









## SPECIAL ISSUE ARTICLE

# The prognostic value of the 12-, 6-, 3- and 1-month ‘Surprise Question’ in cancer patients: A prospective cohort study in three hospitals

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## Abstract

**Objective:** This prospective study aimed to evaluate the performance of the ‘Surprise Question’ (SQ) ‘Would I be surprised if this patient died in the next 12 months?’ in predicting survival of 12, 6, 3 and 1 month(s), respectively, in hospitalised patients with cancer.

**Methods:** In three hospitals, physicians were asked to answer SQs for 12/6/3/1 month(s) for inpatients with cancer. Sensitivity, specificity, positive and negative predictive values were calculated.

**Results:** A total of 783 patients were included, of whom 51% died in the 12-month period after inclusion. Sensitivity of the SQ predicting death within 12 months was 0.79, specificity was 0.66, the positive predictive value was 0.71 and the negative predictive value was 0.75. When the SQ concerned a shorter survival period, sensitivities and positive predictive values decreased, whereas specificities and negative predictive values increased. In multivariable logistic regression analysis, the SQ was significantly associated with mortality (OR 3.93, 95% CI 2.70–5.71,  $p < 0.01$ ).

**Conclusions:** The 12-month SQ predicts death in patients with cancer admitted to the hospital reasonably well. Shortening the timeframe decreases sensitivities and increases specificities. The four surprise questions may help to identify patients for whom palliative care is indicated.

## KEYWORDS

cancer, hospital, observational study, palliative care, prognosis, Surprise Question

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## 1 | INTRODUCTION

According to the definition of the World Health Organisation, palliative care is an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness (World Health Organization, 2002). Palliative care is applicable early in the course of illness, in conjunction with other therapies that are intended to prolong life, such as chemotherapy or radiation therapy, and includes those investigations needed to better understand and manage distressing clinical complications (Sepulveda et al., 2002). Several trials and systematic reviews have shown that early palliative care, alongside disease-directed treatment, can improve quality of life and decrease symptom burden in patients with cancer (Gaertner et al., 2017; Kavalieratos et al., 2016; Temel et al., 2010; Vanbutsele et al., 2018; Zimmermann et al., 2014). However, in daily practice, palliative care is typically initiated late in the disease process, often in the last month or weeks of life (Brinkman-Stoppelenburg et al., 2018; de Oliveira Valentino et al., 2018; Hui et al., 2012).

Prognostic uncertainty and physicians not being able to identify the ideal moment in the disease trajectory to discuss palliative care are considered significant barriers to the early provision of palliative care (Ahmed et al., 2004; Horlait et al., 2016; Wentlandt et al., 2012). Physicians need easy to use instruments to identify patients who may benefit from palliative care. Over the past years, the Surprise Question (SQ) 'Would I be surprised if this patient died in the next 12 months?' has been recommended as a promising tool for such identification (Ferrell et al., 2017; IKNL/Palliatief: Quality Framework for Palliative Care in the Netherlands, 2017; O'Callaghan et al., 2014).

The SQ was first described by Pattison and Romer and by Lynn as an instrument to refer patients to end-of-life care and for palliative care teams to identify the relevant patient population (Lynn, 2005; Pattison & Romer, 2001). Over the past years, the accuracy of the SQ has mainly been studied in patients with renal disease and patients with cancer, although more recently other patients groups were studied as well (Burke et al., 2018; Moroni, Zocchi, Bolognesi, et al., 2014; Straw et al., 2019). Two systematic reviews found a total of seven studies concerning the accuracy of the SQ in cancer patients (Downar et al., 2017; White et al., 2017). In six of these studies, the timeframe of the SQ was 12 months and in one study timeframes of 7 and 30 days were studied. The studies were performed in the outpatient clinic (one study), in the home care setting (one study), in specialised palliative care services (one study), in (academic) cancer centres (two studies) and in an academic institution (one study). In these studies, the sensitivity of the 12-month SQ ranged from 48% to 84% and the specificity from 69% to 90%. Sensitivity for the 7-day SQ was 85%, and specificity was 68%. For the 30-day SQ, these values were 96% and 37%, respectively.

The patient's prognosis is an important driver of personal and clinical decision making (Hui et al., 2019). The 12-month SQ is a tool that is used to inform physicians if palliative care is indicated (Moss et al., 2010). Assessment of shorter survival periods may be useful, for instance, to determine whether a patient is eligible for hospice. However, the prognostic value of 6-month, 3-month and 1-month SQ has

rarely been studied (Downar et al., 2017; Hamano et al., 2015; White et al., 2017).

