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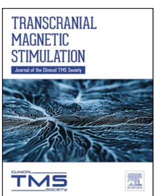

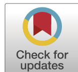

Consensus statement on the maintenance treatment of depression with rTMS in the Netherlands and Belgium

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ABSTRACT

Recent updates to treatment guidelines for depression increasingly incorporate repetitive transcranial magnetic stimulation (rTMS). While rTMS is an established intervention for depression, evidence regarding its use for maintenance treatment remains limited. The Dutch-Flemish Brain Stimulation Foundation convened an expert panel to review the literature, survey clinical practice, and formulate consensus recommendations on maintenance treatment with rTMS in the Netherlands and Flanders. A systematic PubMed search (up to June 2025) identified 22 studies reporting original data on maintenance treatment with rTMS for depression. Approaches could be divided into three categories: tapering (gradual reduction of sessions after acute treatment), maintenance rTMS (fixed-interval sessions), and retreatment (reinitiating rTMS upon relapse). Evidence from one randomized controlled trial and several open-label studies suggests that tapering may help sustain clinical improvement, particularly when the tapering schedule is symptom-guided. For maintenance rTMS, single-session protocols show mixed results, whereas clustered protocols (typically five sessions per month over several days) demonstrate the most benefits, though controlled data are lacking. Retreatment with rTMS is effective in most patients who previously responded to acute rTMS, often requiring fewer sessions. Survey data from 11 Dutch institutions indicate that tapering and maintenance rTMS are applied on a small scale, while retreatment is more common. Patient representatives emphasized the importance of early discussion, flexible scheduling, and structured monitoring to guide maintenance treatment. Overall, evidence supports individualized application of maintenance treatment with rTMS, with a need for further controlled research to establish optimal protocols and long-term effectiveness.

Introduction

Recent updates to clinical guidelines for depression have increasingly recognized repetitive transcranial magnetic stimulation (rTMS) as an evidence-based treatment option (ANON, 2024; Trapp et al., 2025). As rTMS continues to be implemented more widely across

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mental health care services, questions surrounding its long-term use are becoming more prominent. While much is known about the effectiveness of rTMS protocols during acute treatment, uncertainty remains regarding the effectiveness and optimal application of rTMS maintenance treatment to sustain the therapeutic effect and prevent relapse and recurrence.

To address these knowledge gaps, the Dutch-Flemish Brain Stimulation Foundation has drawn up the present consensus statement to map out maintenance treatment protocols and their effectiveness and to formulate recommendations for the application of rTMS maintenance treatment for depression in Dutch and Belgian hospitals and mental health care institutions. It is based on the results of a systematic literature review on the effectiveness of various rTMS maintenance protocols for depression and an inventory of experiences from clinical practice. The literature review includes articles with original data on rTMS maintenance treatment for patients with depression published up to June 2025. Additionally, we offer a recommendation based on two consensus meetings with a team of experts from the Netherlands and Flanders (May 16 and September 2, 2024) and consultation with patient representatives. These recommendations were developed by experts from the Netherlands and Flanders based on their regional clinical experience, but the principles may be applied more broadly to guide rTMS practice in other settings.

Maintenance treatment with rTMS

Acute rTMS treatment is considered successful when it achieves a significant clinical effect, such as remission or full or partial response, based on clinical judgment and validated questionnaires measuring depression severity. Response is defined as a reduction of at least 50% on a depression severity questionnaire, while remission refers to a score below a certain cutoff value. If symptoms worsen after successful acute rTMS treatment, this can be referred to as a relapse if it occurs within six months or a recurrence if it occurs after six months (Frank et al., 1991). If this occurs after a successful rTMS treatment, maintenance treatment can follow. For the purposes of this review, 'maintenance treatment with rTMS' is used as an overarching term that includes three approaches: tapering, maintenance, and retreatment, all aimed at sustaining therapeutic benefit and preventing relapse. See Fig. 1 for a graphical representation of the different protocols.

1. *Tapering* involves continuing the acute rTMS-treatment and gradually reducing the number of rTMS sessions over time to prevent relapse.
2. *Maintenance rTMS* aims to prevent recurrence and can be structured in two ways:

