

# Music therapy as an adjuvant therapeutic tool in medical practice: an evidence-based summary

TA Mattei\*, AH Rodriguez

## Abstract

### Introduction

Music has been suspected of having therapeutic properties for thousands of years. Ancient reports of music therapy can be found in writings from major civilisations including Egypt, China, India, Greece and Rome. The first scientific reports of music therapy in the clinical setting date back to World Wars I and II when music was used to relieve pain and agitation in soldiers with traumatic war injuries. At the present time, the therapeutic effects of music have already been investigated in a variety of clinical scenarios and health care settings. The recent increase in clinical music therapy research has allowed for higher levels of data analysis to take place, such as systematic reviews and meta-analyses that have generated stronger evidence in support of music therapy. The authors reviewed the literature regarding music therapy as an adjuvant therapeutic tool in medical practice.

### Materials and methods

A literature search was conducted using the following criteria: supportive, peer-reviewed, scientific music therapy research on human subjects, available in the English language, dating from 1990 until 2012 and listed on the PubMed/Medline database in the form of randomised and non-randomised clinical trials, meta-analyses and systematic reviews. A multi-word,

multi-search approach was used, utilising various combinations of terms such as 'music', 'therapy', 'anxiety', 'pain', 'symptoms', 'patient', 'anxiolytic', 'analgesic', 'vitals', 'heart rate' and 'blood pressure'. All articles that met the criteria were then systematically categorised twice based on two separate categories: variables under investigation (e.g. anxiety, pain, analgesic use, vital signs and biochemical markers) and level of evidence provided by the research study according to its design (non-randomised or randomised controlled clinical trial, meta-analysis or systematic review).

### Results

Forty-nine studies met the proposed search criteria, consisting of six systematic reviews, three meta-analyses, 33 randomised and seven non-randomised clinical trials. The primary variables targeted by these studies included anxiety/sedative requirements (42 studies), vital signs (30 studies), pain/analgesic use (22 studies), mood/depression (five studies) and biochemical markers related to pain, fear and anxiety (seven studies). The authors found that music therapy has already been investigated scientifically in a broad array of clinical settings in several medical fields including family medicine, paediatrics, internal medicine, nursing, gastroenterology, cardiology, pulmonology, haematology and oncology, otolaryngology, urology, obstetrics and gynaecology, surgery, anaesthesiology, interventional radiology, neurology and psychiatry.

### Conclusion

The results of this review suggest that music therapy may be useful as an adjuvant therapy in medical practice in a broad variety of clinical

settings, from the general clinical exam room to specific scenarios involving interventional procedures and surgical operations. This review provides a useful evidence-based summary for both generalists and specialists about the current scientific evidence of the beneficial effects of music therapy as an adjuvant tool in medical practice. Moreover, as music therapy represents a very inexpensive and safe therapeutic tool, which has been shown to positively influence several physiological variables related to anxiety, stress response and pain, the presented scientific evidence is intended to increase awareness among the medical community of the possible benefits of the widespread application of music therapy throughout modern medical practice.

## Introduction

Music has been suspected of having therapeutic properties for thousands of years. Reports of music therapy can be found in historic writings from many ancient civilisations including Egypt, China, India, Greece and Rome. The first modern use of music therapy in the clinical setting dates back to World Wars I and II, when music was used to relieve pain and agitation in soldiers with traumatic war injuries<sup>1</sup>.

In the last 30 years, the number of prospective, randomised studies evaluating the clinical benefits of music therapy has significantly increased. This proliferation of high quality scientific research in the field of clinical music therapy has generated significant level I evidence, suggesting that music therapy is capable of providing significant benefits as an adjuvant therapeutic tool in

\* Corresponding author  
Email: tobias.a.mattei@osfhealthcare.org

Department of Neurosurgery, University of Illinois, College of Medicine at Peoria, Peoria, Illinois, USA

a wide variety of clinical settings<sup>2-48</sup>. Furthermore, in the last decade, several meta-analyses and systematic reviews addressing the role of music therapy in specific clinical specialties have been performed<sup>2-10</sup>. This growing body of evidence provides robust scientific support for the hypothesis that music can positively influence several subjective and physiological variables related to anxiety and pain, significantly decrease pharmacological analgesia and sedative requirements, and make a meaningful improvement in mood and quality of life measures for a variety of patients<sup>2-48</sup>.

