Shortening the length of stay and mechanical ventilation time by using positive suggestions via MP3 players for ventilated patients

ADRIENN K. SZILÁGYI[1,5,*], CSABA DIÓSZEGHY[2], GÁBOR FRITÚZ[3], JÁNOS GÁL[3], KATALIN VARGA[4]

[1]Jahn Ferenc South-Pest Hospital, Anaesthesiology and Intensive Care Unit, Budapest, Hungary
[2]East Surrey Hospital, Emergency Department and ITU, Redhill, United Kingdom
[3]Department of Anaesthesiology and Intensive Therapy, Semmelweis University, Budapest, Hungary
[4]Department of Affective Psychology, Institute of Psychology, Eötvös Loránd University, Budapest, Hungary
[5]Doctoral School of Psychology, Behavioral Science Program, Eötvös Loránd University, Budapest, Hungary
*Corresponding author: Adrienn K. Szilágyi, Jahn Ferenc South-Pest Hospital, Köves u. 1, H-1204 Budapest, Hungary;
Mailing address: ELTE PPK Affektív Pszichológia Tanszék, Izabella utca 46, H-1064 Budapest, Hungary;
Phone: +36 (20) 476-0242; E-mail: szilidri@yahoo.com

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Abstract: Long stay in intensive care unit (ICU) and prolonged ventilation are deleterious for subsequent quality of life and surcharge financial capacity. We have already demonstrated the beneficial effects of using suggestive communication on recovery time during intensive care. The aim of our present study was to prove the same effects with standardized positive suggestive message delivered by an MP3 player. Patients ventilated in ICU were randomized into a control group receiving standard ICU treatment and two groups with a standardized pre-recorded material delivered via headphones: a suggestive message about safety, self-control, and recovery for the study group and a relaxing music for the music group. Groups were similar in terms of age, gender, and mortality, but the SAPS II scores were higher in the study group than that in the controls (57.8 ± 23.6 vs. 30.1 ± 15.5 and 33.7 ± 17.4). Our *post-hoc* analysis results showed that the length of ICU stay (134.2 ± 73.3 vs. 314.2 ± 178.4 h) and the time spent on ventilator (85.2 ± 34.9 vs. 232.0 ± 165.6 h) were significantly shorter in the study group compared to the unified control. The advantage of the structured positive suggestive message was proven against both music and control groups.

Keywords: intensive therapy, mechanical ventilation, length of stay in ICU, positive suggestions, psychological support, cost effectiveness

Introduction

The goal of intensive care is to recover and to temporarily replace vital functions of critically ill patients [1] in order to achieve the best possible quality of life (QoL) after recovery. However, the longer the intensive care unit (ICU) treatment, the worse the quality of life expected [2] as it gives ground to physical and psychological deteriorations: the chances of complications increase [3], and the patient is more likely to encounter psychologically traumatic experiences which have well-described negative effects on the QoL [4, 5]. All of these increase the risk of post-traumatic stress disorder which puts further physical and psychological burdens on the patient, their families, and on health care expenses.

ICU treatment is an extreme psychological stress source causing physical burden, too. Patients may suddenly find themselves in an unfamiliar environment where they miss their usual confidence helping them to understand the things perceived. The difficulty in ordering perceptions into a normal pattern may lead to ICU-psychosis, which is a well-known complication of intensive care [6]. However, even without these problems, patients may develop learned helplessness [7] as a result of the deprivation of the ability to control even basic physiological needs during intensive care. Humans or animals who have learned to behave helplessly will not be able to use help or to change their inactive behavior to an active one, either they could change their conditions or they could avoid some unpleasant circum-

stance. Learned helplessness will prevent patients from being active and cooperating with the health care team during their recovery phase when it would be so indispensable. Consequently, the physical symptoms persist longer, and the recovery or weaning from the ventilator takes much longer and greater effort [8, 9, 10].

Our team led by Katalin Varga and Csaba Diószeghy has developed a method of psychological support based on positive suggestions delivered to patients during their acute critical care phase [9, 11, 12, 13] with the aim of making their recovery faster by providing psychological support along with the standard intensive care.

One of our previous studies has demonstrated the benefits of a psychologist working as a member of the intensive care team [14]; our goal with this study was to get further evidence of the effects of psychological support based on positive suggestions given to ventilated patients in the ICU. Our hypothesis was that positive suggestions make weaning from mechanical ventilation easier even if they come from an MP3 player as a standardized text. Meta-analysis about suggestions used during general anesthesia has shown that recorded suggestions and hypnotic techniques are as effective as live intervention [15, 16]. With a positive reframing of the situation, positive suggestions also provide a feeling of security and peace which may lead to enhanced cooperation with caregivers and later to a better quality of life.

Background and Aims of the Study

It is an evolutionarily fixed, adaptive, and vital need of humans to feel belong to a group. The group increases the chance of survival by protection and by group cooperation. An alien group which the person does not belong to, however, means a source of threat [17, 18, 19].

As we pointed out elsewhere [20], patients finding themselves in the ICU lose almost all points of reference and therefore may interpret the staff carrying out incomprehensible and painful interventions as a hostile group; consequently, these patients will be scared, will try to escape, or will show hostility toward the staff. The staff has to make the patients feel that they are *part of the care team* and that they have a task, a role, a place. Their tasks are to recover, to rest, to cooperate, and to realize that the care team and all the equipment are here to support their recovery. Once this has been achieved, the patient may no longer feel being in danger in a defenseless position, but instead feel protected in a safe environment where he or she can feel secure and in peace and thus ready for cooperation.

We used a structured positive suggestive communication procedure delivered by a psychologist as a part of the ICU care team to randomly selected ICU patients to achieve this goal. Our previous results suggested that both the length of ICU stay and the time spent on the ventilator can be reduced significantly [14].

Our current study investigates the effect of a similar approach – delivery of positive suggestions to ventilated patients in ICU – in a slightly different way. Instead of personalized messages given by a psychologist, we used a pre-recorded standard text delivered via the earphones of a simple MP3 player.

The text aims to support and encourage the feeling of belonging to the group. Our hypothesis (the "evolutionary theory") was that if this psychological need was satisfied, the length of recovery would be reduced by preventing those complications which are usually the consequences of learned helplessness and other negative psychological effects developing due to the intensive care environment [20].

