Impact of an Active Music Therapy Intervention on Intensive Care Patients

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Background Nonpharmacological interventions appear to benefit many patients and do not have the side effects commonly associated with medications. Music-based experiences may benefit critical care patients.
Objective To examine the effect of an active music therapy intervention on physiological parameters and self-reported pain and anxiety levels of patients in the intensive care unit.
Methods A study was conducted using a pretest-posttest, within-subject, single-group design. The study population consisted of a convenience sample of 52 patients. Study participants received a 30-minute music therapy session consisting of either a relaxation intervention or a "song choice" intervention. The music therapist recorded the patients' vital signs before and after the intervention, and patients completed self-assessments of their pain and anxiety levels before and after the intervention.
Results After the intervention, significant decreases (all $P < .001$) were found in respiratory rate (mean difference, 3.7 [95% CI, 2.6-4.7] breaths per minute), heart rate (5.9 [4.0-7.8] beats per minute), and self-reported pain (1.2 [0.8-1.6] points) and anxiety levels (2.7 [2.2-3.3] points). No significant change in oxygen saturation level was observed. Outcomes differed between the 2 intervention groups: patients receiving the relaxation intervention often fell asleep.
Conclusions The results of this study support active music therapy as a nonpharmacological intervention in intensive care units. This study may lay the groundwork for future research on music therapy in critical care units using larger, more diverse samples. (*American Journal of Critical Care.* 2019;28:48-55)

doi:https://doi.org/10.4037/ajcc2019792

The critical care unit is one of the most anxiety-producing medical environments for patients and their caregivers.[1] Critically ill patients often experience anxiety, depression, posttraumatic stress disorder, cognitive impairment, and a general decline in their overall well-being.[2] Physiological distress can lead to increased respiratory and heart rates, elevated blood glucose levels, hyperlactatemia, and lowered blood pressure, all of which can affect treatment outcomes.[3]

The psychological stress of critical illness also may have lasting effects after discharge. An estimated 15% of intensive care unit (ICU) patients experience posttraumatic stress disorder.[4] Chahraoui and colleagues[5] reported that approximately 25% of ICU patients experience at least 1 psychiatric comorbidity within the first year after hospitalization, and that anxiety affects roughly 70% to 80% of all critical care patients, especially those receiving mechanical ventilation.

Although treatment teams recognize the physiological and psychological impact of an ICU stay, they have limited interventions available to address patients' experiences, as the patients are often unconscious or otherwise unable to engage in self-care.[6] Medications have thus become the primary intervention with which to address patients' clinical needs.[7] Medications can be beneficial in mitigating or masking primary psychological distress, but they can have marked adverse effects that may impede recovery.

In response to these psychophysiological concerns, nonpharmacological interventions have become more widely accepted and implemented, as they appear to benefit many patients without the risks of adverse effects associated with medications.[8] Some nonpharmacological interventions currently being used in critical care are massage, mindfulness-based stress reduction, Reiki therapy, integrative energetic medicine, healing touch, music listening, and music therapy, all of which offer low-risk, low-cost alternatives to standard care.[8,9]

Music listening interventions are among the most widely used nonpharmacological interventions and have been shown to reduce stress and anxiety, pain, depression, and feelings of isolation in critical care patients.[7,10] For example, Bradt and Dileo[11] found that music listening in patients receiving mechanical ventilation reduced anxiety, respiratory rate, and systolic blood pressure, and Chlan and colleagues[12] found that music listening reduced the frequency of sedative administration. However, the impact of music listening experiences is equivocal. Chlan et al[13] concluded that while music listening decreased stress responses in patients undergoing mechanical ventilation, the findings were not significant. Hetland and colleagues[14] found that music listening did not have an impact on duration of weaning trials in patients receiving mechanical ventilation. Cooke and colleagues[15] found that music listening did not significantly affect discomfort or anxiety among postoperative ICU patients during turning procedures.

> Nonpharmacological interventions are becoming more widely accepted and are low-risk, low-cost alternatives.