In order to evaluate the current status of medical evidence regarding the beneficial effects of music therapy in clinical practice, the authors performed a thorough literature review of the current body of scientific evidence regarding the use of music therapy as an adjuvant treatment in several medical specialties.

A summary of the current state-of-the-art research in music therapy is provided in Table 1.

### Materials and methods

In order to determine the current body of scientific evidence supporting the therapeutic effects of music therapy in modern clinical practice, the authors performed a thorough literature search focused on the identification of the available peer-reviewed literature that provided scientific evidence for the benefits of music therapy in human subjects. The authors used the following inclusion criteria for the search: medical literature available in the English language, dating from 1990 until 2012, and listed on the PubMed/Medline database in the form of randomised and non-randomised controlled clinical trials, meta-analyses and systematic reviews (Table 2). A multi-word, multi-search approach was used employing a combination of the

following terms: 'music therapy', 'anxiety', 'pain', 'symptoms', 'patient', 'anxiolytic', 'analgesic', 'anesthesia', 'vitals', 'heart rate', 'pulse', 'blood pressure', 'randomised', 'clinical', 'meta-analysis', and 'systematic review' (Table 2).

Of the 58 studies found, 49 studies met the above-mentioned selection criteria. All of those included were then systematically categorised twice based on two separate categories: the variables under investigation (e.g. anxiety, pain, analgesic use, sedative use, vital signs and biochemical markers) and the methodology of each study (randomised or non-randomised controlled clinical trial, meta-analysis or systematic review). The 49 studies which qualified for evaluation were then analysed for the strength of the provided scientific evidence based on study design, statistical significance, sample size, number of parameters analysed (i.e. anxiety, vitals and analgesic use),

**Table 1. Summary points.**

#### Current state-of-the-art research in music therapy

Music has been suspected of having therapeutic properties for thousands of years. The first modern uses of clinical music therapy date back to World Wars I and II. During the last 20 years, a large amount of basic science and clinical research in music therapy has been conducted. Currently, there is level 1 evidence from several randomised trials, meta-analyses and systematic reviews showing that music may be successfully used in several medical fields in a variety of patient care scenarios as an adjuvant therapeutic tool.

#### Future implications

The evidence summarised by this review supports the beneficial effects of music therapy in several patient-reported outcomes such as anxiety, pain and mood, as well as objective physiological variables such as heart rate, blood pressure and analgesic/sedative use. As music therapy is a safe and inexpensive adjuvant therapeutic tool, the attention of public authorities and health-care providers is urgently required so that implementation of widespread cost-effective music therapy programs may translate the successful results of the scientific research in terms of improvement of patients' health care.

**Table 2. Selection criteria for meta-analysis.**

#### Category of studies

Peer-reviewed, scientific literature clinical research in music therapy in the form of randomised and non-randomised clinical trials, meta-analyses and systematic reviews, available in the English language, published between 1990 to 2012, and listed on the Pubmed/Medline database, was used in this review.

#### Search terms

A multi-word, multi-search approach was used, employing several combinations of the terms such as, 'music therapy', 'anxiety', 'pain', 'symptoms', 'anxiolytic', 'analgesic', 'sedative', 'vitals', 'heart rate', 'blood pressure', 'mood', 'stress', 'relax', 'treatment', 'headphones', etc.

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clinical implications of the presented results, underlying trends in the data, possible biases and the potential impact of each study on current medical practices.

## Results

Of the 49 studies that met our selection criteria, six were systematic reviews<sup>2-7</sup>, three were meta-analyses<sup>8-10</sup>, 33 were randomised clinical trials<sup>13-15,26-30,32-37,44,47</sup> and seven were non-randomised clinical trials<sup>11,12,25,31,45,46</sup>. The primary

variables targeted by these studies included anxiety and/or sedative requirements (42 studies)<sup>2-7,9-11,13,14,16,17,18,19,21,24,26-48</sup>, vital signs (30 studies)<sup>2-4,8,11,14,15,19-21,23-29-31,34-36,37,38-41,43,44,47</sup>, pain and analgesic use (22 studies)<sup>2,4,6,7,9,11,12,20-22,25,31,32,35-37,40,42,44,47</sup>, mood, depression and quality-of-life measures (five studies)<sup>2-4,15,25</sup>, as well as serum levels of relevant biochemical molecules including blood glucose, cortisol, epinephrine, norepinephrine, adrenocorticotropin hormone, dehydroepiandrosterone,

prolactin, growth hormone, dopamine, interleukin-6, catecholamines and immunoglobulin-A (seven studies)<sup>26,31,35-37,43</sup>.