The text on the MP3 player is different from the semi-standard live suggestions used in 2006 [11, 21] at many points, and most importantly, it is a standard pre-recorded text, so everyone receives the same stimulus.

To evaluate the effect of this text given by the MP3 player without the bias of additional and unintentional effects (e.g., personal care by attaching the earphones, reduced ambient sounds due to earphones, etc.) and also to ensure the double blind design of the study, we introduced a control group who had the same type of MP3 player, but which played only relaxing music for the same length of time and pattern. Besides this control group, a "traditional" control group (with the usual care without MP3 players) was also used.

Considering the beneficial effects of music on the immune system [22, 23, 24], the musical control could in fact be the comparative study of the efficiency of another method deemed to be efficient in stress-reduction and healing. This way, we can examine whether suggestions offer anything extra compared to the already known methods (e.g., music).

Methods

Between 1 March and 20 June 2011, a prospective randomized clinical study was performed at the ICU of the Department of Anesthesiology and Intensive Therapy of Semmelweis University, Budapest, Hungary. Ventilated patients admitted to the unit were randomized into suggestion, musical control, or traditional control groups. The selected patients received mechanical ventilation, were above 18 years of age, had unimpaired hearing, and did not suffer from serious psychiatric condition. We analyzed the data of only those patients who were weaned off from the ventilator before discharge and excluded those transferred to other ICU before being weaned off. Therefore, two patients were omitted from final analysis for being transferred to another unit while still on ventilator. One of the patients turned out to have a

more severe hearing disability than originally suspected; therefore, we had to exclude this patient from the final analysis, too.

The study was authorized by Semmelweis University Regional and Institutional Committee of Science and Research Ethics (ref. No. 31/2011). The informed consent was given and signed by the patient or, if that was not possible (due to unconsciousness), by the main caregiver (next of kin) or legal guardian.

The study *(suggestion) group* was exposed to a 30-minute long pre-recorded structured text, spoken by a female voice, once a day. The text contained positive suggestions toward the safety of the environment and the care group, the opportunity to cooperate actively and enhance recovery while receiving the standard ICU treatment. This was based on earlier works of our team [9, 10, 25] and on the results of other authors working with positive suggestions [26].

Each member of this group received the same text on each day of his/her treatment (being ventilated or not).

Some examples from the text:

"And as you can see the signs of your recovery – the movement of tubes, machines, equipment all centered on you, you will realize that everything that happens is happening for you, so that your recovery is supported even more efficiently."

"And you are often filled with a good feeling. The way people are working around you, working for you is pleasant. It is a good feeling to be so important in this team."

"And then you realize that to request something from your body is an utterly natural idea. For all your cells are working for you. It is not only the part of their job, it is the very purpose. Everything happens for you."

The members of the *music group* listened to a 30-min relaxing selection of Vladimir Ashkenazy's album, *Favourite Mozart*, while receiving the standard ICU treatment.

The "traditional" *control group* received the usual ICU care with no additional psychological support.

The MP3 players were coded, so it was impossible to know during the study which patient listened to which record. Accordingly, the same protocol was applied to the music group, and the following was said to them before starting the player: *"Good morning! I am here to put these earphones on you so that what you will hear in them also helps you in your recovery."* This sentence in itself is suitable for attributing a positive, recovery-related meaning to the following stimulus, and thus it has a positive suggested effect in itself. However, we did not deem it ethically feasible to put the earphones on the patients in a neutral way without any comment.

All other intensive care interventions and medications were delivered according to the rules of the profession.

We used the age, sex, and the new Simplified Acute Physiology Score (SAPS II) [27] to ensure the homogeneity of the groups. The Ramsey Sedation Scale was recorded regularly as well. This enabled us to analyze the effects of our interventions on patients with different level of consciousness.

The requirements of sedation-analgesia (opioids, propofol and benzodiazepines – including alprazolam, clonazepam, diazepam) [28] were also recorded, unless part of regular (at home) prescriptions, in order to assess the effects of the interventions on these medications.

Sedative medication was applied according to the local protocol based on the Ramsey Sedation Scale. The amount of medication required during ventilation and during the whole length of stay was observed separately, and a daily average consumption was analyzed.

We recorded the length of stay (LOS) in the ICU in hours, the length of mechanical ventilation (MVH) in hours, and mortality.

A total of 39 patients were randomized into the study. The primary end point was discharge from the ICU or death.

The earphones were put on the patients every day, irrespective of their state of consciousness and physical state, unless they refused it. Patients who rejected the headphones on three consecutive days or said at any time that they did not wish to have them any more were analyzed later as members of the *"rejecter" group*. Three patients rejected the music; six patients rejected the suggestion text. The length of stay of two patients in the control group was extremely long (837 and 853 h, respectively), so they were omitted from analysis in order to avoid possible distorting effects. Two patients in the control group, three patients in the music group, three patients in the suggestion group, and one patient in the rejecter group were ventilated for less than 48 h. In order to be comparable to previous studies in the literature, these patients were also omitted from analysis. According to the above, patients who were ventilated for 48 to 600 h were included in the final analysis.

Data were processed with SPSS v. 17.00 package. The comparison of the groups was performed with independent samples *t*-test and analysis of variance (ANOVA). Significance of differences was calculated as well as effect size by Cohen's *d*.

Descriptive statistics of the whole sample can be seen in *Table I.*

Results

Out of 39 patients initially randomized to the study between 1 March, and 20 June 2011, 26 patients could be included in the final analysis: six in the *control*, six in the *music*, six in the *suggestion*, and eight in the *rejecter* groups.

