**Neurologic music therapy in multidisciplinary acute stroke rehabilitation: could it be feasible and helpful?**

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# Declaration of Interest

The authors declare no potential conflict of interest.

**Neurologic music therapy in multidisciplinary acute stroke rehabilitation: could it be feasible and helpful?**

**Background:** There is increasing evidence for music-based interventions in neurorehabilitation, improving mood and functional outcomes. In response, there is growing interest from healthcare providers in setting up Neurologic Music Therapy (NMT) services. This paper presents some preliminary data on the feasibility and acceptability of NMT in the acute stroke, multidisciplinary team setting, about which little is known.

**Objectives:** Toassess the feasibility and acceptability of a two-day per-week NMT service over 24 months.

**Methods:** Data were collected on thenumber of referrals received, sessions attended, sessions declined and reasons why. Staff completed questionnaires, and collected them from patients and their relatives, rating interventions: 1. Not helpful, 2. Quite helpful, 3. Helpful, 4. Very helpful. Patients completed the Visual Analogue Mood Scale (VAMS) pre-/post- a single session.

**Results:** Of 201 patients referred,177 received treatment and 675 sessions were delivered. Twenty-four patients were discharged before sessions were scheduled and twenty-eight sessions were declined, predominantly due to fatigue. Mean scores (SD) from questionnaire data were: patients (*n* = 99) 3.34 (0.825), relatives (*n* = 13) 3.83 (0.372), staff (*n* = 27) 3.85 (0.388). Mean, post-session VAMS data (*n* = 52) showed a non-significant reduction in ‘Sad’ (7.5, p = 0.007, CI = 2.1, 12.9) and an increase in ‘Happy’ (+ 6.2, p = 0.013, CI = -11.0, -1.4).

**Conclusions:** Data suggest the service was feasible and helpful, particularly for patient mood, possibly improving engagement in rehabilitation. Research to determine generalisability in different stroke environments and treatment effects within them is warranted.

Keywords: acute stroke, neurorehabilitation, Neurologic Music Therapy, feasibility, acceptability, engagement, mood

# Introduction

Music-based interventions, including those from Neurologic Music Therapy (NMT) (1), are not commonly part of acute stroke rehabilitation and little is known about feasibility and acceptability of delivery within these specialist teams and environments.

The value of music therapy within multidisciplinary teams, and potential benefits for patients in neurorehabilitation has been discussed and evaluated in relation to published research (2-8). Benefits for stroke inpatients at acute stage have been reported for arm function (9), non-fluent aphasia (10), gait (11), and cognition (12). There may also be benefits for mood and social interactions (12-15). This could make an important contribution to engagement in rehabilitation, as depression is prevalent amongst inpatients (16), particularly those with aphasia, and is associated with worse rehabilitation outcomes (17). Some music-based exercises, such as those for finger dexterity using keyboards (9), may be transferrable onto tablet-based apps, offering portability for bedside and home-based treatment delivery (18,19). With further development and evaluation along the guidelines being developed for the growing mHealth (the use of smart phones, iPads and wearables in healthcare) industry (20), such technology might offer further patient benefit. Music-based exercises bring massed practice, auditory and tactile feedback promoting neural reorganisation (21-23), and can exploit the temporal frameworks to support the priming and timing of movements (24).

There may be added value for multidisciplinary neurorehabilitation and patient benefit, through the inclusion of NMT as part of standard care. The psychological effects and neural mechanisms of interventions probably share neural networks for reward, arousal, affect regulation, learning and activity-driven plasticity (6), which might lead to enhanced rehabilitation outcomes and quality of life for patients. There may also be benefits in motivation and fatigue reduction (25-27).

This two-year, two-day per-week NMT feasibility project focused on providing clinical contacts for a single cohort (no control group) of in-patients on a 26-bed stroke and rehabilitation unit and four additional beds allocated for neurorehabilitation on the nearby acute major trauma ward. There was no control group, as the purpose of the project was to determine whether or not it would be feasible to deliver NMT interventions to acute stroke patients, which have never been part of multidisciplinary stroke rehabilitation in this setting. Furthermore, the acceptability of these exercises also needed to be determined in terms of whether multidisciplinary team members would refer patients, and whether patients, their relatives and the ward staff regarded the interventions as potentially useful for stroke rehabilitation. The wards were situated within a large hospital and centre for medical research. Interventions were delivered as part of usual care, therefore the project did not undergo ethical review.

