

Supplementary Digital Content

Behaviour Artificial Intelligence Technology to support the decision-making process of continuation or withdrawal of life sustaining therapy

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Vignettes

Pilot Study vignette

English Translation

Patient X has been treated in your ICU for {a}, during which cardiopulmonary support has {m}. The treatment team has begun to question whether it remains meaningful to continue treatment aimed at recovery.

The patient is {b} years old, had an estimated frailty score of {c} at admission, and was admitted with a condition for which the expected life expectancy of the underlying disease was {d}.

At this point, there is {e} burden of suffering. The estimation is that it will take {f} before the patient will function approximately at the pre-existing level again.

It is expected that the following impairments will be present at that time: heart failure, {g} lung failure, leading to {h} kidney failure, leading to {i} and the patient is expected to function cognitively at {j}. There will be {k} dependence on tube feeding or TPN.

During previous admissions, the expected burden of suffering and future impairments were discussed repeatedly. In conversations with the family, it became clear that (l) for the patient and their loved ones.

Would you continue treatment aimed at recovery? Choice:

- Yes, full treatment
- Yes, but without escalation
- No, withdraw treatment

English Translation of Table of criteria levels used in pilot vignette

Criteria	Level 1	Level 2	Level 3	Level 4
a	A few days	A few weeks	A few months	
m	increases	remains stable	decreases	
b	40	55	70	85
c	1-2	3-4	5-6	7
d	years	months to a year	weeks to months	
e	limited	moderate to severe	very severe	
f	less than 3 months	>3 months to a year		
g	NYHA I	NYHA II	NYHA III	NYHA IV
h	No limitations	Moderate limitations	Severe limitations	
i	No limitations (GFR > 30)	pre-dialysis phase (GFR 15-30)	Dialysis (GFR <15)	
j	mRS (modified Rankin Scale) 0-1	mRS 2-3	mRS 4-5	
k	without	with		
l	the expected future limitations are acceptable	certain expected future limitations are acceptable	the expected future limitations are unacceptable	

Original Dutch vignette text

Patiënt X wordt al {a} behandeld op uw IC, waarbij de cardiopulmonale ondersteuning {m}. Het behandelteam is gaan twijfelen of het zinvol is om behandeling gericht op herstel voort te zetten.

Patiënt is {b} jaar oud, had bij opname een ingeschatte frailty van {c} en werd opgenomen met een aandoening waarvan de verwachte levensduur van het onderliggende ziektebeeld {d} zou zijn.

Inmiddels is er sprake van {e} lijdenslast. De inschatting is dat {f} zal duren voordat patiënt weer ongeveer op het pre-existente niveau zal functioneren.

De verwachting is dat er dan sprake zal zijn van de volgende beperkingen:

hartfalen, {g}

longfalen, leidend tot {h}

nierfalen, leidend tot {i}

waarbij patiënt cognitief zal functioneren op {j}

{k} afhankelijkheid van sondevoeding of TPV

Bij eerdere opnames is herhaaldelijk gesproken over de verwachte lijdenslast en toekomstige beperkingen.

In gesprekken met familie werd duidelijk dat (l) voor patient en zijn naasten.

Zou u de behandeling gericht op herstel voortzetten?

- Ja volledige behandeling
- Ja, zonder escaleren
- Nee, stoppen

Original Dutch Table of criteria levels used in pilot vignette

Criteria	Level 1	Level 2	Level 3	Level 4
a	Enkele dagen	Enkele weken	Enkele maanden	
m	toeneemt	stabiel blijft	afneemt	
b	40	55	70	85
c	1-2	3-4	5-6	7
d	jaren	maanden tot een jaar	weken tot maanden	
e	beperkte	Matig tot ernstige	Zeernstige	
f	minder dan 3 maanden	>3 maanden tot een jaar		
g	NYHA I	NYHA II	NYHA III	NYHA IV
h	Geen beperkingen	Matige beperkingen	Ernstige beperkingen	
i	Geen beperkingen (GFR > 30)	pre-dialyse traject (GFR 15-30)	Dialyse (GFR <15)	
j	mRS (modified rankin scale) 0-1	mRs 2-3	mRS 4-5	
k	zonder	met		
l	de verwachte toekomstige beperkingen acceptabel zijn	bepaalde verwachte toekomstige beperkingen acceptabel zijn	de verwachte toekomstige beperkingen onacceptabel zijn	

Study Vignette

In contrast to the pilot experiment, the study vignette showed criteria and the values (see Table 1) for the patient explicitly.