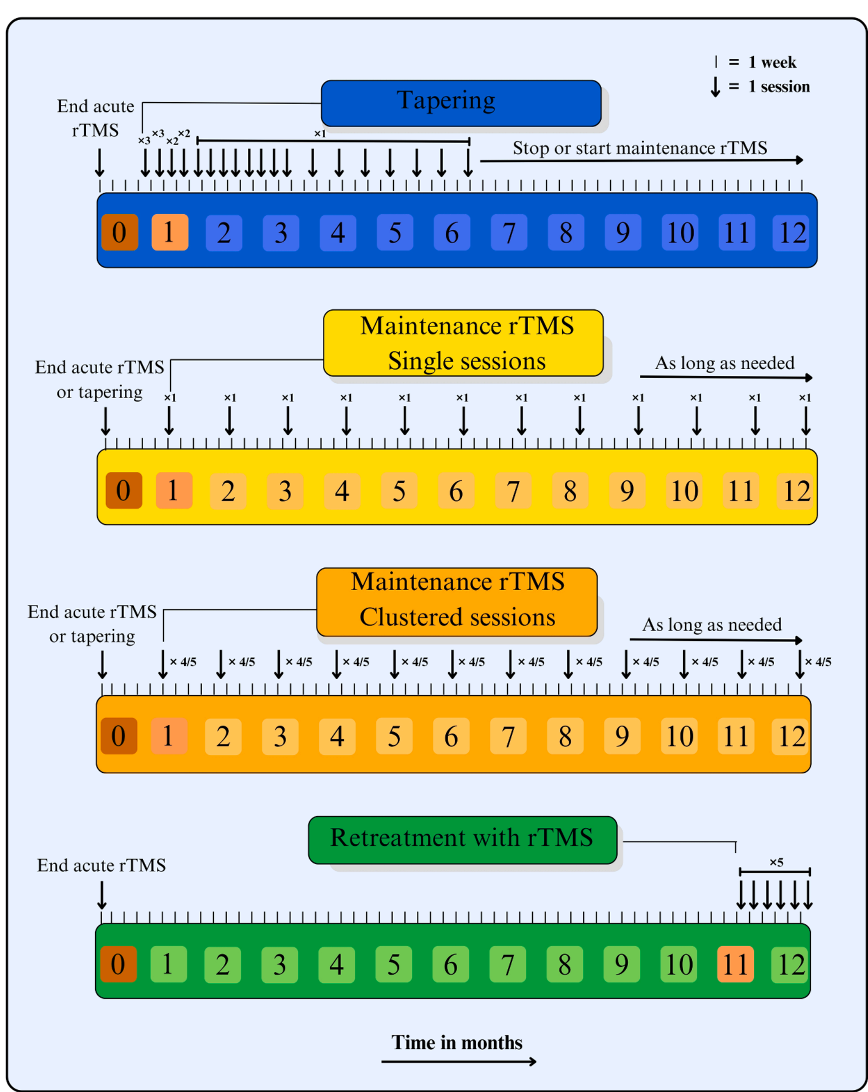

Fig. 1. Overview of the different protocols for maintenance treatment with rTMS. X refers to the number of sessions per week.

a. Multiple clustered rTMS sessions within a specific time frame that are repeated periodically (e.g., one treatment week with five sessions every month).
b. Single rTMS sessions at a fixed frequency (e.g., one session every two weeks). Tapering can also transition gradually to maintenance rTMS.

3. *Retreatment with rTMS* involves offering a new series of sessions after a relapse, recurrence or increase in depressive symptoms to reestablish the clinical effect achieved during acute treatment. This usually involves repeating the acute treatment.

Methods

Literature review

A systematic electronic search was conducted on PubMed on April 5, 2024, and updated on June 11, 2025. The search strategy is described in *Appendix A*. Articles consisting of original research (e.g., randomized controlled trials (RCTs) or case reports) focused on maintenance treatment with rTMS in patients with depression were included. Articles involving molecular or animal research were excluded from the data selection. A total of 629 articles were screened based on their titles and abstracts. The full texts of 40 articles were screened, and ultimately, 22 articles were included in the literature review. See Fig. 2 for the PRISMA flow diagram. An overview of all studies is presented in Table 1.

Consensus meetings

Two consensus meetings were held with a multidisciplinary panel of experts from the Netherlands and Flanders on May 16 and September 2, 2024. Prior to each meeting, the corresponding author prepared and circulated the agenda and discussion points to all participants at least one week in advance. During the meetings, proposed recommendations were discussed in detail and iteratively refined until consensus was reached. In cases of differing viewpoints, discussion continued until a shared formulation was agreed upon. Following each meeting, the drafted recommendations were circulated to the panel, and written feedback was incorporated into the final version.

Results

Tapering

With tapering, rTMS sessions are gradually reduced in frequency after acute treatment, often based on the symptoms. Based on the literature review, five articles on tapering were identified. The literature describes various variants of a tapering schedule. On average, this involves starting with several rTMS sessions per week. If the patient remains stable, this can be further reduced by one session per week until it stops or the decision is made to offer maintenance rTMS. In the only double-blind RCT, seventeen patients, all responders after acute rTMS treatment consisting of 20 sessions, were randomized to active or placebo tapering (Benadhira et al., 2017). The initial protocol consisted of