Incorporating active music therapy involving live music into the ICU may clarify the effectiveness of these music-based interventions. Hunter and colleagues[16] reported that active music therapy was effective in managing anxiety associated with weaning from mechanical ventilation. In their study, a music therapist provided multiple live music therapy sessions while participants were undergoing weaning trials from mechanical ventilation. After assessing the patient's ability to actively participate, the music therapist extemporaneously modified the volume and tempo of the music according to the patient's respiration and/or heart rate. The authors found significant differences in heart and respiratory rates after music therapy sessions, along with lower reported anxiety.[16]

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Table 1
Music therapy vs music listening in health care

Definition of music therapy: "Music therapy is the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program." (American Music Therapy Association)[18]

Music therapy	Music listening
Requires a board-certified music therapist who has been trained to use very specific individualized, live music interventions that match the patient's in-the-moment needs.	Involves a nurse or other practitioner offering patients prerecorded music for listening that will be selected by the nurse, practitioner, or patient, or the patient may be given a list of options from which to choose.
Always involves a therapeutic process in which both the music and the therapeutic relationship serve as healing components in treatment.	Always uses prerecorded music and involves passive listening.
Involves active music making and active listening.	

When examined as a whole, the literature suggests that music-based experiences may be beneficial for patients in the ICU, with the potential to address both physiological and psychological concerns. Variations in reported benefits, however, warrant further examination. In particular, differential effectiveness of music listening experiences, specifically those that use recorded music, may be accounted for by their lack of adaptability to the patient's immediate needs, as well as the absence of an interventionist who can respond "in the moment" to the patient.[1,17] Thus, music-based experiences in which a board-certified therapist uses live music in an attempt to alter the physiological and/or psychological state of the patient, adjusting the activity in response to changes in the patient, may provide additional benefits over music listening experiences alone. Music therapy is a clinical approach in which a licensed music therapist implements music-based interventions to reach a clinical goal (Table 1).[18]

The music therapy intervention was either a relaxation/guided imagery experience or a song choice experience.

Music therapy also encompasses the dynamic relationship between the therapist and the patient and includes verbal processing of the music experience. Little research has been published on active music therapy individualized for critical care patients. Therefore, this study was designed to explore the value of active music therapy in the ICU.

Methods

This study was approved by the Inova Health System institutional review board, and all participants provided informed consent.

Sample

The setting of this study was an American Association of Critical-Care Nurses Beacon Award–winning, 12-bed adult medical-surgical ICU in a Magnet-designated community hospital in the Washington, DC, suburbs. The intervention took place during daytime hours, primarily between 10 AM and 3 PM. A total of 52 English-speaking adults who had been admitted to the ICU were recruited to participate in the study as a convenience sample. The most common diagnoses were ST-elevation myocardial infarction, cardiac arrest, gastrointestinal bleeding, respiratory failure, renal failure, and stroke. There were no restrictions based on the patient's sex, race, or ethnic origin. Exclusion criteria were as follows: (1) being in airborne or special contact isolation, (2) being non-English-speaking, (3) being decisionally impaired, (4) receiving mechanical ventilation, (5) pregnancy, (6) current prisoner status, (7) having been pronounced brain dead, (8) unstable hypotension or bradycardia, (9) having been referred to music therapy with a goal of stimulation (eg, comatose patients), (10) enrollment in another research study, and (11) inability to provide consent. Fifty-four patients declined to participate, and 129 patients were deemed ineligible as a result of meeting exclusion criteria.

Study Design

The study used a pretest-posttest, within-subject, single-group design. Participants were offered a single, 30-minute music therapy session with a board-certified music therapist. Before the session, the music therapist recorded the patient's vital signs (heart rate, respiratory rate, and oxygen saturation level) and self-assessed pain and anxiety levels on a Likert scale ranging from 0 to 10. After assessing the patient's needs, the music therapist selected 1 of 2 music therapy interventions: a relaxation/guided imagery intervention or a "song choice" intervention. At the conclusion of the music therapy session, the patient's vital signs were again recorded, along with self-assessed pain and anxiety levels, for comparison with preintervention data.