English Translation of vignette text

Criteria:

1. Expected ICU admission duration
2. Clinical expectation
3. Age
4. Frailty at hospital admission
5. Life expectancy prior to ICU admission based on comorbidity
6. Current burden of suffering (as assessed by the treatment team)
7. It is anticipated that the following limitations will be present after ICU admission:
 - a. Cardiac
 - b. Pulmonary
 - c. Renal
 - d. Neurological
 - e. Gastrointestinal (tube feeding)
8. Patient and/or family wishes

Would you continue treatment aimed at recovery?

- Yes
- Yes, with a Time-Limited Trial
- No, discontinue

Original Dutch vignette text

Criteria:

1. Verwachte IC-opnameduur
2. Klinische verwachting
3. Leeftijd
4. Frailty bij ziekenhuisopname
5. Op basis van de comorbiditeit was de levensverwachting vóór IC opname
6. Actuele lijdenslast (inschatting door het behandelteam)
7. De verwachting is dat er na de IC-opname sprake zal zijn van de volgende beperkingen:
 - a. Cardiaal
 - b. Pulmonaal
 - c. Renaal
 - d. Neurologisch
 - e. Gastro-intestinaal (sonde-voeding)
8. Wens patiënt en/of familie

Zou u de behandeling gericht op herstel voortzetten?

- Ja
- Ja, met Time Limited Trial
- Nee, stoppen

Table S1. New York Heart Association classification of heart failure

Class	Description
I	Patients with cardiac disease, but without resulting limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea, or anginal pain.
II	Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea, or anginal pain.
III	Patients with marked limitation of physical activity. They are comfortable at rest. Less than ordinary activity causes fatigue, palpitation, dyspnea, or anginal pain.
IV	Patients with cardiac disease resulting in inability to carry on any physical activity without discomfort. Symptoms of heart failure or of the anginal syndrome may be present even at rest. If any physical activity is undertaken, discomfort is increased.

The New York Heart Association (NYHA) classification system categorizes the severity of heart failure into four classes, ranging from Class I (no limitation) to Class IV (severe symptoms at rest)

Table S2. The Modified Rankin Scale

Grade	Description
0	No symptoms at all
1	No significant disability despite symptoms: able to carry out all usual duties and activities
2	Slight disability: unable to carry out all previous activities but able to look after own affairs without assistance
3	Moderate disability: requiring some help, but able to walk without assistance
4	Moderately severe disability: unable to walk without assistance, and unable to attend to own bodily needs without assistance
5	Severe disability: bedridden, incontinent, and requiring constant nursing care and attention

The Modified Rankin Scale is a six-point scale that categorizes the degree of neurological disability into six grades, ranging from Grade 0 (no disability) to Grade 5 (severe disability)

Figure S1. Ordered covariates using level-specific coefficients

Ordered covariates

Using level-specific coefficients (baseline: first level)