We aimed to assess the prognostic value of the SQ for different time frames in patients with cancer in two general hospitals and an academic hospital.

## 2 | METHODS

### 2.1 | Design

This study was a secondary analysis of a prospective cohort study on the effects of palliative care team consultation (Brinkman-Stoppelenburg et al., 2015). In this prospective cohort study, quality of life and costs of hospital care were compared between cancer patients for whom a palliative care team was consulted and patients for whom no such team was consulted. In three hospitals physicians were asked to answer SQs for different timeframes at the moment the patient was admitted to the hospital. The STROBE statement was used for the reporting (von Elm et al., 2014).

### 2.2 | Setting and study population

The study was performed in five wards (three oncology wards, a surgical and internal ward) in three hospitals (two general and one academic hospital) in the Netherlands. Eligible patients were 18 years or older and had been diagnosed with cancer (regardless of the stage) before admission.

### 2.3 | Measurements and methodology

For each patient, the attending physician was asked to answer four SQs: 'Would I be surprised if this patient would die within 12 month (s)?' and similar questions for 6, 3 and 1 month(s). In addition, data were collected about patients' age, sex, comorbidities, treatment status, WHO performance status and the number of previous hospital admissions. At the end of the study period (at least 12 months after the last patient was included) we assessed whether the patient was still alive or had died: if the patient had died the date of death was recorded. In one hospital, the SQs were (independently) answered by both the resident and the outpatient attending medical oncologist.

### 2.4 | Statistical analysis

The sensitivity, specificity, positive predictive value and negative predictive value were determined for the four SQs, based on  $2 \times 2$  tables. The sensitivity was the proportion of physicians that answered 'would not be surprised' for patients who actually died within the period asked. The specificity was the proportion of physicians that answered 'would be surprised' for patients who did not die within the period asked. The positive predictive value was the proportion of patients who died among patients for whom the physicians 'would not be surprised', and the negative predictive value was the

proportion of patients who survived among patients for whom the physicians 'would be surprised'.

T-tests and chi-square tests were used to identify baseline characteristics that were significantly different between patients for whom the physicians 'would be surprised' and patients for whom the physician 'would not be surprised' if the patient would die within 12 months. A Kaplan-Meier analysis was used to generate a survival curve for each group, with difference in survival calculated by log-rank.

Multivariable logistic regression was performed to study the predictive value of the SQs, when taking other clinical parameters into account, such as age, gender, type of cancer, presence of comorbidities, WHO-performance status, type of hospitalisation and treatment status. Multivariable logistic regression was conducted to identify characteristics that were significantly associated with mortality. A *p*-value of <0.05 was considered statistically significant.

**TABLE 1** Baseline characteristics of patients for whom the resident answered the 12-month surprise question (*n* = 783)

	Physician would not be surprised if the patient would die within 12 months <i>n</i> = 447 <i>n</i> (%)	Physician would be surprised if the patient would die within 12 months <i>n</i> = 336 <i>n</i> (%)	<i>p</i> -value
Age (mean, sd)	66 (12.0)	58 (17.1)	<0.01 <sup>a</sup>
Female gender	242 (55)	132 (39)	<0.01 <sup>b</sup>
Male gender	202 (46)	203(61)	
Type of hospital			
General hospital	342 (77)	247 (74)	0.34 <sup>b</sup>
Academic hospital	105 (24)	89 (27)	
Type of cancer			
Gastro-intestinal cancer	117 (26)	138 (41)	<0.01 <sup>b</sup>
Urogenital cancer	12 (3)	5 (2)	
Breast cancer	54 (12)	39 (12)	
Lung cancer	78 (18)	56 (17)	
Other	185 (42)	96 (29)	
Comorbidities			
No comorbidities	179 (40)	169 (50)	<0.01 <sup>b</sup>
1 comorbidity	152 (34)	109 (32)	
>1 comorbidities	116 (26)	58 (17)	
WHO performance status			
0 - Asymptomatic	87 (20)	162 (50)	<0.01 <sup>b</sup>
1 - Symptomatic but completely ambulatory	119 (27)	106 (32)	
2 - Symptomatic, <50% in bed during the day	102 (23)	39 (12)	
3 - Symptomatic, >50% in bed but not bedbound	93 (21)	18 (6)	
4 - Bedbound	44 (10)	2 (1)	
Hospital admission was:			
Planned	111 (25)	155 (47)	<0.01 <sup>b</sup>
Unplanned	332 (75)	175 (53)	
Treatment status at time of admission:			
Patient receives antitumour therapy	225 (51)	240 (74)	<0.01 <sup>b</sup>
Patients will possibly receive antitumour therapy in the future	57 (13)	29 (9)	
No further options for antitumour therapy	143 (32)	14 (4)	
Curative treatment/remission	9 (2)	33 (10)	
Other	7 (2)	8 (3)	

