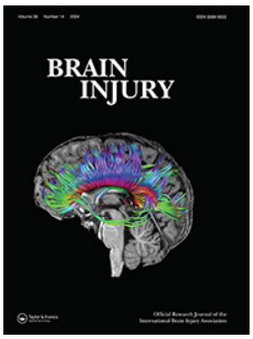

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Medical complications and advance medical decision-making in the minimally conscious state

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ABSTRACT

Objectives: Medical complications occur frequently in MCS and influence advance medical decision-making. This study aimed to report on medical complications and advance medical decision-making in a nationwide group of MCS patients.

Methods: In this descriptive cross-sectional study, clinical and advance medical decision-making characteristics were collected in a survey, completed by the treating physician.

Results: The MCS population consisted of 32 patients: 65.6% traumatic etiology, 68.8% male. Patients had a median of five complications: hypertonia/spasticity (81.3%) and pneumonia (50.0%) occurred most frequently. Most patients had curative goals: three patients had a fully curative treatment scenarios, 29 a curative scenario with ≥ 1 treatment restrictions, two a palliative and two a symptomatic scenario. Conversations about advance medical decisi
on-making were complicated by disputes with next of kin, inability to evaluate medical treatment because of medical instability, next of kin not being ready to discuss medical treatment, or a treatment scenario explicitly based on requests of next of kin.

Conclusion: Medical complications are common in MCS patients and advance medical decision making was complicated. This legitimates realization of specialized care across acute, post-acute and long-term care. Further longitudinal research into advance medical decision-making is recommended.

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Disorders of consciousness; minimally conscious state; medical complications; advance medical decision-making; epidemiology

Introduction

Prolonged disorders of consciousness (PDoC) are amongst the most severe outcomes of acquired brain injury (ABI). The spectrum of PDoC consists of the unresponsive wakefulness syndrome/vegetative state (UWS/VS) and the minimally conscious state (MCS). UWS/VS patients show no behavioral signs of consciousness (1,2), while MCS patients exhibit minimal, but discernible signs of consciousness such as command following, verbal or gestural yes/no answers, object manipulation or purposeful behavior (3).

Medical and nursing care for PDoC patients tends to be complex and challenging, not only during the initial hospital stay, but also during rehabilitation and in chronic care (4). Previously, studies on PDoC patients in the post-acute phase showed that 65–97% of them had medical comorbidities and/or complications (5–7). A single center study among 146 PDoC patients found a mean of 10 different medical and neurological comorbidities and complications per individual (8). Most frequently reported complications were hypertonia/spasticity and respiratory problems (i.e., pneumonia), but also pressure sores and digestive disorders (5–10). These issues are related to frequent referrals to acute care, but also to the fact that many PDoC patients require specialized nursing and medical care due to tracheostomy and percutaneous endoscopic gastrostomy (9,10). Furthermore, the level of consciousness (LoC) is associated with the number of complications; an Italian study showed that at least two medical complications were present in 75% of UWS/VS and in 54% of MCS patients (7).

Medical complications in PDoC patients have far-reaching consequences. First, an accurate PDoC diagnosis can be complicated by problems such as hypertonia/spasticity and infections (8). Second, nursing care can be profoundly influenced because patients are totally dependent on care. Assessment of consciousness and signs of discomfort is difficult. Furthermore, problems such as spasticity, nutritional, and respiratory problems require frequent nursing care. Also, communication with patients and their family demands a lot from nursing professionals (11,12). Third, medical problems have been associated with a lower probability of improvement of LoC (6), a higher mortality rate (6), and a worse functional status one year after brain injury (13). Fourth, medical problems lead to rehospitalization in 15–30% of PDoC patients (5,14) and they are twice as likely to be hospitalized compared to conscious patients with severe traumatic brain injury.

The high number of medical complications in MCS patients influences advance medical decision-making, which is part of the

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process of advance care planning (ACP). ACP has been defined as a process that supports adults at any age or stage of health in understanding and sharing their personal values, life goals, and preferences regarding future medical care (15). However, recently it was proposed to redefine ACP as a process that not only covers decisions in case of illness, but also in earlier stages of life (16). In PDoC patients, an active treatment scenario (i.e., treatment of medical complications and life-sustaining treatment) may be considered because of the chance of recovery of consciousness. In addition to an active treatment, the importance of palliative care, focused on comfort, quality of life, and well-being (17), has also been described for patients with PDoC (18). However, concerning MCS, no studies have been found on advance medical decision-making during the clinical course. If patients do not emerge from MCS, medical-ethical dilemmas arise, for instance whether medical complications should be treated. Therefore, a more palliative oriented treatment scenario can be expected in the absence of recovery from MCS. Treatment scenarios have been studied in UWS/VS in the Netherlands (19,20): in a case series of UWS/VS patients in long-term care the role of physicians in evaluating the treatment plan, and end-of-life decision-making was reported (4). Furthermore, a 2012 Dutch prevalence study identified 24 patients and reported on their treatment scenarios: 5 had an active treatment scenario, 16 a palliative scenario, and in 3 patients the treatment scenario was not further specified (21).