The project was registered with the hospital auditing department, who approved all data collection and patient information materials. The project was approved by the neurosciences divisional lead and senior management, and funded by the hospital’s charitable trust.

# Methods

Patients were referred in team meetings, by e-mail and on the wards by members of the multidisciplinary team, ward staff and by self-referral. Any patient on the stroke ward or on the major trauma ward who was receiving neurorehabilitation could be referred. Sessions were delivered in a speech therapy treatment room, ward dining area, corridor and gym. Session notes for each patient were entered onto the hospital’s electronic patient database by the Neurologic Music Therapist (NMT) (author). He also recorded data into an Excel spread sheet on the number of referrals made and by which discipline, number of patients seen, the number of individual and group clinical contacts, and sessions declined with reasons why. Active engagement in exercises by patients was not timed.

Three questionnaires were designed for the evaluation, to be completed by patients, their relatives and staff, which were not collected in-person by the NMT, but other staff who were available. These provided opportunity for written feedback and ratings on how helpful NMT was thought to be and in which areas: 1. Not helpful, 2. Quite helpful, 3. Helpful, 4. Very helpful. Thematic analysis of questionnaire feedback was conducted by the NMT. Data on patient mood before and after a single session (usually the first) were collected using the Visual Analogue Mood Scale (VAMS) (28) by the NMT and other staff on the ward who were instructed in its use. Using the VAMS tables, t-scores were calculated and used for the statistical analysis.

**Statistical analysis**

Continuous data were expressed as mean and standard deviation or median (IQR) depending on the distribution of the data, categorical variables were presented as count with percentages. Paired t-test was used to examine the changes (continuous variables) between pre- and post-intervention. The effect size (Cohen’s d) was calculated. Statistical tests were performed at the two-sided significance level of 0.05. The Stata statistical package was used to analyse the data.

Comments from questionnaire responses were thematically analysed by the lead author (interventionist). Themes extracted were discussed in terms of correlations that the authors observed with how useful NMT was scored, comments from staff on patient engagement, and published literature.

**Music Interventions**

Treatment protocols for group and individual clinical contacts followed those described in published neurologic music therapy guidelines and published research (1). Sensorimotor exercises for full range of movement including sit-to-stand, upper and lower limb (including gait), were facilitated using hand percussion, drums, keyboard and touchscreen tablet, either on stands or hand-held. Cognitive training exercises, particularly targeting sustained, alternating, divided and selective attention, and executive function, were facilitated using drums and percussion on stands, where patients copied increasingly complex rhythmic patterns, self-monitoring for errors and feeding back to the therapist in order to indicate attention and executive function progress. Exercises for speech, targeting articulation, breath control, speech rate, speech fluency, and/or word retrieval and production utilised familiar song singing, completing the missing lyric (gap-fill) for target words (for example the word at the end of each chorus line), melodic intonation therapy and rhythmic speech cueing. All exercises were adapted for each patient's specific goals, set by or in consultation with speech therapists, physiotherapists, occupational therapists, psychologists and/or patients.

# Use of iPads with touch screen instruments

Using commercially available music software Garageband and Thumbjam, the NMT set up an iPad with touchscreen instruments configured to facilitate a range of exercises for finger dexterity, including pinch grip using a plectrum stylus. Treatment delivery took place in the treatment room and at bedside on the wards. Following this, rehabilitation assistants were shown how to use the equipment in order to deliver exercises to some patients at bedside on days when the NMT was not working, including over weekends when fewer multidisciplinary team members were available. Instructions on which patients would benefit from the exercises and any specific positioning requirements were imparted to rehabilitation assistants by the NMT in-person or by e-mail. Data were collected on number of patients seen, sessions delivered, and number of rehabilitation assistants delivering. Music software did not collect or transmit any data, it effectively enabled the iPad to be used as a portable, musical instrument (keyboard, string instrument or drum/percussion).

