gespeeld, afhankelijk van de wensen en/of klinische toestand van de patiënt en in nauwe samenwerking met de verpleegkundigen. De muziek bestond uit repertoire van de musici en improvisaties waaronder persoonsgerichte improvisaties. Bij persoonsgerichte improvisatie zocht de musicus input van de patiënt door hem te vragen een landschap, een gevoel of een

kleur te beschrijven. Door gebruik te maken van improvisatie kon de musicus de patiënt betrekken bij het creatieproces en ontstond onderlinge interactie (participatieve praktijk). Het primaire eindpunt van deze studie was de postoperatieve pijnbeleving bij de patiënt. Secundaire eindpunten waren angst, fysieke parameters, de mate van ontspanning en patiënt tevredenheid. Vergelijkbare metingen, op vergelijkbare tijdstippen, vonden plaats bij oudere chirurgische patiënten die niet waren blootgesteld aan de livemuziek.
De verschillende fasen van inbedding van de livemuziek aan het bed op de chirurgische afdeling werden beschreven, samen met de eerste ervaringen, belemmerende en bevorderende factoren. De livemuziek aan het bed praktijk paste in de dagelijkse klinische praktijk en verstoorde de dagelijkse routine niet. Bijna alle patiënten en zorgverleners reageerden positief op de livemuziekpraktijk. Ervaren bevorderende factoren waren dat de livemuziek aan het bed de medische behandeling niet verstoorde, en dat de professionaliteit van de musici hen in staat stelde in te spelen op de behoeften van de patiënten wat betreft muziekgenre, volume en interactie. Een nadeel van deze professionele flexibiliteit was het gebrek aan standaardisatie van de livemuziek. Ook is er beperkte beschikbaarheid van musici die deze interventie met deze kwaliteit kunnen uitvoeren. De steun van de hoofdverpleegkundigen was cruciaal tijdens het implementatieproces.

Het effect van de MiMiC praktijk, zoals beschreven in hoofdstuk 3, op de pijnbeleving van patiënten en de mate van activatie van het autonome zenuwstelsel, werden beschreven in hoofdstuk 4 & 5. De invloed van livemuziek aan het bed op de pijnbeleving werd gemeten in 83 muzieksessies bij 35 oudere patiënten. De patiënten beoordeelden hun pijnniveau op een visuele analoge schaal (VAS) van geen pijn tot ondraaglijke pijn **(hoofdstuk 4)**. Vergelijkbare metingen werden uitgevoerd bij een controlegroep van 43 oudere patiënten. De mediane leeftijd in beide groepen was 70 jaar en de groepen verschilden niet significant wat betreft klinische kenmerken. Resultaten laten zien dat, hoewel de gemiddelde cijfers op de VAS in beide groepen bij aanvang laag waren, de pijn na de livemuziekinterventie aan het bed significant daalde ten opzichte van de controlegroep. Dit bleef zo tot drie uur na de interventie. Voorts toonden onze resultaten een afname van de angst bij de interventiegroep in vergelijking met de voormeting en leek de muziek enig effect te hebben op de hartslag. Dit laatste wijst erop dat muziek de mate van activatie van het autonome zenuwstelsel zou kunnen beïnvloeden.

Het autonome zenuwstelsel is belangrijk voor het algemene herstel na een operatie en kan een rol spelen bij het ontstaan van complicaties. Om meer inzicht te krijgen in het mogelijke onderliggende mechanisme en de rol van het autonome zenuwstelsel en de invloed van livemuziek hierop werd de hartslagvariabiliteit (HRV), als proxy voor de reactie van het autonome zenuwstelsel, gemeten **(hoofdstuk 5)**. Bij 101 oudere chirurgische patiënten werden vijf minuten durende metingen van de HRV uitgevoerd,

waarvan bij 57 patiënten livemuziek aan het bed werd gespeeld. HRV werd geanalyseerd op het frequentie- en tijdsdomein, alsmede de coherentiescore. Uit de resultaten blijkt dat de HRV-parameters, met name de frequentieband, positief beïnvloed worden door live muziek in vergelijking met de controlegroep. Dit kan wijzen op ontspanning en parasympatische activiteit in de tijd, wat zou kunnen bijdragen tot het bereiken van een balans tussen het sympathische en parasympatische zenuwstelsel (homeostase). Deze resultaten dragen bij tot een beter begrip van het effect van muziek op het autonome zenuwstelsel als belangrijke determinant van het vermogen tot herstel van oudere chirurgische patiënten.