The Netherlands centralized specialized PDoC care in 2019. All PDoC patients are eligible to 14 weeks of early intensive neurorehabilitation (EIN) in a specialized rehabilitation center (22). Those who do not recover consciousness during this program can be admitted to prolonged intensive neurorehabilitation (PIN), offered by dedicated nursing homes, for up to 24 months after their injury. Chronic residential care for PDoC patients is provided by both specialized and general long-term care facilities, or at home (23–25). Within this chain of care, the nationwide prevalence of institutionalized MCS patients has recently been established (26). This context provides the opportunity to investigate the occurrence of medical complications and aspects of advance medical decision-making in MCS patients, which can improve medical management.

Therefore, the aim of this study was to report on medical complications and advance medical decision-making in a nationwide group of MCS patients.

Methods

The data were derived from a nationwide point prevalence study on September 15, 2021 (26). Data on these patients' clinical characteristics and advance medical decision-making were collected through a secured electronic survey, completed by the treating physician. In the survey, the following characteristics were collected: etiology of brain injury, LoC, and characteristics such as presence of gastric and tracheal tubes. Furthermore, treating physicians were asked to report whether comorbidities, intercurrent disease, and complications had occurred since the onset of brain injury. The survey is shown in Supplementary Table S1.

In the various studies which discussed medical complications, different terms were used to denote them, such as (medical) comorbidities, clinical findings, and medical and neurological complications (5–9). Also, the definitions used varied. Therefore, differences in definition and use of terms need to be considered, which can complicate comparing across studies. In 2013, the complexity of using the concepts of comorbidity and complications in epidemiological research was discussed (27). In this paper, we use the term medical complications to indicate comorbidity, intercurrent diseases, and complications incurred after brain injury.

We chose the term advance medical decision-making as overarching term to indicate treatment scenarios and any treatment limitations included therein. The term ACP is used frequently to indicate advance treatment decisions. Therefore, we chose not to use ACP because it is considered as a long-term process of communication and decision-making over a longer period in life (16). We asked the treating physicians to report both current treatment scenarios and limitations, and the scenarios they thought were most appropriate for their patients. When choosing treatment scenarios, they could indicate the following: fully active (i.e., all life-sustaining treatments are permitted), active with several treatment limitations, palliative, symptomatic, or other scenarios Table 1. Although no international consensus exists about the distinction between a palliative and symptomatic scenario (28), we described both scenarios separately, as it is common practice in Dutch long-term care.

Data on advance medical decision-making were dichotomized into patients with brain injury ≤12 months year and beyond 12 months, as PDoC prognosis remains uncertain at

Table 1. Treatment scenarios that could be indicated in the survey.

Treatment scenario	Explanation
Fully active treatment scenario	No treatment limitations
Active treatment scenario with treatment limitation(s)	No resuscitation
	Refrain from admission to the intensive care
	No artificial ventilation
	No hospital admission
	Active treatment scenario within the capabilities of the nursing home
Palliative treatment goal	Refers to comfort, quality of life and well-being, prolongation of life is desirable
Symptomatic treatment goal	Refers to comfort, quality of life, and well-being, prolongation of life is not desirable
Withholding of medical treatment under certain circumstances, including withdrawal of ANH	Refraining from medical treatment

least during the first year after injury, which is expected to influence advance medical decision-making. Furthermore, treating physicians were asked under what specific circumstances the treatment scenario was agreed upon and if they could describe more elaborate details about the conversations held.

Statistics

For each characteristic, the absolute numbers and percentages were calculated where applicable using SPSS version 25.0 (IBM, Armonk, NY, USA).

Ethical approval

An accredited medical-ethical committee reviewed the research protocol (file number 2020–6169) and considered it not to be subject to the Dutch Medical Research Act involving Human Subjects (1998). No further medical-ethical evaluation was indicated. Representatives of all participating patients gave written, informed consent.