Intervention

The intervention consisted of either a relaxation/guided imagery experience with live music or a "song choice" experience with live music, in which the participant discussed the lyrics of a favorite song or songs after either listening to or singing the song or songs with the music therapist. The music therapist assessed the immediate needs of the patient and selected 1 of the following 2 interventions:

Relaxation/Guided Imagery. The music therapist and patient chose music or a musical style, to be presented live (on guitar) by the music therapist, for a relaxation experience. The patient was instructed in relaxation techniques, such as focused breathing and/or simple imagery. The music therapist would initiate the music's tempo, volume, and intensity on the basis of the patient's current heart rate and/or respiratory rate, and then alter the music to facilitate a relaxation response. In this process, the tempo of the music, or beats per minute, is initially matched with the patient's heart rate or respiratory rate; then, the tempo (as well as the volume and intensity) is gradually decreased in an attempt to synchronize the heart rate (or respiratory rate) with the music. This concept is known as "entrainment," in which the rhythms of the body coordinate with the rhythms and intensity of the music. This can be accomplished only with the use of live music, provided "in the moment" by a music therapist. The goal of this intervention is to reduce anxiety and/or pain perception and promote relaxation through a focus on the music and the relaxation techniques.

Song Choice. The music therapist and the patient discussed the patient's current physical and emotional states. The music therapist facilitated a conversation about the use of music or songs to help with the expression of feelings or thoughts. The patient was offered the opportunity to either choose a song or songs or have the music therapist choose a song or songs on the basis of their conversation that would either be meaningful to the patient or reflect how the patient was feeling at the moment. The music therapist presented the song or songs and encouraged the patient to participate by either singing along or actively listening to the lyrics. The patient was encouraged to discuss the song lyrics, the feelings the song elicited, or what the song meant to him or her. The goals of this intervention are to create a positive and empathic interaction between the music therapist and the patient, reduce anxiety and/or pain perception, and encourage self-expression and the use of music and songs to cope with hospitalization, treatment, and recovery.

Measurements

The physiological measures of heart rate, respiratory rate, and oxygen saturation level were recorded by the music therapist directly from the patient's bedside monitor before and immediately after the music therapy session. Psychological measures, including pain and anxiety, were self-reported by the patient before and immediately after the music therapy session on a Likert scale ranging from 0 to 10. The physiological data as well as the patient's self-reported anxiety and pain were recorded on a data collection form that was developed by the research team.

Procedures

The research team collaborated with the ICU nurses and charge nurse to identify potential study participants. After the patient's consent was obtained, a single music therapy session was scheduled. Once the baseline demographic data were collected, the music therapist entered the participant's room, introduced himself, and explained what the music therapy session would entail. The music therapist then presented a pain and anxiety assessment tool and asked the participant to self-report his or her current pain and anxiety levels on a scale of 0 to 10. The music therapist then collected the physiological data for heart rate, respiratory rate, and oxygen saturation level from the bedside monitor. Concurrently, the music therapist assessed the patient's current needs and desired level of participation. With this information, the music therapist decided which music therapy intervention to use. The music therapist then conducted the music therapy intervention. Afterward, in accordance with standard music therapy practice, the music therapist spent 3 to 4 minutes discussing the experience with the patient (verbal processing). At the conclusion of the session, the music therapist again asked the participant to report his or her pain and anxiety levels on the data collection tool. Concurrently, the music therapist collected postsession physiological data from the in-room monitor.

> Entrainment is when the rhythms of the body coordinate with the rhythm and intensity of the music.

Statistical Analyses

Statistical analyses were performed using the SAS and R programs. A paired *t* test was used to determine differences between preintervention and postintervention pain and physiological stress scores. The data were analyzed first as a single-group design

Table 2
Summary of participants' demographic and medical information (N = 52)

Characteristic	Value[a]
Age, median (range), y	62 (20-89)
Sex	
Women	33 (63)
Men	19 (37)
Race	
White	40 (77)
Black	5 (10)
Asian	2 (4)
Hispanic	1 (2)
Other	4 (8)
Days in intensive care unit	
1	25 (48)
2	18 (35)
3	4 (8)
4-8	5 (10)
Intravenous infusion	
Analgesia	10 (19)
Vasopressor	5 (10)

[a] Value is number (percentage) unless otherwise indicated in the first column.

for the primary analysis. Several secondary analyses were then conducted, with stratification by type of treatment, presence of family members in the room (yes or no), age (split into groups at the median value of 62 years), and sex. Patients who fell asleep during the intervention were unable to provide self-reported postintervention values for pain and anxiety. These missing data were analyzed in 3 ways. First, the missing values were excluded from the sample and the *t* test was performed using available values. Second, single imputation was employed for the missing values using 0 (as suggested by the patient's ability to fall asleep), the lowest point on the scale. Third, multiple imputation analyses were performed, in which missing data were imputed according to regression models relating the missing data to the observed data, selected using a stepwise regression procedure. The imputation was repeated 1000 times, and the results were summarized using the method developed by Rubin.[19] Power calculations suggested that a sample of 50 participants would have more than 80% power to detect a mean change of 0.4 SDs with an α of .05.