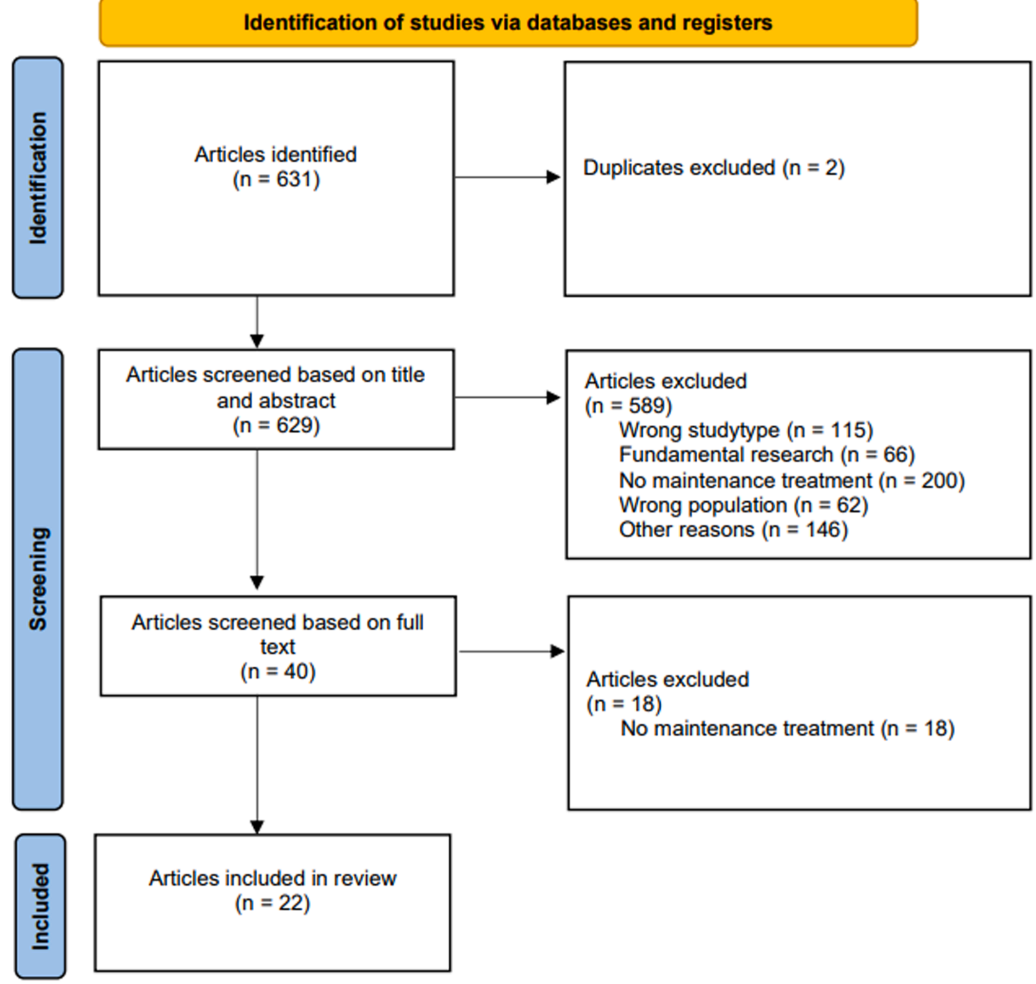

Fig. 2. PRISMA flow diagram.

Table 1
Characteristics of the included studies.

Study	Study type	# of sessions acute treatment	Maintenance protocol	Duration maintenance	# of participants	Results	Stimulation protocol	Distance from acute protocol to start of maintenance
Tapering								
Benadhira et al., 2017 (Benadhira et al., 2017)	Double-blind RCT	20	3x per week for 2 weeks, 2x per week for 2 weeks, 1x per week for 2 months, 1x per fortnight for 3 months	6 months	17 (7 sham; 10 active)	Significant improvement between the first month and the fourth month in active group in comparison with sham	Left DLPFC, 10 Hz, 110% rMT, 25 trains, 8 s on, 30 s ITI, 2000 pulses	No time between acute protocol and start of maintenance
Burton et al., 2014 (Burton et al., 2014)	Case report	18	1x per week for 1 month, 1x per 2 weeks for 1 month, 1x per 3 weeks, increased to 1x per 2 weeks for 4 years	> 4 years	1	Remained in remission throughout her pregnancy and did not develop post-natal depression	Right DLPFC, 1 Hz, 15 mins, and left DLPFC, 10 Hz, 15 mins. Both 110% rMT (trains/ITI not reported)	6 months
Connolly et al., 2012 (Connolly et al., 2012)	Retrospective cohort study	30	3x per week for 1 week, 2x per week for 1 week, 1x per week for 1 month, 2x per month for 2 months, 1x per month for 3 months	6 months	42	62% of patients receiving maintenance maintained their response at 6 months.	Left DLPFC, 10 Hz, 110% rMT, 5 s on, 15 s ITI, 4000 pulses	No time between acute protocol and start of maintenance
Haesebaert et al., 2018 (Haesebaert et al., 2018)	Three-arm open-label study	10–20	2x per week for 1 month, 1x per week for 2 months, 1x per 2 weeks for 6 months.	9 months	66 (25 rTMS; 22 venlafaxine; 19 combined)	The three maintenance approaches showed similar effectiveness in relapse prevention	Right DLPFC, 1 Hz, 120% rMT 6 trains, 60 s on, 30 s ITI, 360 pulses	No time between acute protocol and start of maintenance
Richieri et al., 2013 (Richieri et al., 2013)	Naturalistic observational study	20	3x in for 1 week, 2x in for 1 week, 1x per week for 2 weeks, 1x per 2 weeks for 2 months, 1x per month for 2 months	20 weeks	37	Relapse rate: 14 patients in the maintenance rtms group (37.8%) vs, 18 in the observation only group (81.8%)	Left DLPFC, 10 Hz, 100% rMT, 40 trains, 5 s on, 25 s ITI, 2000 pulses & right DLPFC, 1 Hz, 100% rMT, 24 trains, 30 s on, 30 s ITI, 720 pulses	No time between acute protocol and start of maintenance
Maintenance rTMS – individual sessions								
Kallel & Brunelin, 2020 (Kallel & Brunelin, 2020)	Case report	30	1x per 2 weeks	NA	1	Remission was maintained	Right DLPFC, 1 Hz, 120% rMT, 6 trains, 60 s on, 30 s ITI, 360 pulses	NA
Donse et al., 2018 (Donse et al., 2018)	Naturalistic open-label study	Average of 21 sessions, range 10–50 sessions	1x per 6–8 weeks, combined with psychotherapy	Average of 6 months	39	Patients who received maintenance had a higher depression score during follow-up, possibly indicating that those with higher severity throughout treatment were more likely to receive maintenance treatment	Right DLPFC, 1 Hz, 110–120% rMT, 120 trains, 10 s trains, 1 s ITI, 1200 pulses, & left DLPFC, 10 Hz, 110–120% rMT, 30 trains, 5 s on, 30 s ITI, 1500 pulses	No time between acute protocol and start of maintenance
Noda et al., 2025 (Noda et al., 2025)	RCT	NA	1x per week	24 weeks	75 (38 rTMS; 37 lithium)	No significant difference in MADRS scores at 24 weeks, 7 relapses in both groups	Right DLPFC, 1 Hz, 120% rMT, 900 pulses	2 weeks
O'Reardon et al., 2005 (O'Reardon et al., 2005)	Case series	NA	1–2x per week (257 ± 86 sessions total; 2.1x	More than 2 years	10	Most subjects experienced either	Left DLPFC, 10 Hz, 100% rMT, 40 trains, 5 s	NA