Results

The total MCS population consisted of 32 patients (68.8% male, mean age 44.8 years, 65.6% traumatic etiology). Patients resided in a hospital (3.3%), specialized PDoC rehabilitation facilities (53.1%) providing EIN or PIN, and in general long-term care facilities (43.8%) Table 2.

Feeding tubes, drains and tracheostomy

All but one patient had had at least one medical complication since their injury or within the past year with a median number of five per patient (IQR 3.0–7.5) (Table 3). All but one patient depended on tube feeding: 30 had a percutaneous endoscopic gastrostomy, one a nasogastric tube. Over one in three (34.4%) had a ventriculo-peritoneal (VP) or other cerebrospinal shunt, and about one in five (18.8%) had a tracheostomy.

Medical complications and sensory deficits

The medical complications and sensory deficits are presented in Table 3. Neurological/neurosurgical and infectious complications had been observed most frequently since injury and were reported to be the main causes of readmission to acute care. Of the neurological and neurosurgical problems, hypertonia/spasticity were reported in 81.3% of patients, followed by bone flap complications (37.5%) and cerebrospinal fluid circulation problems (34.4%). Other neurological complications were paroxysmal sympathetic hyperactivity (28.1%), epilepsy (25.0%), hydrocephalus (25.0%) problems in maintaining circadian rhythm (25.0%), and motor restlessness (25.0%). Infections had been present in almost two thirds of the population, mostly pneumonia and urinary tract infections. Readmission to acute care was present in 9/32 (28.1%) and caused by a combination of infectious and neurosurgical complications (3/9): one patient had pneumonia and hydrocephalus, one a pneumonia and placement of an intrathecal baclofen pump (ITB), one had a skull reconstruction, problems with a shunt and pneumonia, and one had a placement of an intrathecal baclofen pump (ITB) and pneumonia. Furthermore, patients were readmitted for aspiration pneumonia (2/9), urinary tract infections with sepsis (2/9), somnolence (1/9), and an elective admission because of placement of an ITB pump and VP-shunt (1/9). In addition, sensory deficits were reported in a quarter of the population. The following

Table 2. Characteristics of the MCS population ($n = 32$).

Gender, number (%)	
Male	22 (68.8)
Female	10 (31.3)
Age (years)	
Mean	44.8
Range	19–74
Time elapsed since incident (months)	
Median (IQR)[a]	16.5 (5.25-52.5)
Range	1-212
Etiology, number (%)	
Traumatic	21 (65.6)
Non-traumatic	11 (34.4)
Time elapsed since incident (months, years)	
Range	1 month–17 years
Subdivision into intervals, number (%)	
≤6 months	9 (28.1)
6–12 months	5 (15.6)
1–2 years	5 (15.6)
2–5 years	8 (25.0)
5–10 years	2 (6.3)
≥10 years	3 (9.4)
Setting, (number (%)	
Hospital[b]	1 (3.1)
Post-acute, specialized PDoC rehabilitation	17 (53.1)
Early intensive neurorehabilitation (EIN)	9 (28.1)
Prolonged intensive neurorehabilitation (PIN)	8 (25.0)
Long-term care facilities	14 (43.8)

[a]IQR: Interquartile range.
[b]Readmission to acute care because of pneumonia.

Table 3. Clinical characteristics of MCS patients.

Characteristic	Number (%)
Number of medical complications per patient	
5-10	17 (53.1)
2-5	8 (25.0)
1-2	6 (18.8)
0-1	1 (3.1)
Median (IQR)	5 (3.0-7.5)
Indwelling devices	
Feeding tubes	31 (96.9)
Ventriculo-peritoneal shunt or other cerebrospinal fluid drain	11 (34.4)
Tracheostomy	6 (18.8)
Neurological and neurosurgical complications	
Hypertonia/spasticity	26 (81.3)
Status after bone flap removal or replacement	12 (37.5)
Paroxysmal sympathetic hyperactivity	9 (28.1)
Difficulty in maintaining circadian rhythm/sleep problems	8 (25.0)
Epilepsy	8 (25.0)
Hydrocephalus	8 (25.0)
Motor restlessness or hyperkinesia	8 (25.0)
Drain problems (e.g., obstruction, infection)	4 (12.5)
Infectious complications	21 (65.6)
Pneumonia	16 (50.0)
Urinary tract infections	7 (21.9)
COVID-19	1 (3.1)
Other	4 (12.5)
Readmission to acute care/hospital	9 (28.1)
Infections and neurosurgical problems	3
Aspiration pneumonia	2
Urinary tract infection with sepsis	2
Somnolence	1
Elective: placement of intrathecal baclofen pump and VP shunt	1
Sensory deficits	
Visual impairments/oculomotor impairments	8 (25.0)
Visual processing impairments	3 (9.4)
Possible auditive impairments	9 (28.1)
Gastro-intestinal: nausea and vomiting	5 (15.6)
Cutaneous: pressure sores	4 (12.5)
Other	8 (25.0)
Diabetes mellitus, peripheral arterial disease, amputation of leg	1
Dyskinesia and dystonia	1
Preferred position of head to left	1
Nausea and vomiting + myositis ossificans + intolerances for midazolam, diazepam, bisacodyl, metimazol.	1
Nephrolithiasis + recurrent urosepsis	1
Discomfort with apnea, oral spasms, decrease of oxygen saturation	1
Urinary retention	1
Psoriasis	1