A music therapist can respond "in the moment" to the patient's needs.

Results

A total of 52 adult patients consented to participate in the study. Most of the patients were white (n = 40, 77%) and female (n = 33, 63%), and the median age was 62 years (range, 20-89 years). Nearly half of the participants (n = 25, 48%) had been in the ICU for only 1 day when they received the intervention, with the average length of stay at the time of the intervention being 2.4 days (Table 2). Fifteen patients were receiving intravenous infusions: 10 were receiving analgesia for pain, and 5 were receiving a vasopressor for hypotension. When self-reported pain and anxiety were compared between the 2 interventions, no significant differences were detected. Of note, more patients fell asleep during the relaxation intervention than during the song choice intervention (10 vs 2 patients, respectively). Therefore, the imputed values in the secondary analysis for sleeping patients on self-reported measures are closer to those in the primary analysis for the song choice intervention than for the relaxation intervention. The results for each analysis are presented in Tables 3 and 4.

Having observed significant differences in pretest-posttest respiratory and heart rates, we examined these differences according to patient sex and age. No differences were found between men and women, with the exception of a larger effect size in women for heart rate, with a mean decrease of 6.91 beats per minute (95% CI, 4.12-9.70; $P < .001$). The mean decrease for men was 4.16 beats per minute (95% CI, 2.08-6.24; $P < .001$). The results as stratified by patients' age (above and below the median of 62 years) showed no significant differences between younger and older patient groups.

Although it was unanticipated in the study design, family members were often present when the intervention was conducted. Consistent with the family-centered philosophy of the hospital, family members were invited to stay for the session or take a break, as they preferred. Given this option, we examined the impact of the presence of a family member during the intervention. No differences were detected between presence and nonpresence of family members. The mean decrease in self-reported pain with family members present was 1.18 points (95% CI, 0.49-1.86; $P < .001$), and the mean decrease in self-reported anxiety with family members present was 3.06 points (95% CI, 1.99-4.13; $P < .001$). The mean decrease in self-reported pain without family members present was 1.17 points (95% CI, 0.63-1.72; $P < .001$), and the mean decrease in self-reported anxiety without family members present was 2.48 points (95% CI, 1.83-3.13; $P < .001$).

Discussion

The purpose of this study was to investigate the effects of 2 music therapy interventions on 3

Table 3
Primary and secondary analyses of physical and self-reported measures

Variable	Mean (95% CI) Before	Mean (95% CI) After	Mean difference[a] (95% CI)	*P* value[b]
Primary analyses				
Respiratory rate, breaths per minute (n = 52)	21.23 (19.8-22.67)	17.58 (16.42-18.73)	3.65 (2.59-4.72)	< .001
Heart rate, beats per minute (n = 52)	89.31 (84.13-94.48)	83.40 (78.06-88.75)	5.90 (3.99-7.81)	< .001
Oxygen saturation level, % (n = 52)	97.25 (96.66-97.84)	97.12 (96.37-97.85)	0.13 (-0.32-0.59)	.56
Self-reported pain, points (n = 40)	3.27 (2.52-4.02)	1.73 (1.11-2.34)	1.18 (0.77-1.58)	< .001
Self-reported anxiety, points (n = 40)	4.90 (4.23-5.58)	2.10 (1.5-2.7)	2.73 (2.16-3.29)	< .001
Secondary analyses with imputations (n = 52)				
Self-reported pain, points (SI)	3.27 (2.52-4.02)	1.33 (0.82-1.83)	1.94 (1.30-2.59)	< .001
Self-reported pain, points (MI)	3.27 (2.52-4.02)	1.95 (1.40-2.51)	1.31 (0.92-1.71)	< .001
Self-reported anxiety, points (SI)	4.90 (4.23-5.58)	1.62 (1.10-2.13)	3.29 (2.64-3.93)	< .001
Self-reported anxiety, points (MI)	4.90 (4.23-5.58)	2.09 (1.59-2.60)	2.81 (2.31-3.31)	< .001

Abbreviations: MI, multiple imputation; SI, single imputation.
[a] Before value minus after value.
[b] From paired *t* test.