<sup>a</sup>T-test.

<sup>b</sup>Chi-square test, number of missings varied between 2 and 31.

### 3 | RESULTS

#### 3.1 | Patient characteristics

A total of 783 patients were included from five hospital departments between December 2013 and March 2015. In two medical oncology departments we were able to obtain data on the proportion of eligible patients that were included: These proportions were 80% and 73%, respectively. In the other departments, also patients with other diagnoses than cancer were admitted which made it not possible to receive data on the number of eligible cancer patients. The number of physicians that answered the SQs for these 783 patients was 119. For the majority of patients, the attending physician was a resident ( $n = 739$ ); in the remaining patients it was a medical specialist or the background of the attending physician was unknown.

For 447 (57%) patients physicians answered 'No' to the 12-month SQ and for 336 (43%) 'Yes'. Table 1 shows that patients for whom the physician answered the 12-month SQ with 'No' were older (mean age of 66 vs. 58 years,  $p < 0.01$ ), more often were female (55% vs. 39%,  $p < 0.01$ ), had different types of cancer ( $p < 0.01$ ), had more comorbidities ( $p < 0.01$ ) and had a worse WHO performance status ( $p < 0.01$ ) compared with patients for whom the physician answered 'Yes'. Furthermore, patients for whom physicians answered 'No' more often had an unplanned hospitalisation (75% vs. 53%,  $p < 0.01$ ) and more often had no further options for antitumour therapy (32% vs. 4%,  $p < 0.01$ ).

#### 3.2 | Prognostic value of the SQs

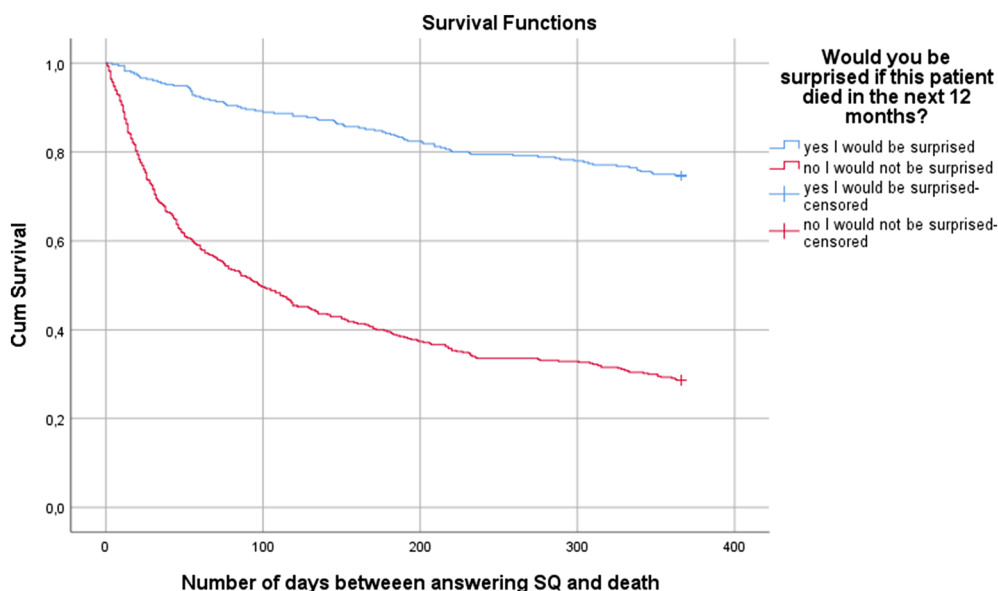
Four hundred four patients (51%) died in the 12-month period following inclusion. The difference in survival between patients for whom the 12-, 6-, 3- and 1-month SQ's were answered with 'yes' and 'no', respectively, is shown in the Kaplan-Meier curves (Figures 1-4). Of patients for whom the SQ was answered with 'no', 71% died within a

year, compared with 25% of patients for whom the SQ was answered with 'yes'.