visual and visual processing problems were reported: deviated eye position, filamentary keratitis, epithelial defect, sicca complaints, bilateral oculomotor nerve palsy with ptosis, diminished visual acuity, nystagmus, doubt about visual perception, and delayed reactions to visual stimuli. Confirmed auditory problems were not reported; however, physicians of nine patients reported that they did not know if an auditory problem was present.

Advance medical decision-making

A fully active treatment scenario including resuscitation and admission to the intensive care unit was present in three patients, who were all within the first year after their brain injuries: two, six, and ten months, respectively. Apart from this difference, no major differences were found between patients shorter than 12 months post-injury, and those beyond this period. A treatment scenario with a curative aim, including life-sustaining treatments but with treatment limitations, was present in 29 patients: a non-resuscitation order in 87.5%, an agreement not to ventilate in 43.8% and no admission to the intensive care unit (ICU) in 21.8%. A palliative scenario was present in two patients, and a symptomatic treatment scenario in two others. Only one patient had an advance care directive, of which contents the treating physician was uncertain.

When asked what treatment scenario was most applicable to the current medical scenario, treating physicians opted for an active treatment scenario, including treatment of complications, and continuing artificial nutrition and hydration (ANH), in most patients (90.1%). Withholding of medical treatment if complications occurred was mentioned as appropriate in one patient, and withholding all curative medical treatment, including withdrawal of ANH in another. In one patient, the treating physician stated they wanted to discuss the treatment scenario with the family first (Table 4).

In response to an open question, treating physicians mentioned several topics about discussing treatment scenarios, such as dispute about the treatment scenario with the next of kin, impossibility to evaluate the treatment scenario because of

Table 4. Current treatment scenario, presence of advance care directive, and the most applicable treatment scenario according to treating physicians.

Treatment scenario	Number (%)	Brain injury duration ≤12 months (n = 19)	Brain injury duration >12 months (n = 13)
Fully active (including resuscitation and admission to the intensive care unit)	3 (9.4)	3	0
≥1 Treatment restriction(s)[a]	29 (90.6)	12	17
No resuscitation	28 (87.5)	12	16
No artificial ventilation	14 (43.8)	5	9
No hospital admission	4 (12.5)	1	3
No admission to the intensive care	7 (21.9)	3	4
Active treatment within the possibilities of the nursing home	5 (15.6)	2	3
Palliative scenario[b]	2 (6.3)	1	1
Symptomatic scenario[c]	2 (6.3)	0	2
Withdrawal of ANH[d] under certain circumstances	0	0	0
Presence of an advance care directive			
Yes	1 (3.1)	1	0
No	26 (81.3)	9	17
Unknown	5 (15.6)	4	1
Treatment scenarios most applicable to current medical scenario according to treating physicians			
Continuation of ANH[d], active treatment of complications, including life sustaining treatment	29 (90.6)	15	14
Continuation of ANH[d], but in case of complications, discontinuation of life sustaining treatment	1 (3.1)	0	1
Withdrawal of all life sustaining treatment, including ANH[d]	1 (3.1)	0	1
Medical scenario in consultation with family	1 (3.1)	0	1

[a]Different treatment limitations could be selected, therefore the total number exceeds the total number of patients (n = 32).
[b]Palliative treatment scenario goal refers to comfort, quality of life and well-being, prolongation of life is desirable.
[c]Symptomatic treatment scenario goal refers to comfort, quality of life and well-being, prolongation of life is not desirable.
[d]ANH: artificial nutrition and hydration.

Table 5. Key statements of physicians about the context of discussing treatment scenarios.