This article is written in full compliance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

# Results

Over two years 201 patients were referred to NMT and 177 received interventions. Table 1 shows the demographic data for these patients. Twenty-four patients who were referred did not receive NMT because they were discharged before time became available to schedule sessions with them. A total of 675 clinical contacts were delivered including 82 sensorimotor groups, usually including four patients. The majority of referrals came from speech and language therapy (89%) and physiotherapy (75%) (Table 2). The average number of sessions was 4.8 (SD = 6.06, 95% CI = 0.97). Twenty-eight sessions were declined. The predominant reason for patients declining sessions was recorded as fatigue. Not wanting to attend (for unspecified reasons), being with a visitor, being too busy, and ‘not feeling like it’ were also recorded as reasons for declining.

|  |  |  |
| --- | --- | --- |
|  | Mean | SD |
| Age (years) | 73.23 | 16.67 |
| Time since stroke & first NMT session (days) (n=145) | 25.9 | 14.03 |
|  | | |
| Characteristic | *n* | % |
| Female (years) | 77 | 43.50 |
| Male | 91 | 51.41 |
| Missing data | 9 | 5.08 |
| Left lesion  Right lesion  Bilateral lesions  Other/Traumatic brain injury/Unknown | 71  60  13  33 | 40.1  33.8  7.3  18.6 |

Table 1. Demographic data for the 177 patients who received NMT over two years.

|  |  |  |  |
| --- | --- | --- | --- |
| Discipline/referred by | Year 1(n=75) | Year 2 (n=102) | Total over 24 months |
| Physiotherapy | 25 (33.3%) | 50 (49%) | 75 (42.3%) |
| Speech and language therapy | 48 (64%) | 41 (40.1%) | 89 (50.2%) |
| Clinical psychology | 1 (1.3%) | 0 | 1 (0.5%) |
| Occupational therapy | 1(1.3%) | 1 (0.98%) | 2 (1.1%) |
| Associate practitioner in rehabilitation | 0 | 3 (2.9%) | 3 (1.6%) |
| Nurse | 0 | 1 (0.98%) | 1 (0.5%) |
| Parent | 0 | 1(0.98%) | 1 (0.5%) |
| Patient/self-referral | 0 | 3 (2.9%) | 3 (1.6%) |
| NMT | 0 | 1 (0.98%) | 1 (0.5%) |
| Missing data | 0 | 1 (0.98%) | 1 (0.5%) |

Table 2. Number of patients referred and the referrer.

Completed patient, relative and staff questionnaires rated NMT as ‘helpful’, tending towards ‘very helpful’ (Table 3). ‘Motivation/Mood,’ ‘Concentration’ and ‘Arm and Hand’ received the highest scores out of five categories patients were asked to rate. ‘Speech/communication’, ‘walking/mobility’ received the highest ratings for ‘not helpful’ (Table 4). Relatives and staff also rated ‘Motivation/mood’ highest (Table 4).

|  |  |  |
| --- | --- | --- |
| Subjects | Questions | Mean (SD) |
| Patients n=99 | What did you think of the NMT sessions? | 3.34 (0.825) |
| Staff n=27 | What do you think about NMT as an intervention for patients? | 3.81 (0.388) |
| Staff n=27 | What do you think about NMT as part of the multidisciplinary team? | 3.85 (0.355) |
| Relatives n=13 | What do you think about NMT as part of stroke rehabilitation? | 3.84 (0.375) |