Table 4
Primary and secondary analyses of physical and self-reported measures presented by intervention type

Variable	Relaxation/imagery intervention (n = 28) Mean (95% CI) Before	Relaxation/imagery intervention (n = 28) Mean (95% CI) After	Relaxation/imagery intervention (n = 28) Mean difference[a] (95% CI)	Relaxation/imagery intervention (n = 28) *P* value[b]	Song choice intervention (n = 24) Mean (95% CI) Before	Song choice intervention (n = 24) Mean (95% CI) After	Song choice intervention (n = 24) Mean difference[a] (95% CI)	Song choice intervention (n = 24) *P* value[b]
Primary analyses								
Respiratory rate, breaths per minute	20.25 (18.53-21.97)	16.61 (15.30-17.91)	3.64 (2.14-5.15)	<.001	22.38 (19.96-97.99)	18.71 (16.70-20.71)	3.67 (2.04-5.30)	<.001
Heart rate, beats per minute	89.96 (84.16-95.77)	81.54 (75.39-87.68)	8.40 (5.33-11.52)	<.001	88.54 (79.08-98.00)	85.58 (76.01-95.16)	2.96 (1.46-4.46)	<.001
Oxygen saturation level, %	96.89 (96.02-97.76)	96.661 (95.51-97.71)	0.29 (-0.47 to 1.05)	.45	97.67 (96.83-98.50)	97.71 (96.72-98.70)	-0.04 (-0.55 to 0.46)	.87
Self-reported pain, points	3.79 (2.64-4.93)	1.89 (0.78-2.99)	1.06 (0.48-1.63)	.001	2.67 (1.76-3.58)	1.59 (0.86-2.32)	1.27 (0.66-1.89)	<.001
Self-reported anxiety, points	5.43 (4.51-6.35)	2.28 (1.24-3.31)	3.06 (2.18-3.93)	<.001	4.29 (3.29-5.29)	1.95 (1.20-2.71)	2.45 (1.67-3.24)	<.001
Secondary analyses with imputations								
Self-reported pain, points (SI)	3.79 (2.64-4.93)	1.21 (0.44-1.99)	2.57 (1.49-3.65)	<.001	2.67 (1.76-3.58)	1.46 (0.76-2.15)	1.21 (0.64-1.78)	<.001
Self-reported pain, points (MI)	3.79 (2.64 -4.93)	2.38 (1.54-3.22)	1.40 (0.84-1.97)	<.001	2.67 (1.76-3.58)	1.46 (0.78-2.13)	1.21 (0.65-1.77)	<.001
Self-reported anxiety, points (SI)	5.43 (4.51-6.35)	1.46 (0.69-2.24)	3.96 (2.97-4.96)	<.001	4.29 (3.29-5.29)	1.79 (1.07-2.52)	2.5 (1.77-3.20)	<.001
Self-reported anxiety, points (MI)	5.43 (4.51-6.35)	2.29 (1.52-3.06)	3.14 (2.43-3.84)	<.001	4.29 (3.34-5.24)	1.86 (1.23-2.50)	2.43 (1.73-3.12)	<.001

Abbreviations: MI, multiple imputation; SI, single imputation.
[a] Before value minus after value.
[b] From paired *t* test.

physiological measures (heart rate, respiratory rate, and oxygen saturation level) and self-reported pain and anxiety among patients in an ICU. After participating in a single music therapy session, patients reported lower pain and anxiety and had decreases in both heart rate and respiratory rate, with no changes in oxygen saturation level detected. Examining each intervention individually, a similar responsiveness profile emerged, with the only difference being in heart rate: participants who received the relaxation intervention had a greater decrease in heart rate than did those who received the song choice intervention.