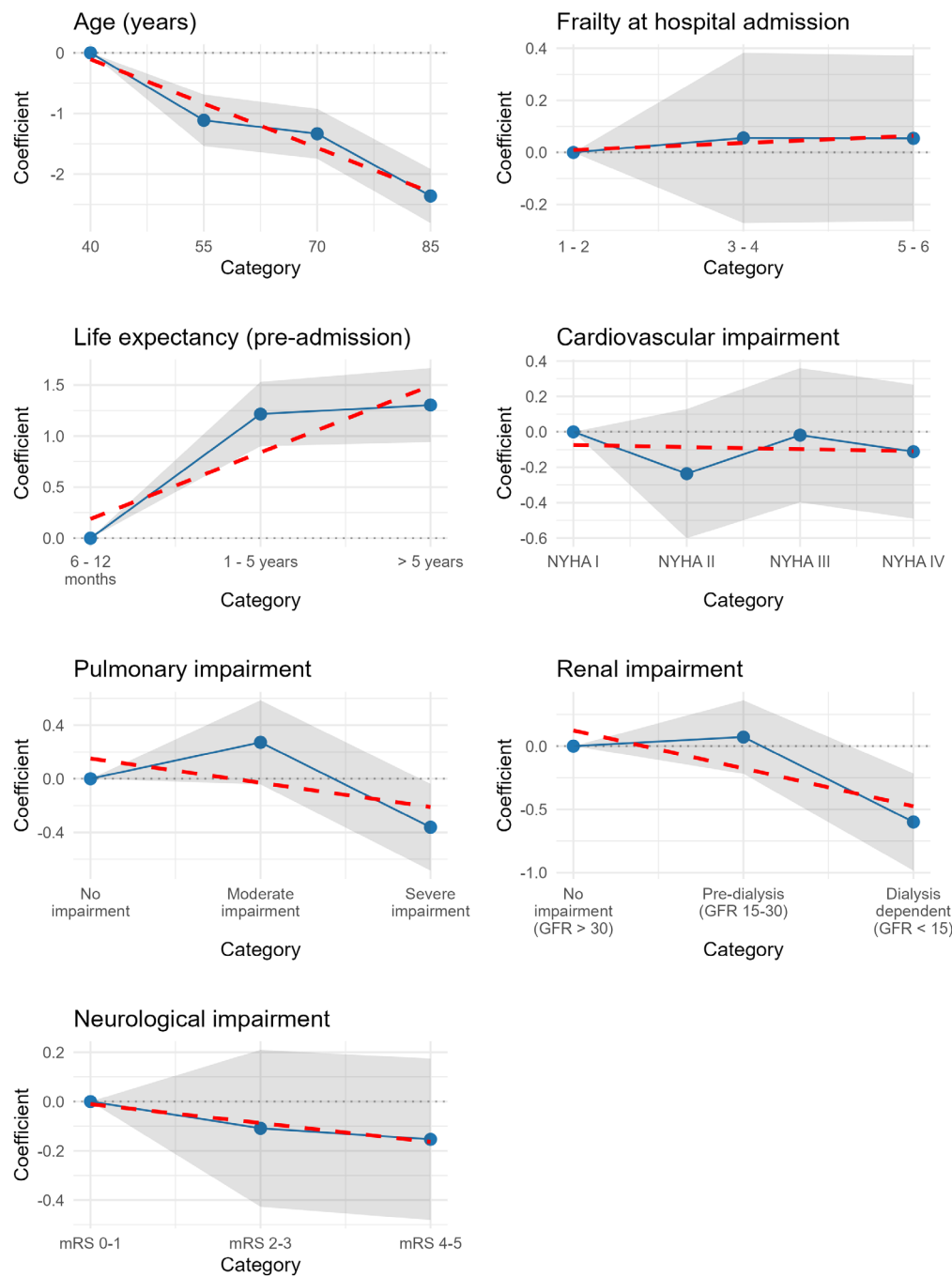


Figure S1. Ordered covariates using level-specific coefficients. Visualizes coefficients for each discretely encoded category.

Table S3. Linearity Diagnostics for Ordered Covariates

Linearity Diagnostics for Ordered Covariates

Covariate	Likelihood-ratio test (<i>p</i>) ¹	Quadratic term (<i>p</i>) ²	AIC: linear model ³	AIC: categorical model ³	Preferred functional form
Age (years)	0.020	0.934	1128.3	1124.5	Non-linear
Frailty at hospital admission	0.842	0.842	1249	1251	Linear
Life expectancy (pre-admission)	< 0.001	< 0.001	1187.6	1173.9	Non-linear
Cardiovascular impairment	0.360	0.548	1249.1	1251	Linear
Pulmonary impairment	0.002	0.002	1245.5	1237.8	Non-linear
Renal impairment	0.012	0.013	1243.4	1239.1	Non-linear
Neurological impairment	0.819	0.819	1248.3	1250.2	Linear

¹ Likelihood-ratio test comparing linear vs. level-specific coefficients model.

² Wald test for the quadratic (x^2) term in a polynomial model.

³ Akaike Information Criterion; lower values indicate better relative model support.