Table 3. Mean questionnaire ratings from patients, relatives and staff: 1. Not helpful, 2. Quite helpful, 3. Helpful, 4. Very Helpful.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Did NMT help with: | | Motivation/Mood | Concentrating | Arm and Hand | Speech/  Communication | Walking/ Mobility |
| **Patients (n=99)** | | | | | | |
|  | No data (%) | 3 (3) | 4 (4) | 7 (7) | 6 (6) | 9 (9) |
| Not helpful | 5 (5) | 6 (6) | 4 (4) | 21 (21) | 22 (22) |
| Quite helpful | 10 (10) | 10 (10) | 13 (13) | 23 (23) | 12 (12) |
| Helpful | 32 (32) | 29 (29) | 25 (25) | 27 (27) | 26 (26) |
| Very helpful | 49 (49) | 48 (48) | 48 (48) | 18 (18) | 25 (25) |
| N/A | 0 | 2 (2) | 2 (2) | 4 (4) | 5 (5) |
| **Relatives (n=13)** | | | | | | |
|  | No data (%) | 1 (7.6) | 2 (15.3) | 1 (7.6) | 1 (7.6) | 1 (7.6) |
| Not helpful | 0 | 0 | 0 | 1 (7.6) | 1 (7.6) |
| Quite helpful | 0 | 0 | 1 (7.6) | 0 | 0 |
| Helpful | 0 | 1 (7.6) | 1 (7.6) | 3 (23) | 3 (23) |
| Very helpful | 12 (92.3) | 11(84.6) | 10 (76.9) | 8 (61.5) | 7 (53.8) |
| N/A | 0 | 0 | 0 | 0 | 1 (7.6) |
| **Staff (n=27)** | | | | | | |
|  | No data (%) | 0 | 1 (3.7) | 2 (7.4) | 0 | 2 (7.4) |
| Not helpful | 0 | 0 | 0 | 0 | 1 (3.7) |
| Quite helpful | 0 | 1 (3.7) | 0 | 1 (3.7) | 3 (11.1) |
| Helpful | 2 (7.4) | 4 (14.8) | 6 (22.2) | 6 (22.2) | 11 (40.7) |
| Very helpful | 25 (92.5) | 19 (70.3) | 17 (62.9) | 20 (74) | 8 (29.6) |
| N/A | 0 | 0 | 2 (7.4) | 0 | 2 (7.4) |

Table 4. Patient, relative and staff questionnaire ratings for NMT in five categories. N/A=not applicable.

Out of a total of 45 patient responses to ‘Did NMT help with anything else?’ the majority fell under the themes of ‘Movement:’19 (42%) and ‘Mood:’ 15 (33%) (Appendix 1).

Ten (43.4%) out of a total of 23 staff questionnaire comments fell under the theme of ‘Mood’ and seven (30%) under ‘Social’. Cognition, tolerance, adherence, and motivation were also themes arising (Appendix 2). Some staff comments suggested that more NMT would be beneficial for patients’ rehabilitation Appendix 3).

Eleven responses from relatives reported that NMT was helpful for patient mood and

speech, building a relative’s understanding of the effects of stroke (‘understanding the problem’) and confidence with their relative (Appendix 4).

Table 5 shows the Visual Analogue Mood Scale mean scores from the 52 patients who completed them, with confidence intervals and p values for each mood pre-/post-a single NMT session.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Pre-mean (SD) | Post-mean (SD) | Difference (95% CI) | Cohen’s d | p-value |
| Afraid | 51.3 (15.9) | 53.9 (16.1) | -2.6 (-7.5, 2.4) | 0.15 | p = 0.30 |
| Confused | 53.9 (15.5) | 52.9 (14.1) | 1.0 (-3.4, 5.4) | 0.06 | p = 0.64 |
| Sad | 61.5 (23.3) | 53.9 (14.4) | 7.5 (2.1, 12.9) | 0.39 | P = 0.007 |
| Angry | 58.0 (21.5) | 56.4 (19.4) | 1.6 (-3.9, 7.1) | 0.09 | p = 0.57 |
| Energetic | 42.3 (12.7) | 42.7 (12.9) | -0.4 (-3.6, 2.8) | 0.04 | p = 0.79 |
| Tired | 51.5 (11.5) | 54.2 (11.5) | -2.6 (-6.1, 0.8) | 0.21 | p = 0.13 |
| Happy | 40.1 (13.9) | 46.3 (12.4) | -6.2 (-11.0, -1.4) | 0.36 | p = 0.013 |
| Tense | 55.6 (18.0) | 52.7 (15.0) | 2.9 (-1.9, 7.8) | 0.17 | p = 0.23 |

Table 5. Visual Analogue Mood Scale means and p-values

# Use of iPads and touch screen instruments

iPads were not used by rehabilitation assistants to deliver exercises in the first year of the project. In the second year, five different rehabilitation assistants delivered 28 sessions to 11 patients over 10 months. In addition, two patients were able to use the touchscreen instruments independently. The average age of users was 22, including nine male and two female patients.