Topic	Statement
Advance care directive present	'I don't know what is in the advance care directive, but it is about euthanasia if the patient is in a certain condition.'
Dispute and disagreement about treatment scenario	'Medical advice toward a more conservative treatment scenario deviates from the wishes of the family (they wish for a fully curative treatment scenario).'
	'Mother does not agree with the no-return scenario of the hospital.'
	'Dispute between two legal representatives about scenario to withdraw life prolonging treatment and about the next place/facility of residence.'
	'Medical advice is withdrawal of life prolonging treatment, but family does not agree with it.'
Treatment scenario determined by explicit request of the family	'Medical scenario determined on explicit request of the family, who wants to await the outcome until two years after injury.'
	'Treatment scenario is based on the wishes of the mother; it has not been discussed recently.'
Active treatment scenario with condition	'Admittance to intensive care unit/hospital if recovery to "earlier" level will be expected.'
Discussion treatment scenario not possible	'Partner is not ready to discuss treatment restrictions.'
Evaluation of treatment not possible	'There is no progress in prolonged intensive neurorehabilitation program, but there are some physical/somatic unsolved problems, which lead to an inability to evaluate.'
	'Patients' stay on the ward is too short to make a judgment.'
Earlier conversation	'There were conversations about a more conservative treatment scenario'

ongoing physical problems, or families who were not ready yet to discuss treatment scenarios (Table 5).

Discussion

This study into the nationwide Dutch population of institutionalized MCS patients in post-acute and chronic phases shows that multiple medical complications in this condition are common. This makes medical treatment intensive because a lot of medical and advance medical decisions have to be made. Taken together with MCS' uncertain prognosis, this creates major clinical challenges when it comes to medical decision-making.

The number and types of medical complications – with hypertonia/spasticity, pneumonia, and bone flap problems as most common – are consistent with other studies (5,6,8). However, when comparing between studies, differences in terminology, methodology and study population must be considered. First, previous studies have operationally defined the terms (medical) comorbidity and (medical) complications differently. In some publications, comorbidity is defined as medical problems existing prior to the brain injury (6,7), in others as problems arising after the brain injury (29), while some studies consider these to be complications (5), or use both concepts together (8). Using the terms comorbidity and complications interchangeably has been discussed in clinical epidemiology (27). Second, study populations were different, as

earlier studies reported on PDoC patients shortly after injury with median time lapses from 47 days – 2.2 months (5–8), whereas in our study patients with a longer time lapse post-injury were included (median 16.5 months).

The high number of patients dependent on feeding tubes is consistent with other studies (6–8). Recent research on swallowing in PDoC patients shows that only 7% of MCS patients could be fed entirely orally (30). The authors explained this low proportion by stating that emergence from MCS is probably necessary to be capable of complete oral nutrition and hydration. Tracheostomy was present in one out of five MCS patients, which is lower than in studies with mixed LoC (i.e., UWS/VS and MCS), but approximately similar to a Belgian MCS cohort (24.2%) (30). Compared to UWS/VS, a diagnosis of MCS is associated with a twice as high chance of successful decannulation (31).

Advance medical decision-making showed that the treatment policy had a curative goal in almost 90% of MCS patients, of which three patients had a fully active treatment scenario. We expected that not emerging from MCS may have led to choosing a more palliative oriented scenario. However, this was not supported by our results. The active treatment scenarios could be explained by the presence of disputes with relatives, when discussing a more restrictive treatment scenario, as this was reported several times by treating physicians as complicating factor. Research into the experiences of next of kin, demonstrates a complicated attitude toward the PDoC condition of their relatives (32). Family members may judge the situation of their relative differently from professionals: ranging from preservation of life at all costs and hope for recovery, to seeking for discontinuation of treatment. Concerning MCS, the presence of discomfort may contribute to difficulty in coping with this condition, since it was reported as being distressful. Next of kin even reported nostalgic experience in which they wished their relative to be in UWS/VS again, because of absent conscious experiences (32). Developing new diagnostic categories can contribute to more diagnostic clarity at first sight but can in turn create new ambivalences in next of kin. Regarding MCS, this diagnosis can lead to a better perspective because of a higher probability for recovery through intensive neurorehabilitation. On the other hand, interpreting observed behavior, possibly indicative of MCS, can be complicated for next of kin, and changes in the interpretation thereof by them during the clinical course have been described. In addition, next of kin struggle to understand and give meaning to the patient's behavior which can easily lead to conflicts between next of kin and clinicians. Dissatisfaction and frustration about inadequate assessments, insensitive communication, and insufficient interest in representing the patient's presumed wishes by next of kin, were reported (33). In addition, the occurrence of conflicts between clinicians en next of kin was previously confirmed in a Dutch study on outcomes of moral deliberation in UWS/VS (34). The moral conflict in MCS has been described as balancing between patient autonomy and well-being (35). Well-being can be inferred from observations, which could demonstrate positive as well as negative experiences. However, reconstruction of patient autonomy is more complicated. This reconstruction of presumed patient's will must usually be done in an indirect way: through conversations with next of kin, because advance care directives are rarely present as demonstrated by this study and an earlier nationwide Dutch prevalence study on UWS/VS (21).