Table I Descriptive statistics of the whole sample

Variable	Group	*N*	Mean	*SD*
Age	Control	6	60.00	19.30
	Music	6	63.83	17.42
	Suggestion	6	71.16	16.36
	Rejecter	8	66.12	16.26
	Total	26	65.34	16.69
SAPS%	Control	6	30.13	15.56
	Music	5	32.62	22.07
	Suggestion	6	57.81	23.65
	Rejecter	8	33.72	17.43
	Total	25	38.42	21.50
LOS	Control	6	315.10	210.61
	Music	6	187.75	108.19
	Suggestion	6	134.24	73.33
	Rejecter	8	313.62	165.59
	Total	26	243.52	162.42
MVH	Control	6	256.75	178.63
	Music	6	135.33	96.09
	Suggestion	6	85.25	34.92
	Rejecter	8	213.47	164.97
	Total	26	175.83	143.11
Ramsey – MV	Control	6	3.44	1.12
	Music	6	3.35	2.01
	Suggestion	6	3.77	2.19
	Rejecter	7	2.94	1.16
	Total	25	3.36	1.59
Ramsey – Sum	Control	6	3.16	1.24
	Music	6	3.25	2.02
	Suggestion	6	3.80	2.02
	Rejecter	7	2.56	1.10
	Total	25	3.17	1.59
Opioid – MV/day	Control	6	12.58	28.56
	Music	5	4.72	4.65
	Suggestion	6	2.34	2.51
	Rejecter	8	27.89	71.78
	Total	25	13.45	42.35
Opioid – Total/day	Control	6	7.33	16.25
	Music	5	6.95	7.82
	Suggestion	6	1.69	1.58
	Rejecter	8	11.30	27.21
	Total	25	7.17	17.17
BZD – MV/day	Control	6	1.92	1.45
	Music	5	15.70	10.10
	Suggestion	6	0.00	0.00
	Rejecter	8	5.00	7.81
	Total	25	5.20	8.23

Table I *(continued)*

Variable	Group	*N*	Mean	*SD*
BZD – Total/day	Control	6	2.15	1.38
	Music	5	14.03	10.28
	Suggestion	6	0.00	0.00
	Rejecter	8	2.43	3.13
	Total	25	4.10	6.89

Abbreviations: Age: Age of patients (year); SAPS%: Percent of predicted death rate; LOS: Length of stay in intensive care unit (hours); MVH: Length of mechanical ventilation (hours); Ramsey – MV: Score of Ramsey Sedation Scale during mechanical ventilation (scores 1–6); Ramsey – Sum: Score of Ramsey Sedation Scale during the whole length of stay (scores 1–6); Opioid – Mv/day: Opioid requirement per day during mechanical ventilation (mg/day); Opioid – Total/day: Opioid requirement per day during the whole length of stay (mg/day); BZD – MV/day: Benzodiazepine requirement per day during mechanical ventilation (mg/day); BZD – Total/day: Benzodiazepine requirement per day during the whole length of stay (mg/day)

Gender

Of 26 analyzed patients, 19 were males and 7 females (control group: 4 males, 2 females, music group: 4 males, 2 females, suggestion group: 5 males, 1 female, rejecter group: 6 males, 2 females). Thus, division by gender was not relevant.

Describing clinical conditions – Scores

The ages of patients were not statistically different among the groups *(Table I)*.

The SAPS II percent of the suggestion group averaged 57.8 (*SD:* 23.6), which was significantly higher than the SAPS II percent of the control group (average: 30.1, *SD:* 15.5) and that of the rejecter group (average: 33.7, *SD:* 17.4) (see *Fig. 1*). Theoretically, it means that patients randomized to the intervention (suggestion) group were in worse conditions; therefore, longer recovery times, ventilation times, and perhaps a higher mortality rate could be expected in their cases.

The Ramsay scores were not statistically different among the groups either during ventilation or during the whole length of stay *(Table I)*. The Ramsay scores of the whole sample averaged 3.36 (*SD:* 1.59) and 3.17 (*SD:* 1.59) during mechanical ventilation and the whole length of stay, respectively.

Medication

There was no difference in opiate and propofol requirement between groups *(Table I)*.

The music group required significantly higher doses of benzodiazepines during the ICU care than any other group during both mechanical ventilation and the whole length of stay (see *Table I* and *Fig. 2*).

Members of the suggestion group required significantly lower doses of benzodiazepines than the music or control groups during both mechanical ventilation

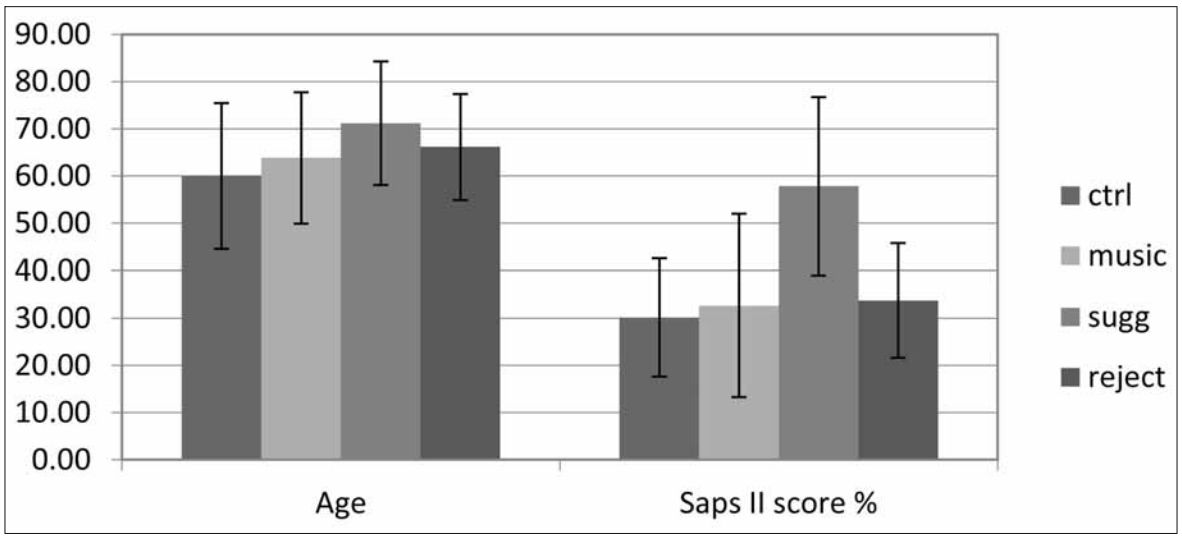

Fig. 1. The SAPS II score of the suggestion group was significantly ($p < 0.04$) higher than that of the control group