A summary of the results is provided in Table 3.

## Discussion

### Music therapy in surgery

A vast number of studies have already investigated the impact of music on patient anxiety in pre-operative, post-operative and intra-operative settings of surgical procedures from several specialties<sup>2,7,11,13,18,25,28,31,32,34,35,37,41</sup>.

A clinical trial of 60 patients undergoing spinal surgery investigated the impact of music therapy in both the pre-operative and post-operative periods. Patients were assigned to one of two groups; one group listened to music from the evening before the operation until the second post-operative day and the control group did not listen to any music. The study found that the group of patients who listened to music had significant reductions in anxiety ( $p = 0.018-0.001$ ), pain ( $p = 0.001$ ) and mean blood pressure ( $p = 0.014$ ), while less significant differences were observed in urinary cortisol, norepinephrine and epinephrine values ( $p = 0.619$ )<sup>31</sup>.

A systematic review that analysed data gathered from 3,936 surgical patients during 42 randomised clinical trials showed that music significantly reduced patient anxiety in 50% of trials, improved pain in 47% of trials, reduced analgesic use in 47% of trials and improved heart rate, blood pressure and respiratory rate in 27% of trials<sup>7</sup>. The trials consisted of various pre-operative, intra-operative and post-operative settings from a variety of surgeries, including gynaecological, abdominal, ear-nose-throat, cardiac, urologic, ophthalmologic, orthopaedic, abdominal, breast and spinal surgery.

**Table 3. Results summary.**

### General overview

Forty-nine studies met the criteria: six systematic reviews, three meta-analyses, 33 randomised clinical trials and seven non-randomised trials. Primary variables targeted included anxiety or sedative requirements (44 studies), vital signs (32 studies), pain or analgesic use (21 studies), mood or depression (five studies), agitation or psychological distress (three studies), nausea (one study) and various biochemical markers.

### Findings by specialty

Internal medicine: improved anxiety, blood pressure and heart rate when music was added to care.

Anaesthesia: reduced anxiety and analgesic/sedative use in surgery and lumbar/epidural punctures.

Cardiology: improved anxiety, pain, blood pressure, heart rate and distress in peri-operative patients.

Gastroenterology: reduced anxiety, analgesic/sedative use and blood pressure during endoscopy.

Genitourology: improved anxiety, blood pressure and oxygen saturation during lithotripsy (ESWL).

Haematology and oncology: improved anxiety, mood and pain during procedures and hospital visits.

Neurology: improved anxiety, mood, participation and communication during Alzheimer's therapy.

Obstetrics and Gynaecology: improved anxiety, pain and analgesic use during colposcopy and caesarean section.

Otolaryngology: reduced anxiety, pain, blood pressure, heart rate and analgesic use post-operatively.

Paediatrics: improved anxiety, pain, heart rate and respiratory rate in procedures and post-operatively.

Pulmonology: reduced blood pressure, heart rate and respiration in bronchoscopy and on ventilator.

Surgery: reduced anxiety, pain, heart rate, blood pressure and respiration peri-operatively and intra-operatively.

ESWL, extracorporeal shockwave lithotripsy.

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### Music therapy in anaesthesiology

There have also been several studies in anaesthesiology that have investigated the ability of music to reduce patients' anxiety and pain, both during general and spinal anaesthesia as well as during conscious sedation<sup>22,30,33,35</sup>. An intra-operative, randomised clinical trial of 50 patients undergoing surgery with spinal anaesthesia found that the group of patients who received intra-operative music via headphones had significant reductions in midazolam requirements ( $p < 0.05$ ) throughout the entire peri-operative period in comparison to patients who received no music<sup>30</sup>.