# Discussion

The questionnaire and VAMS data presented here are not from the full cohort of patients who received NMT on the wards. Questionnaire data are missing for 78 patients. This may be for a variety of reasons, such as cognitive difficulties, reduced availability of support to help collect the data, and patients being discharged before questionnaire completion. Bias may have been reduced in questionnaire ratings and comments, as these data were collected by staff other than the NMT. Referral rate, patient engagement and questionnaire data from patients, staff and relatives indicate that NMT was accepted and considered helpful for stroke rehabilitation and as part of the multidisciplinary team, alongside physiotherapy, occupational therapy, speech therapy and clinical psychology. Interdisciplinary joint sessions with NMT are reported to have helped clarify the referral route and mechanisms of the music-based interventions. The portability and variety of functions of the iPad enabled the rehabilitation assistants to facilitate more frequent practice for patients, which was overseen by the NMT. Using such technology to help increase treatment dosage merits further investigation. Results correspond with published literature reporting on the potential benefits of NMT in acute neurorehabilitation (2-8). VAMS showed non-significant positive changes, which corresponds with findings from NMT research (12-15) and questionnaire feedback from patients and staff that they felt there were benefits for mood (Tables 4 & 5).

There are several limitations to this study. We did not determine how questionnaire and mood data would differ from that of other disciplines within the multidisciplinary team, we only collected this data from patients attending NMT. The effects of the music-based exercises on functional outcomes were not established as treatment effects were not measured. There may be single site bias, so results cannot be generalised to other acute stroke settings. Some data on mood before and after clinical contacts were collected by the NMT, which may have either positively or negatively influenced patient responses.

Questionnaire ratings made by patients were more distributed between the categories (motivation/mood, concentration, etc) than those of relatives and staff (Table 4). This might be simply because patients had direct experience of the interventions, rather than being observers. It may also reflect their uncertainty about NMT and all outcomes regarding their rehabilitation, and their level of clinical knowledge. Staff, particularly multidisciplinary team members, may have more of a grasp of the mechanisms of the music interventions, because of their training and clinical experience, and so rated each domain more specifically in terms of how potentially effective each exercise might be. Speech therapists may have rated speech/communication more highly than ‘concentration’ simply because they were more frequently involved in individual sessions for speech/communication, due to the NMT using one of their treatment rooms. However, the author notes that they were also particularly interested in what music-based interventions might offer patients who were struggling to engage in rehabilitation due to the impact of stroke on cognition and mood. Physiotherapists observed and co-facilitated the sensorimotor group, and so saw the benefits for movement, particularly upper limb, trunk and pre-gait exercises. Relatives attended individual sessions predominantly, where they observed consistently good engagement, the cognitive demands of the exercise, and the benefits for sensorimotor rehabilitation.

VAMS data are missing for 125 patients predominantly because they were not cognitively able to complete them with or without assistance. This might constitute a further limitation to the study, as this mood scale is not recommended for assessing depression with patients who have aphasia or cognitive impairments, or within the first 12 months post-stroke (29). However, it was used here to measure intervention-related changes in mood after a single clinical contact. The VAMS ‘Sad’ category has been used to determine treatment effects of behavioural therapy (17) (mean = 9 sessions of 58 minutes). The cohort of stroke patients was not all acute, but at different stages post-stroke (mean = 9 months). Changes in mean scores were slightly different to those reported here (*n* = 44 completed treatment), with a larger score change of -11.65, and wider confidence intervals (95%) -22.30 to -0.99. The Dynamic Visual Analogue Mood Scale was not used, as it still requires testing for validity with a sufficient sample, at acute stage, including patients with aphasia and in the context of an intervention (30).