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Table 1 (*continued*)

Study	Study type	# of sessions acute treatment	Maintenance protocol	Duration maintenance	# of participants	Results	Stimulation protocol	Distance from acute protocol to start of maintenance
			per week on average)			marked or moderate benefit	on, 2000 pulses, ITI not reported	
Philip et al., 2016 (Philip et al., 2016)	Open-label study	NA	1x per month for 40 weeks	9 months	23	Not sufficient to maintain clinical response	Lef DLPFC, 10 Hz, 120% rMT, 75 trains, 4 s on, 26 s ITI, 3000 pulses	No time between acute protocol and start of maintenance
Rybak et al., 2024 (Rybak et al., 2024)	Case series	NA	1x per week ranging from 32 to 61 weeks	32–61 weeks	7	None of these patients relapsed while receiving rTMS treatment	Left DLPFC, 10 Hz, 120% rMT, 75 trains, 4 s on, 3000 pulses, ITI not reported	No time between acute protocol and start of maintenance
Turnier-Shea et al., 2024 (Turnier-Shea et al., 2024)	Naturalistic open-label observational study (case series)	NA	1x per week or 1x fortnightly for 8–46 weeks	8–46 weeks	14 (10 once-weekly; 4 once-fortnightly)	No patient in either group who were in remission or partial remission at baseline experienced a relapse	Left DLPFC, 10 Hz, 110% rMT, 75 trains, 4 s on, total pulses and ITI not reported; Right DLPFC, 1 Hz, 110% rMT, 1800 pulses, ITI not reported	No time between acute protocol and start of maintenance
Maintenance rTMS – clustered sessions								
Fitzgerald et al., 2013 (Fitzgerald et al., 2013)	Open-label study	NA	Each month 1 course of 5 sessions over a 2,5 days	Average of 10 months	35	Average time to relapse was longer than without maintenance treatmen	Left DLPFC, 10 Hz, 110% rMT, 30 trains, 5 s on, 25 s ITI, 1500 pulses, & right DLPFC, 1 Hz, 110% rMT, 1 train, 900 pulses.	No time between acute protocol and start of maintenance
Pridmore et al., 2022 (Pridmore et al., 2022)	Retrospective chart review	NA	Each month 1 course of 5 sessions over a 2,5 days	9 months	36	83% of patients showed relapse at the start of a course, 81% was in remission at the end of a course	Left DLPFC, 10 Hz, 110–120% rMT, 75 trains, 4 s on, ITI not reported, 3000 pulses	No time between acute protocol and start of maintenance
Pridmore & May, 2018 (Pridmore & May, 2018)	Open-label study	NA	Each month 1 course of 5 sessions over a 2,5 days	12 months	14	85% were on remission during and after rTMS maintenance period	Left DLPFC, 10 Hz, 110% rMT, 3000 pulses	No time between acute protocol and start of maintenance
Pridmore et al., 2018 (Pridmore & Pridmore, 2018)	Open-label study	20	Each month 1 course of 5 sessions over a 2,5 days	10 months	39	70% of patients showed relapse at the start of a course, 79% was in remission at the end of a course	Left DLPFC, 10 Hz, 110% rMT, 75 trains, 4 s on, ITI not reported, 3000 pulses	No time between acute protocol and start of maintenance
Pridmore et al., 2017 (Pridmore et al., 2017)	Naturalistic observational study	NA	5 sessions in 2–5 days	Not applicable	18	In 22 cases HDRS-6 scores indicated relapse before a course. After the series 16 cases improved from relapse to remission	Left DLPFC, 10 Hz, 120% rMT, 75 trains, 4 s on, ITI not reported, 3000 pulses	No time between acute protocol and start of maintenance
Retreatment								
Burton et al., 2014 (Burton et al., 2014)	Case report	18	20 sessions in 4 weeks	Not applicable	1	HDRS decreased from 24 to 3	Left DLPFC, 10 Hz, 11-% rMT, & right DLPFC, 1 Hz, 11-% rMT	> 12 weeks
Chatterjee et al., 2012 (Chatterjee et al., 2012)	Case report	20	20 sessions in 2 months	Not applicable	1	Patient was in remission after retreatment	Left DLPFC, 20 Hz, 110% rMT, 20 trains, 10 s on, 60 s ITI, 3000 pulses	First retreatment: 7 months s retreatment: 12 months
Demirtas-Tatlidede et al., 2008 (Demirtas-Tatlidede et al., 2008)	Open-label prospective study	10	10 session in two weeks	Not applicable	16	Mean HDRS-17 decrease of 65%	Left DLPFC, 10 Hz, 90% rMT, 20 blocks, 8 s on, 52 s ITI, 1600 pulses	NA