Naast het effect op fysiologische parameters, is door middel van interviews met patiënten meer inzicht verkregen in de toegevoegde waarde van livemuziek aan het bed van oudere patiënten **(hoofdstuk 6)**. Dit onderzoek werd verricht in twee ziekenhuizen in Nederland en Oostenrijk. Er werden semigestructureerde interviews afgenomen bij 23 patiënten die waren opgenomen op een chirurgische afdeling van een academisch ziekenhuis in Groningen, Nederland, en een radiotherapieafdeling in Wenen, Oostenrijk. Vanwege de COVID-19 pandemie werden de muzieksessies in Oostenrijk uitgevoerd via een live internetverbinding met behulp van een tablet. De deelnemende patiënten gaven aan de praktijk van livemuziek aan het bed te waarderen en wensten de voortzetting ervan. Uit de thematische analyse kwamen vier thema's naar voren die ten grondslag lagen aan deze ervaringen. Deze thema's waren: (1) emotionele ontlading, (2) positieve afleiding, (3) veranderingen in contact en (4) een gedeelde ervaring. Uit de interviews bleek dat livemuziek een positieve bijdrage levert aan de ziekenhuiservaring en dat het tegemoet kan komen aan de emotionele behoeften van oudere patiënten doordat het afleiding biedt en emotionele ontlading bevordert. Deze behoeften van patiënten zijn vaak onderbelicht tijdens een ziekenhuisopname, maar zijn wel degelijk van belang voor het verbeteren van welzijn. Ook ervaarden patiënten dat het contact veranderde tussen hen en de verpleegkundige, en gaven zij door deze praktijk aan een oprechte verbondenheid tussen hen en de verpleegkundige(n) en de musici te ervaren.

De resultaten laten zien dat livemuziek aan het bed een positieve patiëntervaring oplevert en onderdeel kan zijn van integratieve en holistische ziekenhuiszorg voor oudere patiënten, als aanvulling op bestaand onderzoek naar muziek in de ziekenhuiszorg dat vooral gericht is op klinische uitkomstmaten. Het aanbieden van muziek kan een manier zijn om persoonsgerichte zorg, zorg gericht op de unieke behoefte, doelen en waarden van de patiënt, te vergemakkelijken en te bevorderen. Zoals beschreven in hoofdstuk 1 t/m 6 groeit het bewijs voor de toegevoegde waarde van muziek in de gezondheidszorg. **Hoofdstuk 7** bespreekt toekomstperspectieven en beschrijft waarom muziek structureel ingebed zou moeten worden in de zorg en wat er nodig is om dat doel te bereiken.

Door de vergrijzende samenleving, stijgende zorgkosten en personeelsbehoud staat de zorg de komende decennia voor grote uitdagingen. Muziek heeft duidelijk positieve effecten op zowel patiënten als zorgpersoneel en is laagdrempelig inzetbaar bij een groeiende (kwetsbare) patiëntenpopulatie. Muziek biedt de mogelijkheid om interventies te integreren die passen bij de onderliggende principes van de verpleegkunde. Het past in de transitie naar waardegedreven zorg, ook wel passende zorg genoemd. Hierin staat niet de genezing van de ziekte, maar de menselijke waarde centraal. Naast zorgverleners zoeken ook musici naar andere vormen van zingeving in de uitvoering van hun beroep. Dit heeft o.a. geleid tot de ontwikkeling van participatieve praktijken waarbij wordt samengewerkt met andere disciplines. Om muziek te laten bijdragen aan de transitie naar waardegedreven zorg, zijn (landelijke) veranderingen in onderwijs en opleiding, onderzoek en financiering noodzakelijk. Door middel van interprofessioneel onderwijs kunnen zorgverleners en musici kennis en vaardigheden uitwisselen. Longitudinale studies gericht op zowel klinische uitkomsten, als meer patiëntgerichte uitkomsten kunnen aan deze transitie bijdragen. Voor structurele implementatie van muziek in de ziekenhuiszorg, is samenwerking tussen beleidsmakers van zorginstellingen en zorgverzekeraars noodzakelijk. Een investering in de samenwerking tussen zorgprofessionals en musici zal resulteren in betere patiëntuitkomsten.