Table S3. Linearity Diagnostics for Ordered Covariates. Demonstrates validity of linearity assumptions using the likelihood-ratio test comparing linear vs. level-specific coefficients model, the Wald test for the quadratic (x^2) term in a polynomial model and the Akaike Information Criterion (AIC).

Figure S2. Relative importance of covariates for the binary model

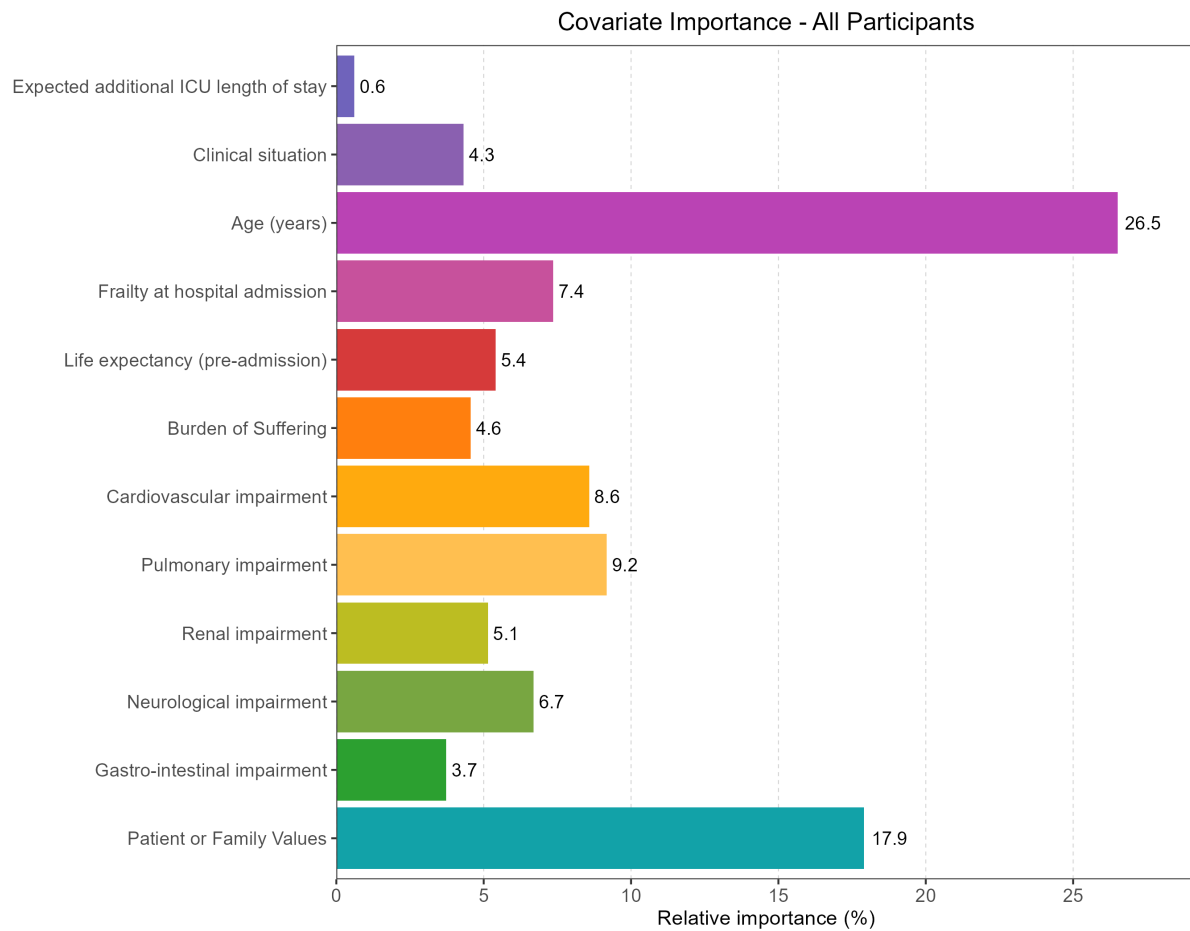


Figure S2. Relative importance of covariates for the binary model.

Expected additional ICU length of stay did not appear to significantly influence the decision to continue or withdraw life-sustaining therapy.