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Table 1 (*continued*)

Study	Study type	# of sessions acute treatment	Maintenance protocol	Duration maintenance	# of participants	Results	Stimulation protocol	Distance from acute protocol to start of maintenance
Fitzgerald et al., 2006 (Fitzgerald et al., 2006)	Naturalistic study	20–30 sessions	20–30 sessions	Not applicable	19	63% of patients were responders after retreatment	Left DLPFC, 10 Hz, 30 trains, 5 s on, ITI not reported, 1500 pulses, & right DLPFC, 1 Hz, 1 train, 540 pulses	10 months
Fukuda et., 2019 (Fukuda et al., 2019)	Retrospective chart review	Average of 35 sessions, range 21–52 sessions	Average 34 sessions, range15–59 sessions	Not applicable	42	Response to retreatment was 59.5% (IDS-SR) and 73.8% (PHQ9)	Left DLPFC, 10 Hz, 120% rMT, 3000–4000 pulses	Average of 51 weeks, range of 10–248
Garzon et al., 2025 (Garzon et al., 2025)	Open-label study	30	Max 30 sessions, mean of 22 sessions	Not applicable	28	Number of sessions needed during retreatment was lower than for acute treatment	Left DLPFC, 10 Hz, 110% rMT, 75 trains, 4 s on, ITI not reported, 3000 pulses	Average time to retreatment was 153 days
Janicak et al., 2010 (Janicak et al., 2010)	Open-label study	NA	Average of 14 sessions	Not applicable	38	32 patients (84.2%) benefited from retreatment	Left DLPFC, 10 Hz, 120% rMT, 75 trains, 4 s on, 26 s ITI, 3000 pulses	Average time to retreatment 109 days

three sessions per week for two weeks, followed by two sessions per week for six weeks. Then, it was reduced to one session per week for two months, followed by one session every two weeks for two months, for a total duration of six months. During the first four months, the placebo group exhibited a gradual return of depressive symptoms, with an average HDRS-17 score increase from 8.7 to 12.3 (range HDRS-17: 0–7 no depression, 8–16 mild depression, 17–23 moderate depression, >23 severe depression). The group treated with active rTMS showed a slight decrease, from 9.1 to 7.7. This difference did not remain significant after Bonferroni correction for multiple testing. After four months, however, this difference was no longer apparent, possibly because one session every two weeks was insufficient to maintain the clinical effect for these patients.

In an open-label study, patients were treated with rTMS alone ($n = 54$), venlafaxine alone ($n = 51$), or a combination of both ($n = 55$) (Haesebaert et al., 2018). The acute rTMS course consisted of 10–30 sessions. Patients who were in remission after one of the three treatments (16, 17 and 12 patients respectively) received continuation treatment with the same modality as in the acute phase. For rTMS, the tapering protocol consisted of two sessions per week for one month, followed by one session per week for two months and one session every two weeks for the remaining nine months of the study. A survival analysis revealed that, over a twelve-month period, patients treated with rTMS alone had an 80% chance of not relapsing, while the combination group had an almost identical percentage of 79%. In contrast, the percentage was 59% for patients treated with venlafaxine alone.

Another open-label study followed 59 patients who responded to successful acute rTMS treatment consisting of 20 sessions (Richieri et al., 2013). Patients could choose whether or not to continue rTMS treatment, and propensity analyses were used to account for the resulting differences between groups. Thirty-seven patients opted for continued rTMS treatment, while 22 declined but were still observed. The tapering schedule was as follows: three sessions in week one, two sessions per week for two weeks, one session per week for two weeks, one session every two weeks for two months, and one session per month for two months. After the 20-week period, 38% of patients who received tapering experienced a relapse, defined as an increase in symptoms of > 50%, compared to 82% relapse in the observed-only group.

In a retrospective cohort study, Connolly and colleagues followed 100 patients treated with rTMS (up to 30 sessions) (Connolly et al., 2012). Forty-two of the patients underwent tapering according to the following schedule: three sessions in week one, two sessions in week two, and one session in week three. This schedule was then reduced to one session per week for four weeks, two sessions per month for two months, and one session per month for three months. Based on clinical judgment, the frequency of sessions could be increased or decreased. Sixteen of the 42 patients (38%) experienced a relapse during the six-month follow-up period.

Finally, Burton and colleagues reported a case study of a patient who received tapering after successful acute treatment consisting of 20 rTMS sessions (Burton et al., 2014). The patient was tapered from one session per week to one session every two weeks, and then to one session every three weeks. However, a relapse occurred at this frequency, so the patient returned to one session every two weeks for maintenance rTMS. She remained stable for years, including during and after pregnancy.