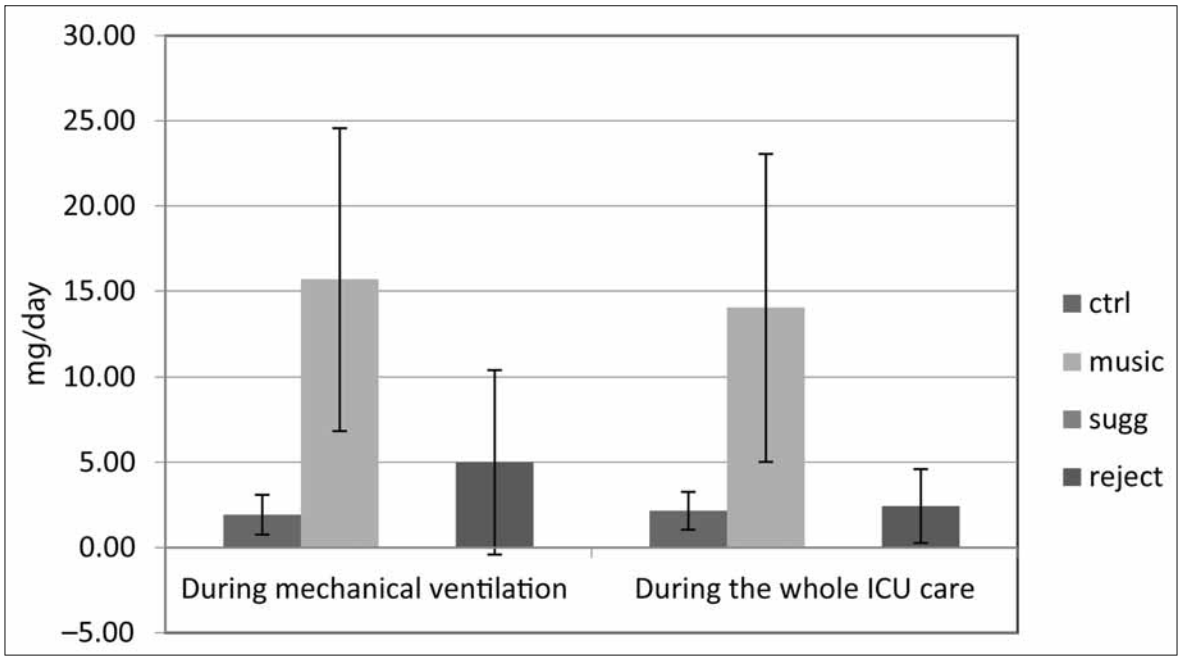

Fig. 2. The suggestion group required significantly lower doses of benzodiazepines than any other group ($p < 0.01$). The music group required significantly higher doses of benzodiazepines than any other group ($p < 0.02$)

and the whole length of stay. During the whole length of stay, this requirement was also less than the requirement of the group of rejecters; this difference, however, reached only the tendency level of statistical significance.

Length of mechanical ventilation

The suggestion group had significantly shorter mechanical ventilation (85.25 h, *SD:* 34.92) compared to the control (256.75 h, *SD:* 178.63) and the rejecter groups (213.47 h, *SD:* 164.97), in spite of the fact that their SAPS II scores were significantly higher. Even though the differences in both cases reached only the level of tendency ($p < 0.06$), Cohen's d showed a huge effect size ($d = 1.46$) compared to the control group with a 171.5-h difference, and a large effect size ($d = 1.08$) with a 128.2-h difference compared to the rejecter group (see *Fig. 3* and *Table II*).

Length of stay in ICU

The suggestion group had significantly shorter length of stay (134.24 h, *SD:* 73.33) compared to the control (315.1 h, *SD:* 210.61) and the rejecter groups (313.62 h, *SD:* 165.59), again in spite of their higher SAPS II scores. The effect sizes are very large both in the case of the 180.8-h difference as compared to the control group ($d = 1.26$, while $p < 0.07$ is only a tendency level) and in the case of a 179.3-h difference as compared to the rejecter group ($d = 1.43$, where the difference is statistically significant at the $p < 0.03$ level) (see *Fig. 4* and *Table II*).

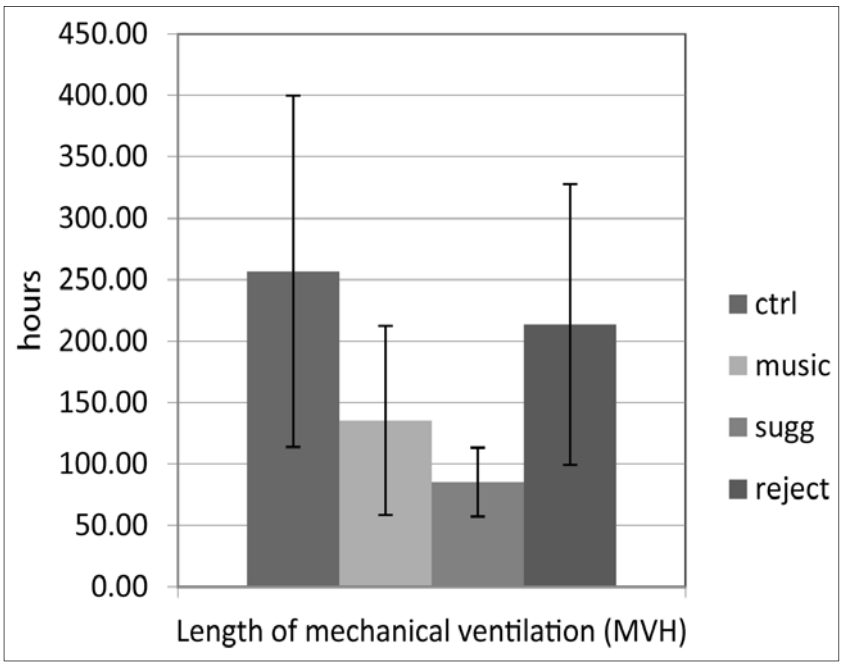

Fig. 3. The suggestion group received 7 days less mechanical ventilation than the control ($p < 0.06$) and 5.3 days shorter than the rejector group ($p < 0.06$). Cohen's d shows a huge effect size between the control and suggestion groups

Table II *t*-Test results (significant values are in bold)