### Music therapy in family medicine

The identified studies in the family medicine specialty investigated the therapeutic effects of music on patient anxiety in both the clinical examination room and nursing home settings<sup>15,45</sup>. For example, a randomised clinical trial with 47 elderly patients at a Hong Kong community centre found that subjects exposed to music therapy for one month had a statistically significant reduction in depression scores ( $p < 0.001$ ), blood pressure ( $p = 0.001$ ), heart rate ( $p < 0.001$ ) and respiratory rate ( $p < 0.001$ )<sup>15</sup>.

### Music therapy in paediatrics

The identified studies in paediatrics have investigated the therapeutic effects of music on patient care in both the peri-operative setting of surgery as well as other medical procedures<sup>6,20</sup>. A randomised clinical trial, consisting of 79 children aged 1 year to 16 years who were recovering from congenital heart surgery, investigated the impact of music during the first 24 hour post-operative period. The study found that the group exposed to music had significant reductions in facial pain scale ratings ( $p < 0.001$ ), heart rate ( $p = 0.04$ ) and respiratory rate ( $p = 0.02$ ) in comparison to the non-music control group<sup>20</sup>. A systematic review that analysed data gathered

from 1513 children aged one month to 18 years during 19 clinical trials, demonstrated that listening to music during medical procedures significantly reduced children's anxiety (standardised mean difference [SMD]  $-0.39$ ; 95% confidence interval [CI]  $-0.76, -0.03$ ) and pain (SMD  $-0.39$ ; 95% CI  $-0.66, -0.11$ )<sup>6</sup>.

### Music therapy in internal medicine

Some studies have already tested the effects of music in both hospitalised and non-hospitalised general medical patients<sup>4,8</sup>. A meta-analysis that analysed data gathered from 11 clinical trials demonstrated that music therapy caused a statistically significant reduction in both systolic ( $p < 0.001$ ) and diastolic ( $p < 0.001$ ) blood pressure as well as heart rate ( $p < 0.001$ ) in patients from a diverse range of health care settings<sup>8</sup>.

### Music therapy in gastroenterology

Studies in gastroenterology have tested the effects of music on patient anxiety and discomfort as well as its benefits as a pharmacological sedative requirement during interventional diagnostic procedures such as sigmoidoscopy, oesophago-gastroduodenoscopy and colonoscopy<sup>10,12,17,24,38</sup>.

A randomised clinical trial of 104 patients undergoing upper endoscopy found that the group exposed to Indian classical music before and during the procedure had significant reductions in systolic and diastolic blood pressure, respiratory rate and subjective anxiety in comparison to the non-music control group<sup>24</sup>. A meta-analysis which evaluated data gathered from 641 patients during six randomised clinical trials showed that listening to music during endoscopy procedures significantly reduced patient anxiety ( $p = 0.004$ ), analgesia requirements ( $p = 0.001$ ) and procedure times ( $p = 0.002$ )<sup>9</sup>. A reduction in sedative requirements was also observed that approached statistical significance ( $p = 0.055$ ).

### Music therapy in cardiology

Several studies have examined the effects of adjuvant music therapy on patient well being in the peri-operative and peri-procedural settings, as well as in the acute coronary disease unit<sup>3,42</sup>. A randomised clinical trial of 61 patients recovering from open heart surgery found significant reductions in anxiety, pain sensation and pain distress ( $p < 0.001$ ) in patients who received 30 minutes of music therapy after the surgical procedure in comparison to the control group which was not subjected to music therapy<sup>42</sup>. A systematic review that analysed data gathered from 1461 coronary heart disease patients during 23 clinical studies using music therapy found that after standardising for inter-study variability in subjective measurements and data heterogeneity due to the varying clinical settings (operating room versus exam room), the data demonstrated an overall improvement in anxiety ( $p = 0.003$ ), mood ( $p < 0.0001$ ), heart rate ( $p = 0.009$ ), systolic blood pressure ( $p < 0.00001$ ) and pain ( $p = 0.03$ ) in groups subjected to music therapy compared to non-music control groups<sup>3</sup>.