CHAPTER 10

Future perspectives

Currently, the majority of older people undergo surgery at a certain point in their lives, and the number of older surgical patients is inspected to increase considering the demographic developments (1,2). As older patients are more prone to develop postoperative complications, it is increasingly urgent to prevent negative sequelae of a surgical procedure (3). Nurses play a pivotal role in postoperative care. As early as 1859, one of the founders of modern nursing, Florence Nightingale, already described music as a factor that could positively influence recovery (4-6). Music is a suitable intervention in postoperative care, regardless of the primary disease, because of its role in society and versatility (7). The evidence regarding the effect of music on hospitalized patients is growing and the World Health Organisation stipulates the role of arts, specifically music, in healthcare in a recent paper and recognises the need to embrace new approaches as in healthcare (8). Still, structurally embedding music in daily clinical practice poses challenges that require further research.

THE EFFECT OF MUSIC ON POSTSURGICAL RECOVERY AND CARE

Although the results of this thesis and other studies show the influence of music on postsurgical recovery, the underlying physiological mechanisms are yet not understood (9). To elucidate these, large scale research is necessary, in which patient-related and clinical outcome measures as well as physiological parameters related to surgery induced stress and inflammatory responses (such as cortisol and interleukin-6) are examined. When further investigating the effect of music on postoperative outcome, it is also important to define appropriate outcome measurements. Traditionally, outcomes such as complications, mortality rates and survival are dominant clinical outcomes parameters in patient related research. These outcomes are often considered as golden standard to determine treatment efficacy and guidelines for daily clinical practice are shaped based on these. Despite their relevancy, it remains difficult to define what is of real value to the individual patient. Nurse sensitive outcome measurements are considered to be one of the most promising strategies to enhance patient care and satisfaction of patients and their relatives, and caregivers (10).

Results of this thesis showed that the live music practice altered the contact between patients and nurses, and that they experienced a shared humanity (11). Music facilitates social and emotional contact which may deepen the relation between nurse and patient. It's known that when patients feel more heard and emotionally safe, better and faster diagnosis are made (12). Compassion is a crucial element of nursing care with proven influence on patient safety (13,14). Focussing on the abovementioned outcomes in addition to the more classical ones gives insight into the effectiveness of live bedside

music practice on outcomes that matter to patients; compassionate care and patient safety.

PARADIGM SHIFT

In current healthcare practice, interventions are embedded in guidelines when the level of evidence is of high level, and, exceptions aside, only then financed. Current research is dominated by quantitative research and focused on illness and not well-being. Creating a better understanding of the added value of interventions like music, requires exploratory research, which is often in the qualitative field, preferably designed in close collaboration with the patient. Outcomes of this less traditional research should be increasingly valued in shaping clinical practice. This is also in line with the shift that healthcare is beginning to make in which the perspective of care shifts from 'What is the matter with the patient' to 'What matters to the patient' (15,16). This transformation is stated by the Dutch government in 'Appropriate care' ('Passende zorg') in which the focus is no longer disease-centred. In order to maintain healthcare sustainable, the goal of healthcare should be overall well-being including mental and social factors, and not merely physical wellbeing (17). This is where live music practice steps in as it not only supports recovery, but it also contributes to well-being (8). This requires that healthcare policy, funders (healthcare insurance) as well as healthcare professionals and grant providers value arts as not only an aesthetic addition to life and health, but as a significant part of it. Healthcare and arts should combine their expertise for the benefit of both patient and the professionals involved. National policy regarding the role of arts in healthcare is therefore needed, and lessons can be learned from already developed programs in the United Kingdom and United States of America. Initiatives such as Arts and Health Netherlands that aim to work with specially trained artists to bring art and creativity into healthcare facilities and communities, can function as a catalyser for further development of policy.