Figure S3. Comparison of Covariate Importance

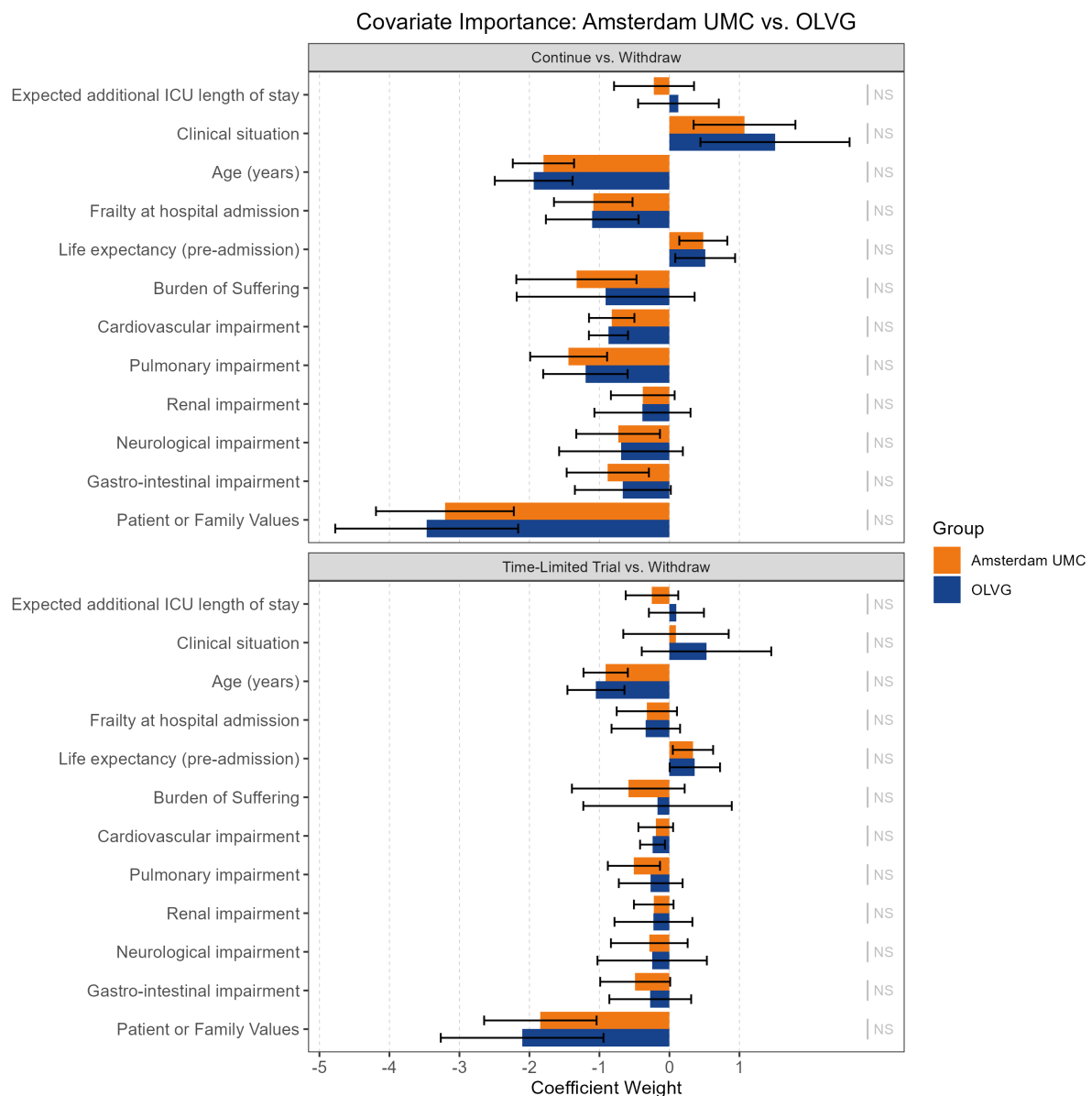


Figure S3. Comparison of Covariate Importance. Covariate importance is expressed as coefficient weights. Differences in coefficient weights were tested using the Wald test in a pooled interaction model of both groups. Error bars show 95% confidence intervals.

Abbreviations: NS not statistically significant. * $p < 0.05$. ** $p < 0.01$.