The strength of this study is that it provides insight into medical complications and advance medical decision-making in a clearly defined nationwide group of institutionalized MCS patients within a context of a specialized and cohesive PDoC rehabilitation and easily accessible long-term care system (25). However, there are some limitations that need to be discussed. First, the data were derived from a cross-sectional study, limiting understanding developments over time. Second, the clinical data were collected by a survey, and not by a comprehensive medical file review. Therefore, relevant medical information might have been missed.

The occurrence of many medical complications in MCS patients and the complex advance medical decision-making warrants the importance of establishing multidisciplinary teams of qualified nurses, therapists and physicians specialized in PDoC care, which has been advocated before in general as well as specialized PDoC rehabilitation (6,7,36).

Further longitudinal research is recommended into both medical complications and advance medical decision-making to study the evolution of these over time. Especially for advance medical decision-making it is important to have a better understanding of its course. The views of patients, families, and professionals on pDoC outcomes are currently being studied in the Netherlands in a qualitative longitudinal study (24). Research is recommended across different phases (i.e., in the acute, post-acute and long-term care) of the clinical course. The inclusion of long-term care into this research is necessary, as our results demonstrated that a substantial proportion of the MCS population resided in long-term care facilities. To conduct research across all phases in this low prevalence group is a challenge. However, this kind of research is possible when academic research and dedicated facilities are connected to each other, as demonstrated by recent Dutch advances in developing knowledge infrastructures for low prevalence groups (37).

Concerning medical complications, it is necessary to achieve uniformity in terminology and operationalization of the concepts of comorbidity and complications to improve comparability across studies.

Conclusions

Medical complications are common in this MCS population, with clinical care further complicated by difficulties in advance medical decision-making. This legitimizes the realization of highly specialized care and treatment throughout acute care, specialized neurorehabilitation, and long-term care. There is a discrepancy between what treating physicians consider appropriate advance medical decisions in MCS, and the treatment scenarios they carry out in practice. Advance medical decision-making deserves further research, including the role of next of kin. This will increase the understanding of the process of advance medical decision-making.

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Data availability statement

Anonymized data will be shared on reasonable request.