Speech therapists and physiotherapists on the wards felt that joint working allowed them to quickly gain an understanding of how NMT interventions could benefit patients and be delivered. The NMT attended meetings to demonstrate music-based exercises in the cognitive, communication and sensorimotor domains, which enabled the multidisciplinary team to identify which patients would be suitable for referral. Handover meetings with physiotherapy were held each week to ensure optimum quality of movement, fatigue management and alignment for each patient, in order to help achieve specific movement goals. Observing and co-facilitating NMT sessions sometimes assisted speech and language therapists in finding ways to deliver their interventions, as they could observe different mechanisms of a patient’s communicative intent during music-based exercises. They observed that the music and equipment stimulated arousal, awareness and attention levels in a particular way, functioning via non-verbal interactions, such as turn-taking and call and response using vocalisations or percussion. This enabled patients with significant cognitive difficulties and/or aphasia to understand and take part, without the need for verbal instruction. Speech therapists commented that the music-based exercises contributed towards some patients overcoming low mood and fatigue, thus increasing engagement in rehabilitation. These comments correspond with research findings reporting on the benefits on arousal and affect regulation, learning, activity-driven plasticity and possibly causing less fatigue (6,25,26). Where patients declined NMT sessions due to fatigue, this was not fatigue caused by the NMT exercises, but fatigue as a symptom of their stroke or head injury, which would also cause patients to decline sessions in other clinical areas, such as physiotherapy. Singing familiar songs and using songs as gap-fill exercises helped some patients with, for example aphasia, apraxia and/or dysarthria, experience moments of fluent output. Therapists observed this to be motivating for patients and relatives.

Whether NMT should become part of all acute stroke multidisciplinary rehabilitation depends on the evidence-base for interventions being deemed sufficient, and further investigation into the feasibility of NMT in different acute stroke settings. The current evidence-base for music-based interventions with acute stroke is quite small, although there is a greater body of evidence for interventions at sub-acute and community stage, as reported in a recent Cochrane review (31).

# Potential Use of Apps in Acute Stroke Rehabilitation

Apps that provide music-based interventions to improve finger dexterity might be deliverable by non-NMT staff in order to increase treatment dosage and improve outcomes for patients. Some research has shown that using keyboards helps to improve hand rehabilitation at acute stage (9), which could translate into using touchscreen keyboard apps. Touchscreen instruments on tablets have been used to improve finger dexterity following stroke; also using a touchscreen stylus (plectrum) for pinch grip, but this has been in home-based stroke rehabilitation, not acute (32). There is some case study data to support the use of touchscreen exercises using music apps within the first three months post-stroke (18), and at the acute stage (19), however both of these cases involved highly trained musicians, the latter also incorporating Functional Electrical Stimulation. Further research in this area, where the music-based apps are combined with those of other Allied Health Professionals (AHPs) within the multidisciplinary team, might help develop ways of enhancing treatment dosage cost effectively, in combination with face-to-face interventions delivered by a full team of clinicians at the recommended dosage. This could potentially lead to self-delivery of exercises by patients using apps, or delivery with spouse/relative. These exercises could also continue in the home post-discharge.

# The added value of NMT in acute stroke rehabilitation

Research into music-based exercises for upper limb hemiparesis on an acute ward improved arm function and were reported by patients as the highlight of their rehabilitation process; motivating and enjoyable (9). Two sessions of Melodic Intonation Therapy not only improved speech in patients with non-fluent aphasia, but may also have reduced frustration and risk of withdrawal from rehabilitation programmes (10). Stroke patients who listened to self-selected music every day for two months, made significantly better cognitive recovery than controls, also experiencing less depression and less confusion (12).

These are examples of the added value, or ‘other dimension’ (Appendix 2, comment No. 8), that music-based interventions might bring to multidisciplinary team rehabilitation on acute stroke wards. It could be that these exercises appear less clinical to patients. Yet, the exercises are goal-driven and of comparable structure when compared to those delivered by occupational, speech and physiotherapy, facilitating massed practice. The psychological effects and neural mechanisms of such interventions may share neural networks for activity-driven plasticity, including reward, arousal and affect regulation (6), which might lead to enhanced rehabilitation outcomes and quality of life for patients. They may also be less fatigue inducing than standard treatments and increase motivation (25, 26). Well-designed studies in the acute setting are warranted in order to try and determine the treatment effects and neural mechanisms of music-based interventions.

# Conclusion

This study measured the feasibility of delivering music-based interventions to patients on an acute stroke ward as part of multidisciplinary team rehabilitation. It also collected data to help determine acceptability of these interventions by patients, their relatives and stroke team clinicians. Based on patient engagement, number of sessions delivered, and questionnaire data, it is feasible to set-up a two-day NMT service within the multidisciplinary teams serving the ward. A similar service would need to be trialled on other acute stroke wards in order to establish whether it would be generalisable. Questionnaire data indicate that patients and relatives thought that NMT was helpful, possibly for mood, movement and concentration and in facilitating social interactions. Speech and language therapists observed the positive impact on arousal, engagement and mood as precursors to functional engagement. Neurologic Music Therapy was received enthusiastically by patients, their relatives and staff throughout the project.