Groups	Variable	Mean difference	Standard error difference	*p*	Cohen's *d*[1]	Percent change (increase/ decrease)[2]
Control ($N = 6$) vs. Music ($N = 6$)	BZD mv/day	–13.78	4.1	**0.009**	**2.23**	–88
	BZD total/day	–11.87	4.6	0.061	**1.9**	–85
Control ($N = 6$) vs. Suggestion ($N = 6$)	SAPS II %	–27.68	11.5	**0.038**	**1.51**	–48
	LOS	180.80	91.0	0.075	1.26	135
	MVH	171.50	74.3	0.065	**1.46**	201
	BZD mv/day	1.92	0.6	**0.009**	**2.05**	Zero
	BZD total/day	2.15	0.5	**0.012**	**2.41**	Zero
Control ($N = 6$) vs. Rejecter ($N = 8$)	(None)					
Music ($N = 6$) vs. Rejecter ($N = 8$)	BZD mv/day	10.70	5.0	0.054	1.34	214
	BZD total/day	11.60	4.7	0.064	**1.89**	477
Suggestion ($N = 6$) vs. Rejecter ($N = 8$)	SAPS II %	24	10.9	**0.048**	1.28	71
	LOS	–179.37	72.9	**0.03**	1.43	–57
	MVH	–128.21	60	0.66	1.08	–60
	BZD total/day	–2.43	1.1	0.064	1.1	–100
Music ($N = 6$) vs. Suggestion ($N = 6$)	BZD mv/day	15.70	4.5	**0.026**	**2.58**	Zero
	BZD total/day	14.03	4.6	**0.038**	**2.26**	Zero

Abbreviations: BZD – mv/day: Benzodiazepine consumed per day while mechanically ventilated (mg/day); BZD – Total/day: Benzodiazepine consumed per day during the whole length of stay in ICU (mg/day); SAPS II %: New Simplified Acute Physiologic Score; LOS: Length of stay in intensive care unit (hours); MVH: Length of mechanical ventilation (hours).
[1]Relative effect sizes of Cohen's *d:* negligible effect (≥ –0.15 and < 0.15); small effect (≥ 0.15 and < 0.40); medium effect (≥ 0.40 and < 0.75); large effect (≥ 0.75 and < 1.10); very large effect (≥ 1.10 and < 1.45); huge effect > 1.45.
[2]Relative sizes of percent change (from comparison to treatment): huge decrease < –75; very large decrease (≤ –50 and > 75); large decrease (≤ –30 and > –50); medium decrease (≤ –15 and > –30); small decrease (≤ –5 and > –15); negligible change (≥ –5 and < 5); small increase (≥ 5 and < 15); medium increase (≥ 15 and < 30); large increase (≥ 30 and < 50); very large increase (≥ 50 and < 75); huge increase > 75

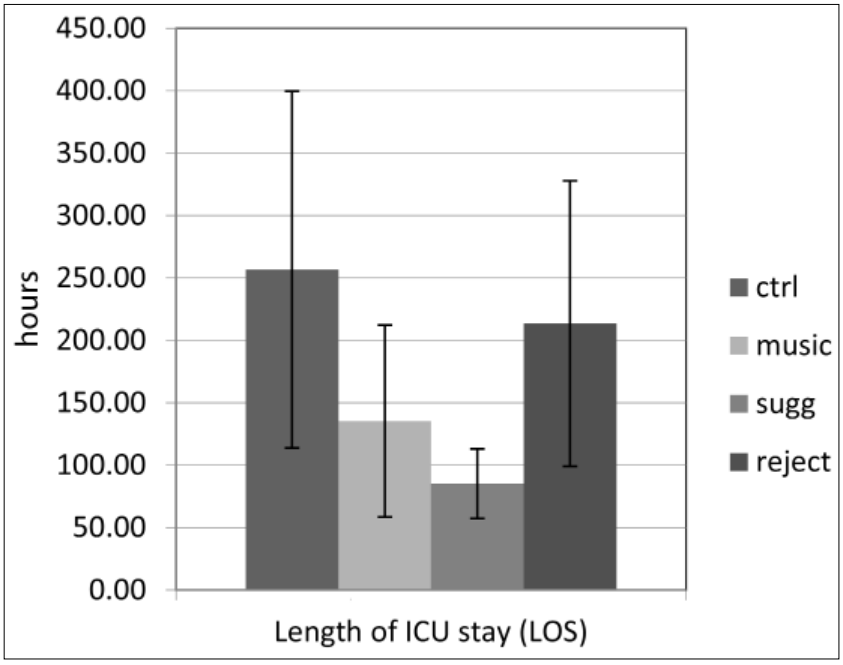

Fig. 4. The suggestion group had 7.5 days shorter length of stay in ICU than the control ($p < 0.09$) and the rejecter ($p < 0.02$) groups. Cohen's *d* shows a very large effect size

Mortality

Three patients died and three survived in both the intervention (suggestion) and the music groups, and five died in the rejecter group, but this difference was not significant statistically (Chi-square: 1.077, $p < 0.993$).

In conclusion, there was no difference in mortality among the groups.

Post-hoc *analysis*

As no statistical difference was found between the control and the rejecter groups, and as the two groups were identical according to our theoretical approach as well (i.e., groups of ICU patients given no support or accepting no support), the two groups were combined into a *unified control group.*

Table III ‖ Descriptive statistics of the whole sample

Variable	Group	*N*	Mean	*SD*
Age	Unified Control	14	63.50	17.19
	Music	6	63.83	17.42
	Suggestion	6	71.16	16.36
	Total	26	65.34	16.69
SAPS%	Unified Control	14	32.18	16.13
	Music	5	32.62	22.07
	Suggestion	6	57.81	23.65
	Total	25	38.42	21.50
LOS	Unified Control	14	314.25	178.40
	Music	6	187.75	108.19
	Suggestion	6	134.24	73.33
	Total	26	243.52	162.42
MVH	Unified Control	14	232.02	165.60
	Music	6	135.33	96.09
	Suggestion	6	85.25	34.92
	Total	26	175.83	143.11
Ramsey – MV	Unified Control	13	3.17	1.12
	Music	6	3.35	2.01
	Suggestion	6	3.77	2.19
	Total	25	3.36	1.59
Ramsey – Total	Unified Control	13	2.84	1.16
	Music	6	3.25	2.02
	Suggestion	6	3.80	2.02
	Total	25	3.17	1.59
Opioid – MV/day	Unified Control	14	21.33	56.12
	Music	5	4.72	4.65
	Suggestion	6	2.34	2.51
	Total	25	13.45	42.35
Opioid – Total/day	Unified Control	14	9.60	22.46
	Music	5	6.95	7.82
	Suggestion	6	1.69	1.58
	Total	25	7.17	17.17
BZD – MV/day	Unified Control	14	3.68	6.01
	Music	5	15.70	10.10
	Suggestion	6	0.00	0.00
	Total	25	5.20	8.23
BZD – Total/day	Unified Control	14	2.31	2.46
	Music	5	14.03	10.28
	Suggestion	6	0.00	0.00
	Total	25	4.10	6.89