UPSCALING LIVE BEDSIDE MUSIC PRACTICE

In the Netherlands several initiatives regarding live bedside music have been developed in the past decade. However, musicians should be carefully introduced to hospital wards. In order to be able to enter an unfamiliar hospital ward, musicians need to be prepared, get to know safety protocols, and be guided through the encounter with all aspects of human suffering. To make live bedside music practice sustainable and scale it up, education for both healthcare professionals and musicians needs to be organized. Furthermore, nurses and musicians need to get to know each other, understand each

other's communication and build trust. During their career, nurses may experience a loss of compassion due to the continuous physical and mental strain on the work floor and the responsibility of taking care of severely ill patients with complex medical conditions (13). The engagement of nurses in participatory music practice can have a positive influence on their well-being (18). However, this is new and unfamiliar to them. Currently an international research project, between hospitals, conservatoires and universities of applied sciences, is aiming to gain more insight in the needs of interdisciplinary collaboration and the effect on nurses' compassion.

Considering the increasing nursing shortage, high drop-out rates and increasing demand for care, new innovative practices should be considered and facilitated by hospital management and human resource departments.

CONCLUSION

While there is a growing body of evidence on music's positive impact on postoperative recovery, the underlying physiological mechanisms are not yet fully understood and need more research with specific attention to outcomes that are meaningful for patients. Music can enhance the nurse-patient relationship, contributing to better patient experiences and care related outcomes. Further research is needed to explore the impact of music on nursing care and related outcomes. In order to structurally embed live music in daily clinical practice and in the light of the challenges that healthcare is facing, a shift towards more patient-centred and holistic care is needed. To make this a reality, further research, education, and policy support are needed, along with collaboration between the world of arts and health.

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APPENDICES &

List of publications
Dankwoord
Curriculum Vitae

LIST OF PUBLICATIONS

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CURRICULUM VITAE

Hanneke van der Wal-Huisman werd op 17 mei 1983 geboren in Buitenpost, waar ze opgroeide als tweede kind van Gerrit en Ettha Huisman samen met haar oudere zus Margreet, jongere zus Corien en broer Gert Jan. Haar middelbareschooltijd begon ze aan het Lauwers College in Buitenpost en werd in 2000 succesvol afgerond met een HAVO diploma aan het Gomarus College. Aansluitend startte ze haar studie HBO-V aan de Hanzehogeschool in Groningen, waarbij ze al haar stages in het toenmalige AZG liep, de zogenaamde AZG-variant. Daarnaast deed ze tijdens haar studie werkervaring op in de verschillende werkvelden van de gezondheidszorg. In 2004 rondde ze haar opleiding af waarna ze als verpleegkundige is gaan werken in verschillende zorginstellingen, waaronder het UMCG op de afdeling Neurologie waar ze doorgroeide naar de functie van senior verpleegkundige. Voor een verdere verbreding en verdieping van het vak is Hanneke in 2007 naast haar werk, gestart met de premaster Verplegingswetenschap aan de Universiteit van Utrecht en aansluitend de master welke in 2010 succesvol werd afgerond. In tussentijd (2009) koos ze ervoor om als senior verpleegkundige te gaan werken op de afdeling chirurgische oncologie waar ze sinds 2010 eveneens in de functie van onderzoeker werkzaam is. In verschillende (inter)nationale onderzoeksprojecten, gericht op het veranderen van zorg voor chirurgische (oudere) patiënten van ziekte gedreven naar waardegedreven zorg (onderzoek consortium CHANGE), werkt ze nauw samen met andere disciplines en specialismen van zowel het UMCG, in het bijzonder het Universitair Centrum Ouderengeneeskunde, als de Hanzehogeschool, waaronder de samenwerking met het Prins Claus Conservatorium. Daarnaast is ze lid van het kernteam van het voorbeeldprogramma van het UMCG, genaamd `Passende zorg: mensgericht en waardegedreven werken' en lid van de stuurgroep Arts in Health Nederland. Dit alles met specifieke aandacht voor de rol van de verpleegkundige en verpleegkundige zorg voor patiënten. Naast aanverwante initiatieven rondom passende en waardegedreven zorg waar ze bij betrokken is, is Hanneke (bestuurs)lid van verschillende nationale en internationale (beroeps)verenigingen.

Hanneke is getrouwd met Richard van der Wal. Samen hebben ze drie zoons: Florian (2013), Jort (2015) en Tobin (2017).