References

1. Multi-Society Task Force on PVS. Medical aspects of the persistent vegetative state (1). N Engl J Med. 1994;330(21):1499–508. doi:10.1056/NEJM199405263302107.
2. Laureys S, Celesia GG, Cohadon F, Lavrijsen J, Leon-Carrion J, Sannita WG, Sazbon L, Schmutzhard E, von Wild KR, Zeman A, et al. Unresponsive wakefulness syndrome: a new name for the vegetative state or apallic syndrome. BMC Med. 2010;8(1):68. doi:10.1186/1741-7015-8-68.
3. Giacino JT, Ashwal S, Childs N, Cranford R, Jennett B, Katz DI, Kelly JP, Rosenberg JH, Whyte J, Zafonte RD, et al. The minimally conscious state: definition and diagnostic criteria. Neurology. 2002;58(3):349–53. doi:10.1212/WNL.58.3.349.
4. Lavrijsen J, van den Bosch H, Koopmans R, van Weel C, Froeling P. Events and decision-making in the long-term care of Dutch nursing home patients in a vegetative state. Brain Inj. 2005;19(1):67–75. doi:10.1080/02699050410001720013.
5. Whyte J, Nordenbo AM, Kalmar K, Merges B, Bagiella E, Chang H, Yablon S, Cho S, Hammond F, Khademi A, et al. Medical complications during inpatient rehabilitation among patients with traumatic disorders of consciousness. Arch Phys Med Rehabil. 2013;94(10):1877–83. doi:10.1016/j.apmr.2012.12.027.
6. Estraneo A, Loreto V, Masotta O, Pascarella A, Trojano L. Do medical complications impact long-term outcomes in prolonged disorders of consciousness? Arch Phys Med Rehabil. 2018;99(12):2523–31.e3. doi:10.1016/j.apmr.2018.04.024.
7. Estraneo A, Masotta O, Bartolo M, Pistoia F, Perin C, Marino S, Lucca L, Pingue V, Casanova E, Romoli A, et al. Multi-center study on overall clinical complexity of patients with prolonged disorders of consciousness of different etiologies. Brain Inj. 2021;35(1):1–7. doi:10.1080/02699052.2020.1861652.
8. Zhang B, Huang K, Karri J, O'Brien K, DiTommaso C, Li S. Many faces of the hidden souls: medical and neurological complications and comorbidities in disorders of consciousness. Brain Sci. 2021;11(5):608. doi:10.3390/brainsci11050608.
9. Saout V, Ombredane MP, Mouillie JM, Marteau C, Mathe JF, Richard I. Patients in a permanent vegetative state or minimally conscious state in the Maine-et-Loire county of France: a cross-sectional, descriptive study. Ann Phys Rehabil Med. 2010;53(2):96–104. doi:10.1016/j.rehab.2010.01.002.
10. Donis J, Kraftner B. The prevalence of patients in a vegetative state and minimally conscious state in nursing homes in Austria. Brain Inj. 2011;25(11):1101–07. doi:10.3109/02699052.2011.577047.
11. Puggina AC, Paes da Silva MJ, Schnakers C, Laureys S. Nursing care of patients with disorders of consciousness. J Neurosci Nurs: J Am Assoc Neurosci Nurses. 2012;44(5):260–70. doi:10.1097/JNN.0b013e3182666407.
12. Raciti L, Corallo F, Manuli A, Calabro RS. Nursing, caregiving and psychological support in chronic disorders of consciousness: a scoping review. Acta Biomed. 2021;92(S2):e2021013.
13. Ganesh S, Guernon A, Chalcraft L, Harton B, Smith B, Louise-Bender Pape T. Medical comorbidities in disorders of consciousness patients and their association with functional outcomes. Arch Phys Med Rehabil. 2013;94(10):1899–907. doi:10.1016/j.apmr.2012.12.026.
14. Nakase-Richardson R, Tran J, Cifu D, Barnett SD, Horn LJ, Greenwald BD, Brunner RC, Whyte J, Hammond FM, Yablon SA, et al. Do rehospitalization rates differ among injury severity levels in the NIDRR traumatic brain injury model systems program? Arch Phys Med Rehabil. 2013;94(10):1884–90. doi:10.1016/j.apmr.2012.11.054.
15. Sudore RL, Lum HD, You JJ, Hanson LC, Meier DE, Pantilat SZ, Matlock DD, Rietjens JAC, Korfage IJ, Ritchie CS, et al. Defining advance care planning for adults: a consensus definition from a multidisciplinary delphi panel. J Pain Symptom Manage. 2017;53(5):821–32 e1. doi:10.1016/j.jpainsymman.2016.12.331.
16. Hickman SE, Lum HD, Walling AM, Savoy A, Sudore RL. The care planning umbrella: the evolution of advance care planning. J Am Geriatrics Soc. 2023;71(7):2350–56. doi:10.1111/jgs.18287.
17. van der Steen JT, Onwuteaka-Philipsen BD, Knol DL, Ribbe MW, Deliens L. Caregivers' understanding of dementia predicts patients' comfort at death: a prospective observational study. BMC Med. 2013;11(1):105. doi:10.1186/1741-7015-11-105.
18. Goss AL, Creutzfeldt CJ. Prognostication, ethical issues, and palliative care in disorders of consciousness. Neurologic Clinics. 2022;40(1):59–75. doi:10.1016/j.ncl.2021.08.005.
19. van Erp WS, Lavrijsen JCM, Vos PE, Laureys S, Koopmans R. Unresponsive wakefulness syndrome: outcomes from a vicious circle. Ann Neurol. 2020;87(1):12–18. doi:10.1002/ana.25624.
20. de Beaufort I. Patients in a persistent vegetative state — a Dutch perspective. N Engl J Med. 2005;352(23):2373–75. doi:10.1056/NEJMp058094.
21. van Erp WS, Lavrijsen JC, Vos PE, Bor H, Laureys S, Koopmans RT. The vegetative state: prevalence, misdiagnosis, and treatment limitations. J Am Med Dir Assoc. 2015;16(1):85 e9–e14. doi:10.1016/j.jamda.2014.10.014.
22. Eilander HJ, Wijnen VJ, Scheirs JG, de Kort PL, Prevo AJ. Children and young adults in a prolonged unconscious state due to severe brain injury: outcome after an early intensive neurorehabilitation programme. Brain Inj. 2005;19(6):425–36. doi:10.1080/02699050400025299.
23. Driessen DMF, Utens CMA, Ribbers GM, van Erp WS, Heijenbrok-Kal MH. Outcome registry of early intensive neurorehabilitation in patients with disorders of consciousness: study protocol of a prospective cohort study. BMC Neurol. 2021;21(1):69. doi:10.1186/s12883-021-02099-7.
24. Sharma-Virk M, van Erp WS, Lavrijsen JCM, Koopmans R. Intensive neurorehabilitation for patients with prolonged disorders of consciousness: protocol of a mixed-methods study focusing on outcomes, ethics and impact. BMC Neurol. 2021;21(1):133. doi:10.1186/s12883-021-02158-z.
25. Bodien Y, Rao CV, Lavrijsen J, Giacino JT. Models and systems of care for patients with disorders of consciousness. In: Schnakers C Laureys S, editors. Coma and disorders of consciousness. Cham: Springer International Publishing; 2023. p. 243–62.
26. Overbeek BUH, van Erp WS, Eilander HJ, Koopmans R, Lavrijsen JCM. Prevalence of the minimally conscious state among institutionalized patients in the Netherlands: a nationwide study. Neurology. 2023;101(20):e2005–13. doi:10.1212/WNL.0000000000207820.
27. Ording AG, Sørensen HT. Concepts of comorbidities, multiple morbidities, complications, and their clinical epidemiologic analogs. Clin Epidemiol. 2013;5:199–203. doi:10.2147/CLEP.S45305.