In conclusion, although the evidence is currently limited to one small RCT and a few small-scale open-label studies, tapering may potentially contribute to maintaining the clinical effect after acute treatment.

Maintenance rTMS

For maintenance rTMS, sessions are scheduled at regular intervals, such as every two weeks or once a month. These may be single sessions or in clusters of several sessions.

Maintenance rTMS with individual sessions

We found seven articles in the scientific literature on the effectiveness of a maintenance rTMS protocol with individual sessions. Two systematic studies have been published on maintenance rTMS with single sessions (Noda et al., 2025; Philip et al., 2016). In the study by Philip and colleagues, 49 patients were randomized after acute treatment (30 sessions) to receive either maintenance rTMS, consisting of one session per month, or no maintenance treatment (observation only), for a period of twelve months (Philip et al., 2016). To be eligible for maintenance treatment, patients had to show more than a 25% improvement from baseline at the end of acute treatment. No significant difference was found between the two groups; however, patients receiving maintenance rTMS showed a longer average time to relapse (91 vs. 72 days).

In the other study, 75 patients who were classified as responders after an acute 30-session treatment course were randomized to receive either lithium or maintenance rTMS, consisting of one session per week (Noda et al., 2025). The patients were then followed for 24 weeks. No significant differences were found between the two groups in terms of clinical effect: seven patients in each group experienced a relapse. However, the lithium group had more side effects; 16 patients in this group reported side effects, compared to three patients in the rTMS group.

A positive effect was described in a case series involving ten patients who underwent two maintenance sessions per week, as well as in a case report involving one session every two weeks (Kallel & Brunelin, 2020; O'Reardon et al., 2005). Two articles reported on seven and fourteen patients, respectively, who were treated once a week (Rybak et al., 2024; Turnier-Shea et al., 2024). None of these patients experienced a relapse or recurrence during the maximum 46 weeks of follow-up. In the follow-up to a large Dutch study, some patients received maintenance rTMS at a frequency of one session every six to eight weeks. Their acute course was naturalistic and consisted of at least 10 sessions, with an average of 21 sessions. The decision to continue with maintenance rTMS after the acute course was made in consultation with the practitioner and the patient. No statistically significant difference in the severity of depressive symptoms was found between these patients and those who did not receive maintenance rTMS (Donse et al., 2018). It should be noted that patients at higher risk for recurrence were more likely to receive maintenance rTMS. Despite this higher risk, there was no difference between the two groups.

In conclusion, maintenance rTMS with single sessions could potentially be effective, but the optimal frequency remains unclear. The literature on maintenance rTMS with single sessions consists of two systematic studies and case reports. Based on these studies, maintenance rTMS with individual sessions does not appear to be more effective than observation alone or other treatments, such as lithium. The effect also appears to vary in the case reports. Consequently, no definitive recommendation can be made for this specific protocol.

Maintenance rTMS with clustered sessions

Five articles describe the effectiveness of a maintenance rTMS protocol consisting of clustered sessions. In an open-label study 35 patients received a cluster of five rTMS sessions once a month for two consecutive days (Fitzgerald et al., 2013). One-third of the patients did not experience a relapse or recurrence during the study period, which averaged twelve months in duration. The remaining patients did experience a relapse or recurrence, though time to relapse was significantly longer compared to their own prior course without maintenance rTMS (relapse in 3 months versus 10 months).

The other four studies on this protocol were conducted by Pridmore and colleagues and all involved a cluster of five rTMS sessions within 2.5–5 days, once per month. A first series of case reports describes the effects of this protocol on fourteen patients who were in remission after acute treatment (Pridmore & May, 2018). None of the patients were in remission at the start of a new cluster, but they were afterward. Another study reports the results of 11 patients receiving one cluster and 7 patients receiving two clusters (Pridmore et al., 2017). The average score was in the relapse range at the beginning of a cluster, and in the remission range at the end of the cluster. A prospective study followed 39 patients for ten months while they received clustered maintenance rTMS after an acute course of 20 sessions (Pridmore et al., 2018). At the start of a cluster 70% of patients were not in remission anymore, but after completing a cluster, 79% were. A chart review of 100 patients yielded similar results: 80% were not in remission at the start of a cluster, and 83% were in remission after completing a cluster with rTMS (Pridmore et al., 2022).

Based on these results, one could very cautiously conclude that a clustered maintenance rTMS protocol could have some effect on maintaining the clinical effects of acute treatment with, in this context, the most evidence supporting a monthly protocol consisting of clusters of five rTMS sessions spread over 2.5–5 days. However, this has been investigated in open-label studies only, and controlled studies are absent. An additional consideration is that the apparent advantage of clustered protocols over single sessions may relate not only to the clustering itself but also to the total number of sessions provided within a given period. It is therefore possible that cumulative session dose, rather than session frequency or structure alone, contributes to sustaining clinical effects. Future research should compare both the scheduling format and total session number to determine which parameters are most relevant for maintaining treatment response.

Retreatment with rTMS

Unlike tapering and maintenance rTMS, retreatment occurs in the event of a relapse or recurrence. In this case, treatment may consist of repeating the entire acute treatment protocol or undergoing a series of rTMS sessions that is shorter than the initial treatment. In our literature review we identified eight articles on retreatment with rTMS.