This evaluation of the feasibility and acceptability of NMT in acute stroke rehabilitation, including the use of touchscreen instruments, provides some preliminary data that might support the development of research into treatment efficacy in this setting, comparing the interventions and patient engagement with those of other disciplines, and establishing potential effects on recovery rate and hospital length of stay.

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**Author contributions**

Service delivery and data analysis: Alex Street; helping with procedures in the acute inpatient setting: Helen Palmer; data collection and writing: Alex Street, Helen Palmer, Susan Pethers, Katie Bond and Lydia Wiffen; data analysis: Jufen Zhang

**Disclosure of Interest**

The authors report no conflict of interest.

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**Appendices**

|  |  |
| --- | --- |
| Did NMT help with anything else? | Themes |
| 1. I didn’t realise I had been playing for so long! | Tolerance and adherence |
| 1. It made exercises less boring and more interesting. Exercise time passed quickly | Tolerance and adherence |
| 1. Put in a good mood | Mood |
| 1. Movements, mood, coordination | Movement/mood |
| 1. Strength of UL (upper limb) | Movement |
| 1. Useful to be involved in group activities | Social |
| 1. Helpful getting people together who have the same problems | Social |
| 1. Helped to get brain into action, thinking about what to do | Cognition |
| 1. Helped me with my exercising as I had to go to the beat | Tolerance and adherence |
| 1. Gets me very motivated | Tolerance and adherence |
| 1. Helped with my movements | Movement |
| 1. I had to concentrate to stay on the beat | Cognition |
| 1. I did a lot of hand and arm movements using different instruments | Movement |
| 1. Control with wrist | Movement |
| 1. Improved confidence with legs | Movement |
| 1. Enjoy music | Mood |
| 1. Boosting morale | Mood |
| 1. Coordination | Movement |
| 1. Mood +++ | Mood |
| 1. Enjoyment | Mood |
| 1. Helped with coordination and concentration and working as a team | Movement/cognition/social |
| 1. Physical | Movement |
| 1. Mood enhancement | Mood |
| 1. Stimulation/coordination | Cognition/Movement |
| 1. Brings happiness, lift me up, brings childhood memories | Mood |
| 1. Nice to be doing it, enjoyed it | Mood |
| 1. Balance | Movement |
| 1. Confidence | Mood |
| 1. Enjoyment, nice way to spend time | Mood |
| 1. Tapping left foot, my hand and leg responding well | Movement |
| 1. Timing of movement | Movement |
| 1. Socializing | Social |
| 1. Coordination | Movement |
| 1. Coordination | Movement |
| 1. Strength/coordination | Movement |
| 1. Increased attention | Cognition |
| 1. Socialising | Social |
| 1. Brings my memories of my grandchildren | Cognition/mood |
| 1. Coordination | Movement |
| 1. Mood | Mood |
| 1. Helped with my mood | Mood |
| 1. Fun | Mood |
| 1. Rhythm produced encouraged physical activity for sure | Movement |
| 1. Mixing with other people | Social |
| 1. Got me active | Movement |

Appendix 1. Patient questionnaire responses to ‘Did NMT help with anything else?’