Abbreviations: Age: Age of patients (year); SAPS%: Percent of predicted death rate; LOS: Length of stay in intensive care unit (hours); MVH: Length of mechanical ventilation (hours); Ramsey – MV: Score of Ramsey Sedation Scale during mechanical ventilation (score 1–6); Ramsey – Sum: Score of Ramsey Sedation Scale during the whole length of stay (scores 1–6); Opioid – Mv/day: Opioid requirement per day during mechanical ventilation (mg/day); Opioid – Total/day: Opioid requirement per day during the whole length of stay (mg/day); BZD – MV/day: Benzodiazepine requirement per day during mechanical ventilation (mg/day); BZD – Total/day: Benzodiazepine requirement per day during the whole length of stay (mg/day)

Table IV *t*-Test results in the *post-hoc* analysis (significant values are in bold)

Groups	Variable	Mean difference	Standard error difference	*p*	Cohen's *d*[1]	Percent change (increase/ decrease)[2]
Unified Control (*N* = 14) vs. Music (*N* = 6)	BZD vh/day	–12.02	3.7	**0.005**	**1.77**	–77
	BZD total/day	–11.72	4.6	0.063	**2.28**	–84
Unified Control (*N* = 14) vs. Suggestion (*N* = 6)	SAPS II %	–25.63	9.0	**0.011**	**1.46**	–44
	LOS	180.01	56.3	**0.005**	1.21	134
	MVH	146.70	46.5	**0.006**	**1.09**	172
	BZD vh/day	3.68	1.6	**0.039**	**0.76**	Zero
	BZD total/day	2.31	0.6	**0.004**	**1.16**	Zero
Music (*N* = 6) vs. Suggestion (*N* = 6)	BZD vh/day	15.70	4.5	**0.026**	**2.58**	Zero
	BZD total/day	14.03	4.6	**0.038**	**2.26**	Zero

Abbreviations: BZD – vh/day: Benzodiazepine consumed per day while mechanically ventilated (mg/day); BZD – Total/day: Benzodiazepine consumed per day during the whole length of stay in ICU (mg/day); SAPS II%: New Simplified Acute Physiologic Score; LOS: Length of stay in intensive care unit (hours); MVH: Length of mechanical ventilation (hours); Unified Control = Control + Rejecter.
[1]Relative effect sizes of Cohen's *d:* negligible effect (≥ –0.15 and < 0.15); small effect (≥ 0.15 and < 0.40); medium effect (≥ 0.40 and < 0.75); large effect (≥ 0.75 and < 1.10); very large effect (≥ 1.10 and < 1.45); huge effect > 1.45.
[2]Relative sizes of percent change (from comparison to treatment): huge decrease < –75; very large decrease (≤ –50 and > –75); large decrease (≤ –30 and > –50); medium decrease (≤ –15 and > –30); small decrease (≤ –5 and > –15); negligible change (≥ –5 and < 5); small increase (≥ 5 and < 15); medium increase (≥ 15 and < 30); large increase (≥ 30 and < 50); very large increase (≥ 50 and < 75); huge increase > 75

The unification of the groups was particularly justified because although there seemed to be only a tendency level differences statistically, Cohen's *d* showed a huge difference in effect size.

Naturally, if there is no statistically significant difference, effect size can also be zero, but for that very reason, it is worth to see what we could find behind these results factually.

The music and suggestion groups cannot be unified because of the statistical differences between them at several points and because the two groups were exposed to different stimuli.

The descriptive statistics of the *post-hoc* analysis with the unified control group are shown in *Table III*, while the results of the *post-hoc* analysis are presented in *Table IV*. As can be seen, benzodiazepine consumption of the music group (15.7 mg/day, *SD:* 10.1) was significantly higher ($p < 0.005$) than that of the unified control group (3.68 mg/day, *SD:* 6.0); this difference also had a huge effect size ($d = 1.77$). When we