The positive findings related to heart rate and respiratory rate in patients receiving the relaxation intervention may reflect the presence of a music therapist, who could respond to the patient "in the moment," in 2 interrelated ways. First, the therapist could select the intervention in response to the patient's current needs. Second, the therapist could modify the elements of the music—tempo, timbre, and modal elements—during the intervention in an attempt to guide the patient into a more relaxed state. When the tempo and intensity of the music are matched to the patient's heart rate or respiratory rate and then adjusted, the patient may "entrain," with heart rate and respiratory rate synchronizing with the music.[1] This process can promote changes in the patient's physiology.

Although both interventions appeared to have a positive impact on patients' physiological measures, some differences were noted. Patients receiving the relaxation intervention had a greater decrease in heart rate (8.40 beats per minute; 95% CI, 5.33-11.52; $P<.001$) than did those receiving the song choice intervention (2.96 beats per minute; 95% CI, 1.46-4.46; $P<.001$). Additionally, more patients fell asleep during the relaxation intervention (10) than during the song choice intervention (2). This finding may indicate that patients receiving the song choice intervention took a more active role during the session (actively listening, singing) than those receiving the relaxation intervention, affecting the type of relaxation experienced during the session. However, as respiratory rates decreased at similar levels in the 2 interventions, moderators of this benefit are not yet known.

Changes in self-reported anxiety and pain perception further support the presence of a music therapist and adaptability of the interventions. With the flexibility to select the music intervention, as well as the manner in which the musical elements were presented, the therapist could tailor the intervention to the patient's current needs. Whereas some patients found the song choice intervention to be especially beneficial (either listening to or singing along with meaningful songs) as a means of addressing psychological distress, other patients preferred the relaxation intervention, allowing the music to guide them into a more relaxed and comfortable physical and psychological state.

The findings from this study also showed no significant differences in responsiveness to the interventions based on the patient's age (median, 62 years), the patient's sex, or the presence of a family member. These findings suggest that the benefits of these music therapy interventions are not age- or gender-specific, further supporting the presence of a music therapist who can tailor the music intervention to the patient's preferences.

Limitations

Although these findings suggest benefits from participation in a single music therapy session, the study had some limitations. The lack of a control or comparison group limits the intervention outcomes and prevents direct examination of the differential treatment effects of a music therapy intervention versus a music listening intervention. Direct comparison of these interventions, including moderators of intervention effectiveness, is essential to clarify differences and identify conditions under which each intervention may benefit a patient. In addition, the single postintervention measurement limits our understanding of the duration of each intervention's impact. There was potential for bias in the patient's self-report of pain and anxiety, as these data were collected by the music therapist. Another limitation is that the study was conducted in a single critical care environment in a community hospital. The study was originally intended to include patients receiving mechanical ventilation; however, limited resources prevented the involvement of critical care nurses, which would have enabled evaluation of patients before and after the intervention using validated nursing assessment tools.

Conclusion

As ICU treatment teams seek to reduce reliance on medications to address patients' needs,[8] nonpharmacological interventions, including music-based interventions, are being more widely implemented. Although findings from studies of music-based interventions in the ICU are mixed, the results of this study indicate that reductions in pain, anxiety, heart rate, and respiratory rate can be achieved after a single music therapy session. The presence of a

music therapist, who can tailor an intervention to the patient's immediate physiological and psychological needs, may be an important variable in the differential effects of these interventions.

Future research should address the timing and quantity of music therapy sessions in the ICU and whether additional sessions, scheduled at specific times of day, might improve patients' medical or psychological outcomes. Similarly, following up with patients after they leave the ICU and addressing any psychological distress they experience may also affect long-term health outcomes after an ICU stay.[20,21] The promising results from this study underscore the value of nonpharmacological interventions and the need for larger, multisite studies in the highly technical environment of critical care.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the ICU and nursing leadership at Inova Loudoun Hospital, Leesburg, Virginia, for its support. This abstract was presented at the International Congress of Integrative Medicine and Health Conference in Baltimore, Maryland, May 9-10, 2018. The study was also presented at the ANCC National Magnet Conference in Denver, Colorado, October 26, 2018.

FINANCIAL DISCLOSURES

Raymond Leone is an employee of A Place to Be, which provides contracted services to Inova Loudoun Hospital.

SEE ALSO

For more about music therapy, visit the *Critical Care Nurse* website, **www.ccnonline.org**, and read the article by Supnet et al, "Music as Medicine: The Therapeutic Potential of Music for Acute Stroke Patients" (April 2016).

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