### Music therapy in pulmonology

Previous studies in pulmonology have explored the ability of music to improve patient care primarily during mechanical ventilation and interventional procedures such as bronchoscopy<sup>23,29,39</sup>. A randomised trial of 60 patients aged 18 years to 70 years, requiring mechanical ventilation, demonstrated that a 60-minute session of classical music via headphones caused significant reductions in systolic ( $p = 0.024$ ) and diastolic ( $p = 0.016$ ) blood pressure, respiratory rate ( $p = 0.043$ ) and significant differences in heart rate over time ( $p = 0.024$ ), but no significant differences were observed in blood oxygen saturation<sup>23</sup>.

### Music therapy in haematology and oncology

Studies in haematology and oncology have explored the effects of music on patient anxiety and discomfort during hospital visits as well as in the peri-operative settings of invasive procedures such as bone marrow biopsies. A systematic review that analysed data gathered from 1891 oncology patients during 30 clinical trials showed that both pre-recorded and live music reduced anxiety ( $p = 0.0007-0.009$ ), improved mood ( $p = 0.03$ ) and had a moderate analgesic effect ( $p = 0.0003$ ) in patients with cancer<sup>2</sup>.

### Music therapy in otolaryngology

Studies in otolaryngology have examined the effect of music in patients recovering from nasal and oral surgery<sup>21,40</sup>. A randomised clinical trial of 57 patients undergoing nasal surgery found significant reductions in pain ( $p < 0.0001$ ), systolic blood pressure, heart rate and analgesic use in patients who listened to music during the post-operative period in comparison to those who did not<sup>40</sup>. Another randomised clinical trial with 219 patients scheduled for surgical extraction of an impacted mandibular molar tooth studied the effect of music on peri-operative anxiety. According to the results, the group exposed to music during the operation had significant reductions in anxiety ( $p < 0.05$ ). The observed reduction in heart rate was significant but small, and blood pressure did not show a statistically significant change between the groups<sup>21</sup>.

### Music therapy in urology

Studies have already been conducted to evaluate the impact of music on patient anxiety and discomfort during extracorporeal shockwave lithotripsy (ESWL). For example, a randomised clinical trial of 98 patients with nephrolithiasis undergoing ESWL found significant differences in mean arterial blood pressure and oxygen saturation in patients

who received music via headsets throughout the procedure in comparison to patients who received 2 mg of midazolam five minutes before the procedure began without intra-procedural music<sup>44</sup>. The study found no statistically significant difference in anxiety levels between the groups, suggesting that intra-operative music had an equivalent sedative effect in comparison to 2 mg of pre-operative midazolam during ESWL.

### Music therapy in obstetrics and gynaecology

Obstetrics and gynaecology studies investigated the application of music to improve patient comfort and anxiety during colposcopy and caesarean section procedures<sup>5,16,47</sup>.

A randomised clinical trial of 220 women undergoing colposcopy found that the group exposed to music throughout the procedure had significant reductions in pain ( $p < 0.001$ ) and anxiety ( $p = 0.002$ ) in comparison to the control group<sup>16</sup>. A systematic review that analysed data gathered from 1441 women during 11 clinical trials showed that listening to music during colposcopy reduced patient anxiety levels ( $p < 0.002$ ) in comparison to those who only received pre-procedural information or counselling with standard intra-procedural treatment<sup>5</sup>.

### Music therapy in nursing

One study examined if music could help to reduce the stress of new nursing employees during patient care. A randomised clinical crossover trial of 54 newly employed (<one year) nurses were assigned to either a 30-minute daily session of music or a 30-minute daily session of chair rest. The study found that the group exposed to 30 minutes of music had lower post-intervention perceived stress, cortisol levels, heart rate, mean arterial pressure and increased finger temperature (a surrogate parasympathetic marker of tension release) than the non-music control group ( $p < 0.05$ )<sup>26</sup>.

### Music therapy in interventional radiology

The authors identified one study which explored the ability of music to improve patient care in the peri-procedural setting of angiography. The study was a randomised clinical trial of 170 patients scheduled for angiography which investigated the ability of music to reduce anxiety and pulse during the pre-procedural period<sup>14</sup>. The study found that 15 minutes of patient-selected pre-procedural music decreased patient anxiety ( $p = 0.05$ ) and pulse rate ( $p = 0.02$ ) in comparison to those who received no music therapy.