|  |  |
| --- | --- |
| Was NMT helpful in any other ways? | Themes |
| 1. A good way for patients to socialise and incorporate fun into therapy | Social/mood |
| 1. Patients with cognitive difficulties engaging in therapy sessions | Cognition/motivation |
| 1. Engaging patients where language alone has been unsuccessful in establishing meaningful interactions | Speech/cognition |
| 1. Feel like it's quite uplifting. Have been able to achieve some results not able to with speech therapy alone | Mood/speech |
| 1. Gives patients an event to look forward to and a chance to get off the ward. To observe a patient's communication/interactions in a different setting. To engage patients in therapy programmes if they have been reluctant to do so | Motivation |
| 1. Good joint activity with patients and their families at a different time. Helpful to guide speech and language therapy intervention. Relaxing for patients at a stressful time of their life | Social/mood |
| 1. Group session, getting patients to work together | Social |
| 1. It adds another dimension to multidisciplinary team working and has helped me to consider other ways of helping patients to improve their communication | Communication |
| 1. It has been fantastic to have NMT in the department. It has been fantastic to see the positive impact on patients' mood and the incredible work (name of therapist) has done with some of our patients who are unable to speak at all. I am unable to comment on the success of the work with arm/hand/movement as this is not my area, however it certainly seems to be making a huge difference | Mood |
| 1. Patient interaction, teamwork, male and female working together, otherwise separated on the ward. Brings back memories from previous work at school | Social |
| 1. Patients I've worked with have enjoyed the experience-promoted social communication by giving them a story/talking point to discuss with family/multidisciplinary team. Also think its good for building staff patient relationships/rapport as a joint activity | Social |
| 1. Patients look forward to it | Motivation |
| 1. Reminiscence therapy | Memory |
| 1. Very helpful with assisting in calming a patient who was extremely frustrated/tearful and assisted in distracting her | Mood |
| 1. Yes, patients' participation and entertainment that lift their mood and they look forward to joining the group | Mood |
| 1. Yes, supporting teamwork/cooperation | Interdisciplinary teamwork support |
| 1. Relating to mood-a good way to work on arm function while having fun | Mood/movement, tolerance and motivation |
| 1. As a diversion of mind | Mood |
| 1. Social interaction for the patient and also aids/supports physio for facilitating movement which we have been working on in our sessions | Social/movement |
| 1. Turn-taking, neglect, looking to the neglected side | Cognition |
| 1. Confidence building, motivation, quality of life, memory, communication, exercise and concentration stamina | Mood, cognition, social, movement, tolerance and adherence |
| 1. Helping patient to focus on rehab | Cognition, tolerance and adherence |
| 1. ++ useful in supporting patient mood | Mood |

Appendix 2. Staff questionnaire responses to ‘Was NMT helpful in any other ways?’

|  |  |
| --- | --- |
| Is there anything that was not helpful or that you would change about NMT within the multidisciplinary team? | Themes |
| Add a small keyboard? | Increase selection of equipment |  |
| I would want it to be more widely available | Increase NMT provision |  |
| It would be great to have more of it! It's a real shame that (name of therapist) is only able to be here 2 days per week | Increase NMT provision |  |
| It would be nice to have more of it so that there can be groups and patients can be seen more often | Increase NMT provision |  |
| More sessions, increase from two days per week | Increase NMT provision |  |
| To ensure we break down movements prior to music to help sessions progress. Think it is great and really works | Increase interdisciplinary working |  |
| We need more of it please | Increase NMT provision |  |
| I don’t think so, maybe more time if possible | Increase NMT provision |  |
| More NMT for patients and staff | Increase NMT provision |  |
| We need (name of NMT) to be here more often | Increase NMT provision |  |
| More music therapists. You make such a difference. Thank you. | Increase NMT provision |  |
| Maybe involve family members more | Working with relatives more |  |

Appendix 3. Staff questionnaire responses to ‘Is there anything that was not helpful or that you would change about NMT within the multidisciplinary team?

|  |  |
| --- | --- |
| Is there anything else that NMT helped with? | Themes |
| Confidence with (relative) | Confidence (for the relative) |
| Generally saw improvement in mood, very helpful with this | Patient mood |
| Yes, understanding the problem | Understanding the  effects of stroke |
| Wellbeing, mood | Patient mood |
| This is an amazing service that needs extending. Thank you. (Note attached to form) | Increasing NMT availability |
| Thank you (name of therapist) for your support, your fun, relaxed manner helped in difficult times | Coping |
| As the first tool to (name of relative) finding their voice we were thrilled, we continue to sing! | Speech |
| Good for mixing with other people | Social |
| Understanding the issues being faced (Name of therapist) explains things very well and seems to have a very good understanding of stroke rehabilitation | Understanding the effects of stroke |
| The Rhythmic patterns at the music sessions have really helped (relative) with their words and with forming sentences. Speech and (relative’s) confidence-memories back making them happy | Speech/confidence |
| Stimulation because so different | Stimulation |

Appendix 4. Relatives’ questionnaire responses to ‘Is there anything else that NMT helped with?’