One naturalistic study describes the results of nineteen patients who experienced a recurrence after successful acute treatment (10–20 sessions) (Fitzgerald et al., 2006). These patients then received a new series of rTMS sessions, with a maximum number of sessions equal to that of the original acute treatment. On average, ten months (range: 2–25 months) passed between acute treatment and retreatment, and fewer sessions were required to achieve remission during retreatment than during acute treatment. Of the nineteen patients, two showed no clinical improvement after retreatment, while the remaining seventeen did. Seven of those patients underwent a second retreatment protocol, with an average of eleven months between treatment series. The number of sessions required remained comparable, and five of the seven patients showed a clinical effect after the second retreatment.

A retrospective chart review described 42 patients who were seen for retreatment with rTMS due to relapse or recurrence after successful acute rTMS treatment (Fukuda et al., 2019). The treatment series consisted of a minimum of ten rTMS sessions, averaging 34 sessions (range 15–59 sessions), comparable to the initial treatment (average of 35 sessions, range 21–562 sessions). The average time between treatment series was one year (range 10–248 weeks). With response and remission rates of 79% and 57%, respectively, the authors concluded that retreatment with rTMS is an effective option for patients who have previously responded to acute rTMS treatment.

Similar results have been shown in other studies. The time between acute treatment and retreatment ranges from three to twelve months. Generally, the number of sessions required is lower than for acute treatment, though it can be the same (Donse et al., 2018; Philip et al., 2016; Chatterjee et al., 2012; Demirtas-Tatlidede et al., 2008; Garzon et al., 2025; Janicak et al., 2010). In all studies, the vast majority of patients experienced a clinically relevant effect again when rTMS was reapplied.

Based on these results, retreatment with rTMS appears to be effective for the majority of patients. The time between acute treatment and retreatment varies, and the treatment series may consist of the same or fewer sessions as acute treatment.

Results of the survey in Belgium and the Netherlands

Due to the limited evidence regarding maintenance treatment with rTMS, experiences from clinical practice were examined as well. To map the application and effectiveness of rTMS maintenance treatment in Belgium and the Netherlands, a survey was sent to 18 institutions that use rTMS. Eleven institutions in the Netherlands completed the survey. Both tapering and maintenance rTMS are used, but on a small scale. Three of the eleven institutions indicated that they offer tapering. Four institutions use maintenance rTMS, but only for a small number of

patients. One institution uses a cluster of four sessions per month. The other institutions offer individual sessions with intervals ranging from one to eight weeks, which are tailored to the minimum frequency required to prevent recurrence. Retreatment with rTMS is common. Four of the nine institutions that offer retreatment report an average interval of three to six months between acute treatment and retreatment. Three institutions report a longer interval of 6–12 months, and two indicate that there is generally more than 12 months between treatments. Half of the institutions report an average interval of 3–6 months between two treatments, while two institutions indicate that patients do not return for a second treatment after an initial treatment with rTMS. The number of sessions also varies. Among the institutions surveyed, 44% report that an average retreatment consists of 11–20 sessions. Two institutions report continuing treatment until the desired effect is achieved. The treatment schedule is similar to that for acute treatment, but the survey shows that fewer sessions are generally required, consistent with the literature (Donse et al., 2018; Philip et al., 2016; Chatterjee et al., 2012; Demirtas-Tatlidede et al., 2008; Fitzgerald et al., 2006; Fukuda et al., 2019; Garzon et al., 2025; Janicak et al., 2010). Additionally, respondents estimate that retreatment with rTMS is effective for the vast majority of patients (over 85%, on average).

Consultation with patient representatives

To gain insight into patients' experiences and preferences regarding maintenance treatment with rTMS, four patient representatives were interviewed, all recruited from a single center. Two of them were receiving acute rTMS treatment at the time of the interview, while the other two were receiving maintenance rTMS after successful acute treatment. Patients were approached consecutively, without additional selection criteria. This small, single-center sample was intended to provide insight into patient perspectives rather than a comprehensive qualitative analysis. The interviews focused on their considerations regarding continuation of treatment, experiences with maintenance treatment, and wishes for future care.

Most representatives indicated that they had not actively considered tapering or maintenance rTMS during acute rTMS treatment. Although some were aware that this was an option, the subject only really came into focus when their mood improved and the treatment was nearing completion. Patients also consider this to be the most appropriate time to discuss maintenance treatment: earlier in the process, the information often does not stick. In general, there is a preference for a proactive approach to prevent relapse, provided that the time and logistical burden remains limited. With regard to maintenance rTMS, three of the patient representatives mentioned that it is difficult to determine the right time to start this, especially when mood is already beginning to decline. Self-insight and taking initiative appear to be more difficult in such cases. They would therefore like to see structural monitoring, for example through a short monthly telephone appointment or a questionnaire, to support timely assessment of whether maintenance rTMS is needed. Of the patients receiving maintenance rTMS, one mentioned this is essential for remaining stable, while the other struggles to find the right rhythm or moment. A feeling of familiar contact with the practitioner and a personal approach are considered important in lowering the barriers to restarting treatment.

In practical terms, all patient representatives indicate that treatment must remain workable in combination with other obligations, for example by clustering sessions on a single day or in short series. In addition, they appreciate clear information about expectations and possible side effects, and when the care team actively contributes ideas and provides support in recognizing signs of relapse.