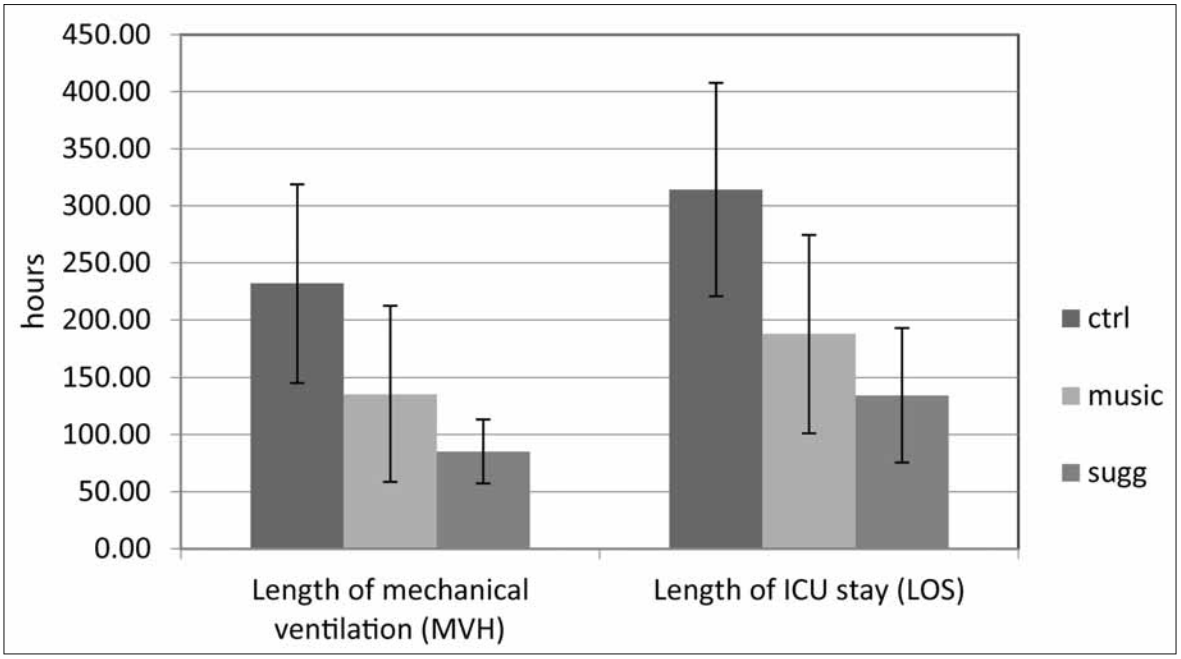

Fig. 5. The suggestion group had six days shorter mechanical ventilation ($p < 0.006$) and 7.5 days shorter length of stay in ICU ($p < 0.005$) than the unified control group. Cohen's *d* shows large and very large effect sizes

compared the suggestion group to the unified control group, the level of significance became higher and the effect size of the 25% SAPS II differences become larger (d = 1.46).

The difference in benzodiazepine consumption between the suggestion and unified control groups is invariably significant (3.68 mg/day while mechanically ventilated, $p < 0.039$; and 2.31 mg/day during the whole length of stay in ICU, $p < 0.004$), and the effect sizes are large (d = 0.76 and d = 1.16, respectively) (see *Fig. 7* and *Table IV*).

The differences in the length of mechanical ventilation and in the length of stay are really essential. The difference in the time of ventilation between the unified control and the suggestion groups was 146.7 h, which is 6.1 days ($p < 0.006$, with a large effect size: d = 1.09). The difference in the length of stay was 180.1 h, which is 7.5 days shorter in the suggestion group, which is also significant at the $p < 0.005$ level, with a very large effect size (d = 1.21) (see *Fig. 5* and *Table IV*).

Discussion

The first prospective, randomized, multicentered, controlled effect study of the method was conducted in 2006 [11]. In that study, the control group received traditional ICU care; the members of the intervention (suggestion) group received a 20-min conversation with positive suggestions, independent of their condition and state of consciousness. The ages and SAPS II scores of the two groups were balanced. The study demonstrated the beneficial effect of this intervention both on the length of stay and the length of mechanical ventilation. The suggestion group could be weaned off from the ventilator 3.6 days earlier ($p < 0.014$) and were discharged from the ICU 4.2 days earlier ($p < 0.02$), which meant a 30–40% shorter length of stay [14, 21].

We consider positive suggestions as a method of helping ventilated patients regain their confidence in the safety of the ICU environment and the care team and as a means of supporting them in developing a positive at-

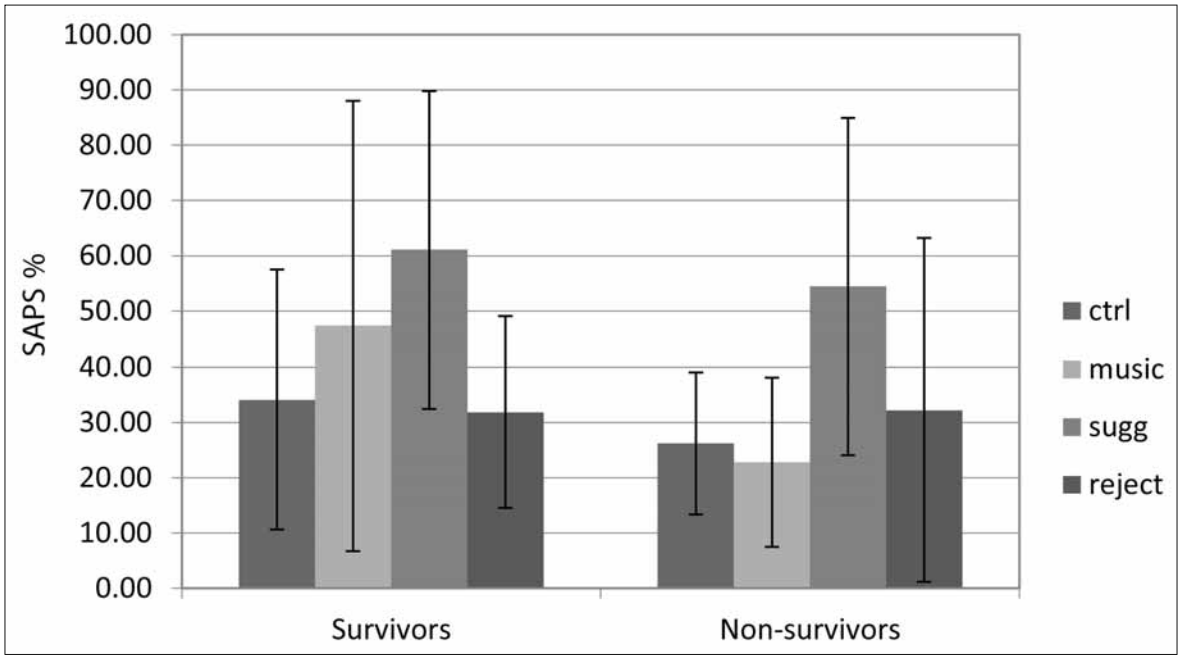

Fig. 6. Due to the low number of subjects no statistical difference could be demonstrated

Table V The length of mechanical ventilation and stay on ICU of survivors and patients who died in the different groups

Variable	Group	Survivors		Deceased	
		Mean	*SD*	Mean	*SD*
MVH	Suggestion	88	22	82	50
	Control	201	152	312	217
	Rejecter	143	93	330	212
LOS	Suggestion	186	53	82	50
	Control	260	117	370	297
	Rejecter	302	159	333	211

Abbreviations: MVH: Length of mechanical ventilation (hours); LOS: Length of stay in intensive care unit (hours)