28. van der Maaden T, van der Steen JT, de Vet HC, Achterberg WP, Boersma F, Schols JM, van Berkel JFJM, Mehr DR, Arcand M, Hoepelman AIM, et al. Development of a practice guideline for optimal symptom relief for patients with pneumonia and dementia in nursing homes using a delphi study. Int J Geriatr Psychiatry. 2015;30(5):487–96. doi:10.1002/gps.4167.
29. Estraneo A, Briand MM, Noe E, Schnakers C, Zasler ND. Medical comorbidities in patients with prolonged disorder of consciousness: a narrative review. NeuroRehabilitation. 2024;54(1):61–73. doi:10.3233/NRE-230130.
30. Melotte E, Maudoux A, Delhalle S, Lagier A, Thibaut A, Aubinet C, Kaux J-F, Vanhaudenhuyse A, Ledoux D, Laureys S, et al. Swallowing in individuals with disorders of consciousness: a cohort study. Ann Phys Rehabil Med. 2021;64(4):101403. doi:10.1016/j.rehab.2020.04.008.
31. Hakiki B, Draghi F, Pancani S, Portaccio E, Grippo A, Binazzi B, Tofani A, Scarpino M, Macchi C, Cecchi F, et al. Decannulation after a severe acquired brain injury. Arch Phys Med Rehabil. 2020;101(11):1906–13. doi:10.1016/j.apmr.2020.05.004.
32. Kitzinger C, Kitzinger J. This in-between': how families talk about death in relation to severe brain injury and disorders of consciousness. In: Van Brussel L, and Carpentier N, editors. The social construction of death: interdisciplinary perspectives. Basingstoke (UK): Palgrave MacMillan; 2014. pp. 239–258.
33. Nettleton S, Kitzinger J, Kitzinger C. A diagnostic illusory? The case of distinguishing between "vegetative" and "minimally conscious" states. Soc Sci Med. 2014;116(100):134–41. doi:10.1016/j.socscimed.2014.06.036.
34. Span-Sluyter C, Lavrijsen JCM, van Leeuwen E, Koopmans R. Moral dilemmas and conflicts concerning patients in a vegetative state/unresponsive wakefulness syndrome: shared or non-shared decision making? A qualitative study of the professional perspective in two moral case deliberations. BMC Med Ethics. 2018;19(1):10. doi:10.1186/s12910-018-0247-8.
35. Shepherd J. Moral conflict in the minimally conscious state. In: Sinnott-Armstrong W, editor. Finding consciousness: the neuroscience, ethics, and law of severe brain damage. Wellcome trust-funded monographs and book chapters. Oxford (UK): Oxford University Press; 2016. pp. 1–14.
36. Ladbrook E, Bouchoucha S, Hutchinson A. Frequency and characteristics of medical complications in rehabilitation settings: a scoping review. J Rehabil Med. 2022;54:jrm00350. doi:10.2340/jrm.v54.2752.
37. Koopmans R, Leerink B, Festen DAM. Dutch long-term care in transition: a guide for other countries. J Am Med Dir Assoc. 2022;23(2):204–06. doi:10.1016/j.jamda.2021.09.013.