Advice from the Clinical TMS society

In 2022 the Clinical TMS Society has also written advice on maintenance treatment with rTMS based on a systematic review (Wilson et al., 2022). For patients who have benefited from acute rTMS treatment and experience a recurrence of significant depressive symptoms, the Society recommends retreatment with rTMS. The guidance further emphasizes the importance of periodically monitoring patients following acute treatment to detect early signs of symptom return and to enable timely intervention. Retreatment is recommended with the aim of restoring patients to wellness, or as close to their prior level of remission as possible, upon re-emergence of symptoms. If the recurrence occurred < 1 year after acute treatment, tapering or maintenance rTMS can be initiated after retreatment to sustain the therapeutic effect and prevent a second recurrence. However, if a relapse occurs more than one year after acute treatment and the patient subsequently undergoes retreatment, tapering or maintenance rTMS is not recommended after retreatment. The Society also highlights the favorable safety profile of rTMS, which supports its use in maintenance and retreatment strategies. While our own recommendations do not fully align with this guidance, we have included the Society's advice to provide readers with an overview of the available guidance on maintenance rTMS.

Consensus recommendations

Maintenance treatment with rTMS may be offered following successful acute rTMS treatment, provided that it is indicated based on the practitioner's clinical judgment and shared decision-making. It is advised to develop a follow-up plan in advance, specifying how relapse prevention and maintenance of response will be addressed, including potential use of tapering, maintenance rTMS, or retreatment. Decisions regarding the timing of maintenance or retreatment with rTMS should be individualized, taking into account relapse risk, the pattern and speed of symptom deterioration, prior treatment response, patient preferences, and clinical judgment.

Tapering involves gradually decreasing the frequency of rTMS sessions immediately after acute treatment and may be particularly relevant for patients at increased risk of early relapse based on the psychiatric history or prior relapse patterns. It is recommended that the frequency of sessions is reduced based on symptoms.

Maintenance rTMS consists of single or clustered sessions at fixed time intervals and may be considered when sustained symptom control is needed beyond tapering. While single sessions may be effective, the optimal frequency is unclear based on the literature. The optimal frequency should be determined on a patient-by-patient basis. The goal is to achieve a rhythm that requires the fewest possible sessions to maintain the clinical effect. While there is little literature, the most evidence supports clustered sessions. A cluster of five sessions per month over two and a half to five days is the only protocol that has been studied and appears effective.

Retreatment may be considered when a clear relapse has occurred. In such cases, repeating the acute treatment protocol is recommended, although fewer sessions are often sufficient to re-establish response.

Patient representatives emphasize the importance of a proactive approach to prevent relapse, but also indicate that in practice it can be difficult to determine the right moment for maintenance treatment. Structural monitoring (e.g., through periodic contact or questionnaires) and a trusted, personal treatment relationship can help in this regard. In addition, patients value clear information about the purpose and burden of maintenance treatment, as well as practical integration into daily life, for example by clustering sessions. In the event of a relapse, retreatment with rTMS is possible. In this case, repeating the acute treatment protocol is recommended, though fewer sessions are usually necessary. It is advisable to regularly evaluate the effectiveness of tapering and maintenance rTMS. If tapering, maintenance rTMS, or retreatment is insufficiently effective, further treatment in accordance with the Multidisciplinary Guideline for Depression can be considered, including pharmacological, psychotherapeutic, or neuromodulatory treatment. These recommendations are based on existing scientific research, clinical experience, two consensus meetings held in 2024, as well as

consultations with patient representatives. The available evidence is limited and mostly comes from uncontrolled studies, emphasizing the need for more systematic research on this subject, such as RCTs comparing different protocols.

CRediT authorship contribution statement

Iris van Oostrom: Writing – review & editing, Conceptualization. **Odile A. van den Heuvel:** Writing – review & editing, Conceptualization. **Eric van Exel:** Writing – review & editing, Conceptualization. **Philip van Eijndhoven:** Writing – review & editing, Conceptualization. **Lianneke Egberink:** Writing – review & editing, Conceptualization. **Chris Baeken:** Writing – review & editing, Conceptualization. **Eva S.A. Dijkstra:** Writing – review & editing, Conceptualization. **Hannelore Tandt:** Writing – review & editing, Conceptualization. **Sjoerd M. van Belkum:** Writing – review & editing, Conceptualization. **Dennis J.L.G. Schutter:** Writing – review & editing, Conceptualization. **Martijn Arns:** Writing – review & editing, Conceptualization. **Teresa Schuhmann:** Writing – review & editing, Conceptualization. **Stan Steenkamp:** Writing – original draft, Visualization, Data curation, Conceptualization. **Alexander T. Sack:** Writing – review & editing, Conceptualization. **Iris Dalhuisen:** Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **de Roos Bernard:** Writing – review & editing, Conceptualization.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Martijn Arns reports a relationship with neuroCare Group GmbH that includes: consulting or advisory and equity or stocks. Martijn Arns reports a relationship with Sama Therapeutics that includes: consulting or advisory and equity or stocks. Martijn Arns reports a relationship with Roche that includes: consulting or advisory. Martijn Arns reports a relationship with Synaeda that includes: consulting or advisory. Given their role as editorial board member, Odile van den Heuvel, Chris Baeken, Alexander Sack and Martijn Arns had no involvement in the peer review of this article and had no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to another journal editor. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.transm.2026.100210.

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