### Music therapy in neurology and psychiatry

Studies in neurology and psychiatry have investigated not only the physiological consequences of music therapy but also the underlying activity in the central nervous system which is correlated to these therapeutic effects<sup>46,47</sup>. A randomised clinical trial of 26 patients suffering from Alzheimer's dementia found statistically significant reductions in anxiety and agitation in patients who received music therapy in group listening ( $p = 0.033$ ), individual listening ( $p = 0.007$ ) and singing sessions ( $p = 0.008$ )<sup>46</sup>.

### Critical appraisal of the validity of music therapy and clinical translation

There currently exists a large body of high quality scientific evidence suggesting that music therapy may be used as an adjuvant therapeutic tool in a wide variety of clinical settings, from the general clinical exam room to specific scenarios involving interventional procedures in various medical specialties. These studies provide significant evidence that music therapy is able to positively influence several physiological variables related to anxiety, stress-response, pain and more.

It is important to emphasise that although most of the studies demonstrated a significant effect of music therapy on the analysed variables,

a small number of studies found no significant differences in certain variables when music therapy was applied to patients. According to our analysis of these negative findings, the positive effects of music therapy were found to be more prominent and consistent in patient-reported anxiety and mood than in pain-related scores and physical parameters such as vital signs.

Another important point for discussion is the fact that music therapy poses virtually no risk to patients and has also been shown to help reduce and avoid the unnecessary risks related to excessive consumption of powerful pharmacological agents such as narcotics and sedatives. Moreover, the fact that music therapy programs are relatively inexpensive, suggest that significant benefits in patient well-being and quality of patient care could be achieved by implementation of widespread programs of music therapy throughout the health care system.

In relation to future research on the issue, further studies are required in order to investigate which music genres and subgenres may have the greatest therapeutic impact on different subgroups of patients. Such research would also be important to customise music therapy for each specific clinical scenario and medical specialty in order to maximise its therapeutic application and effects.

Additional information for patients and healthcare professionals is provided in Table 4. Short summaries of the future implications and areas of future research are provided in Table 1 and Table 5, respectively.

### Conclusion

In summary, although widely unknown by the vast majority of physicians and healthcare providers, the field of scientific clinical music therapy research has significantly progressed in recent decades so that at the present moment there is a robust body of level I evidence supporting the benefits of music

therapy when used as an adjuvant treatment in clinical practice. Therefore, the authors of this review advocate not only for further support from the scientific and medical communities for advancing research in this field but also for the urgent attention of public authorities and healthcare providers so that implementation of widespread music therapy programs may translate the successful results of scientific research presented in this review in terms of improvement of patients' care, especially in public healthcare systems.

### Abbreviations list

ESWL, extracorporeal shockwave lithotripsy.

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**Table 4. Additional resources for patients and healthcare professionals.**

American Music Therapy Association: <a href="http://www.musictherapy.org/">http://www.musictherapy.org/</a>
University Hospitals of Cleveland Music Therapy: <a href="http://www.musicasmedicine.com/">http://www.musicasmedicine.com/</a>
Louis Armstrong Department of Music Therapy: <a href="http://www.musicandmedicine.org/">http://www.musicandmedicine.org/</a>
Weill Cornell Medical College - Music and Medicine: <a href="http://weill.cornell.edu/music/">http://weill.cornell.edu/music/</a>
MD Anderson Center - Music Therapy: <a href="http://www.mdanderson.org/patient-and-cancer-information/care-centers-and-clinics/specialty-and-treatment-centers/integrative-medicine-center/clinical-services/music-therapy.html">http://www.mdanderson.org/patient-and-cancer-information/care-centers-and-clinics/specialty-and-treatment-centers/integrative-medicine-center/clinical-services/music-therapy.html</a>

**Table 5. Areas for future research.**

Future studies are required in order to investigate the effects of different music genres and subgenres on different subgroups of patients.
Further research is required in order to study the effects of music in terms of health-care in the hospital setting not only in patients but also in the quality of care provided by employees.
Medical interactions, such as the increased efficacy with specific classes of analgesic, sedatives or narcotics, need to be specifically addressed.
The effect of music therapy in waiting areas in improving patient comfort and attitude should also be studied.
Further general policies and guidelines for implementation of music therapy in the healthcare system are required.
Cost-benefit analysis studies addressing the impact of music therapy in the healthcare system would also be very useful.

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