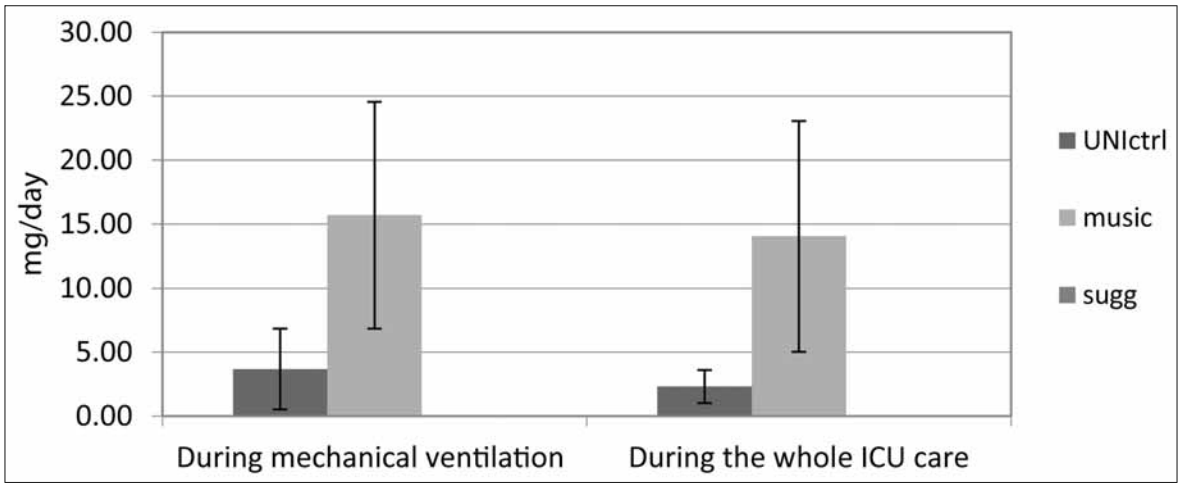

Fig. 7. Benzodiazepine requirement per day in mg with the unified control (UNIctrl) group. The suggestion group required significantly lower doses of benzodiazepines than the unified control and the music groups. The music group required significantly higher doses of benzodiazepines than any other group

titude toward their recovery and an active contribution to their own care.

In this study, the efficiency of a standard psychological guidance based on positive suggestions via MP3 players with ventilated patients was demonstrated. As compared to those patients who did not receive this supportive intervention, the length of stay was shorter (by 6 days on average) in spite of the fact that while their ages and Ramsay scores were balanced, the SAPS II scores of the suggestion group were significantly higher.

The survivors of the suggestion group had higher SAPS II scores compared to the survivors of the other groups (see *Fig. 6*), while the length of ventilation and length of ICU stay were still shorter compared to the survivors of the other groups (see in *Table V*). Fifty percent of our patients, admitted to the ICU and ventilated for more than 48 h, died. Considering the length of stay and mechanical ventilation of the patients who died, it can be seen that while these times were short in the suggestion group (LOS: 82.55 h, *SD:* 50.57, MVH: 82.55 h, *SD:* 50.57), they were longer in the control (LOS: 369.72 h, *SD:* 297.18, MVH: 312.38 h, *SD:* 217.42) and rejecter groups (LOS: 332.99 h, *SD:* 211.24, MVH: 330.3 h, *SD:* 212.13). Here, due to the small number of subjects, no statistical difference could be demonstrated among the various groups of the deceased patients. Nevertheless, in our previous study in 2006 [11, 14], we received the same, but statistically significant results with a higher number of subjects. Considering the above, we may conclude that the supplementary treatment based on positive suggestions helped patients with the potential to survive, and to recover faster, but the results may also suggest that patients who were not to survive had a shorter and perhaps therefore less stressful time on the ventilator before they passed away. If we could manage to make the unavoidable dying process shorter and hopefully more peaceful, this would be beneficial for the patients, the relatives and the health care system alike.

Benzodiazepine requirement during the ICU treatment of the suggestion group was significantly lower (actually, they did not require any benzodiazepine), while the unified control group required 3.68 mg/day (*SD:* 6) during ventilation and 2.31 mg/day (*SD:* 2.4) after successful weaning; the music group required an average of 14.86 mg (*SD:* 10.1) benzodiazepine on each day of their treatment. It is important to emphasize that the MP3 sets (devices) were coded, so it was impossible to distinguish the music group from the suggestion group either by the staff or the psychology students who put the earphones on the patients. So this lower requirement of benzodiazepine may be a sign of peace and cooperation in the suggestion group during treatment as well.

In the meantime, the music group required significantly more sedatives than any other group during their ICU stay. This might suggest the need of a more careful selection of the musical material, although another study reached good results with the same music [29]. It would be hard to consider all individual needs from both methodological and practical points of view, just as it would be difficult to find a musical material that is suitable for all subjects. Until these questions are satisfactorily clarified, no music groups will be used in our upcoming studies *(Fig. 7)*.

On the other hand, these results could be explained by our "Evolutionary Theory" [20]. These subjects received extra attention, support, and suggestions when earphones were put on, implying that the recording would be of help to them. However, the groups who received no suggestions via the tape could have been disappointed: They did not get any reliable information or support from the music. Therefore, they could have felt this as an "unfulfilled promise," escalating the feeling of insecurity and tension.

Summary

Using a standardized communication with positive suggestions via an MP3 player to critically ill patients ventilated in ICU shortened both the time of mechanical ventilation and the length of stay in the ICU, and therefore, can likely support recovery.

These promising results need further confirmation by a study with a higher number of subjects. Our group is currently working on achieving this aim.

Using positive suggestions is now an accepted method, but it supplements the standard intensive care in a few places only. Some sort of cultural change is probably needed to get it more widely recognized and to get the psychologists to be an integral part of the critical care team not only during the rehabilitation phase (as traditionally accepted) but also during critical care.

Lang and Rosen [30] have done cost-effectiveness calculations when using positive suggestions during health care interventions. We have not done this kind of calculation, but it seems fairly logical that as long as mechanical ventilation time and the length of ICU stay are shorter when positive suggestions are used (as proven statistically), the related health care costs are also reduced. The results of our other studies [31, 32] show that achieving significant changes is feasible when the staff is involved and if they also receive psychological support. We recommend that psychologists working with positive suggestions be involved in more than a single ICU team. Such a network of psychologists could play several roles: training the staff for using positive suggestions, supporting them to cope with difficult situations by communication training, conducting case study sessions, etc. Furthermore, this network could provide mutual help by providing psychotherapy for the other hospital's ICU staff when needed [20].

* * *

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