The sensitivity of the 12-month SQ was 0.79, the specificity was 0.66, the positive predictive value was 0.71 and the negative predictive value was 0.75. When the SQ concerned a shorter survival, the sensitivity and positive predictive value decreased, and the specificity and negative predictive value increased (Table 2). Predictive values for the 12-month SQ differed between the three hospitals. Sensitivity was 0.75 (95% CI 0.65-0.85), 0.78 (95% CI 0.73-0.83) and 0.85 (95% CI 0.77-0.93) respectively; specificity 0.49 (95% CI 0.38-0.61), 0.71 (95% CI 0.65-0.77) and 0.69, (95% CI 0.60-0.77); positive predictive value 0.57 (95% CI 0.47-0.68), 0.78 (95% CI 0.73-0.83) and 0.67 (95% CI 0.58-0.76); and negative predictive value 0.69 (95% CI 0.56-0.81), 0.71(95% CI 0.65-0.77) and 0.87 (95% CI 0.79-0.94).

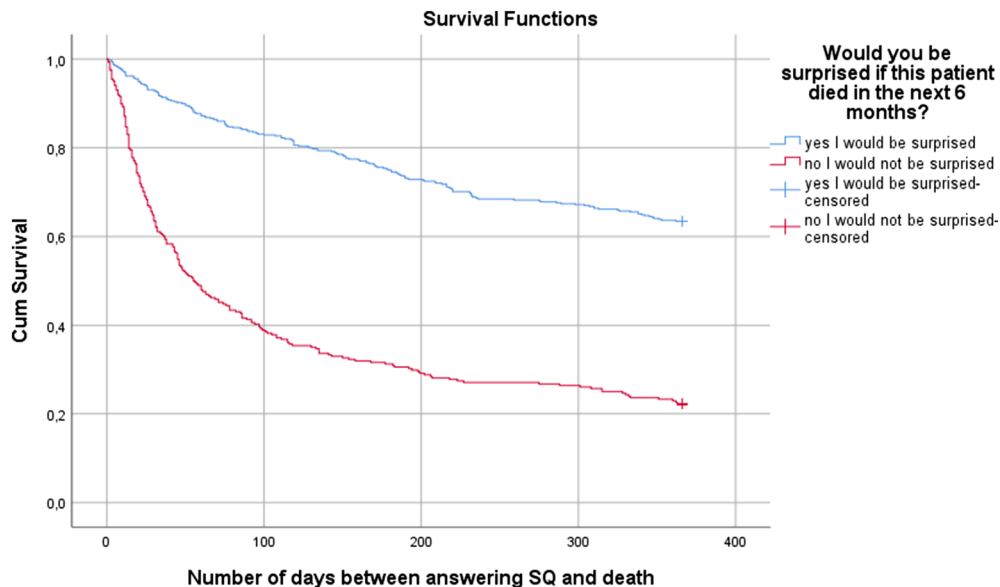
In one hospital, sensitivity, specificity, positive and negative predictive values were calculated for answers from medical oncologists attending the patient in the outpatient setting and residents responsible for the patient during clinical admittance separately. Sensitivity and negative predictive value for the 12-month SQ were 0.94 (95% CI 0.87-1.00) and 0.95 (95% CI 0.89-1.00) for medical oncologists, compared with 0.85 (95% CI 0.77-0.93) and 0.87 (95% CI 0.79-0.94) for residents. Sensitivity and negative predictive value for the other SQs were also higher for the medical oncologists than for residents, but the differences were not statistically significant.

In multivariable logistic regression analyses that took other clinical parameters into account, the 12-month SQ remained significantly associated with 1-year mortality (odds ratio 3.93, 95% confidence interval 2.70-5.71,  $p < 0.01$ ) (Table 3). Other characteristics that were associated with death within a year were WHO performance status, having no further options for antitumour therapy, having an unplanned hospitalisation and type of cancer. The same characteristics, including the 6-month, 3-month and 1-month SQ, were significantly associated with death with 6, 3 and 1 month(s), respectively. The 3-months and 1-month SQ were also significantly associated with age (see Tables 4-9).

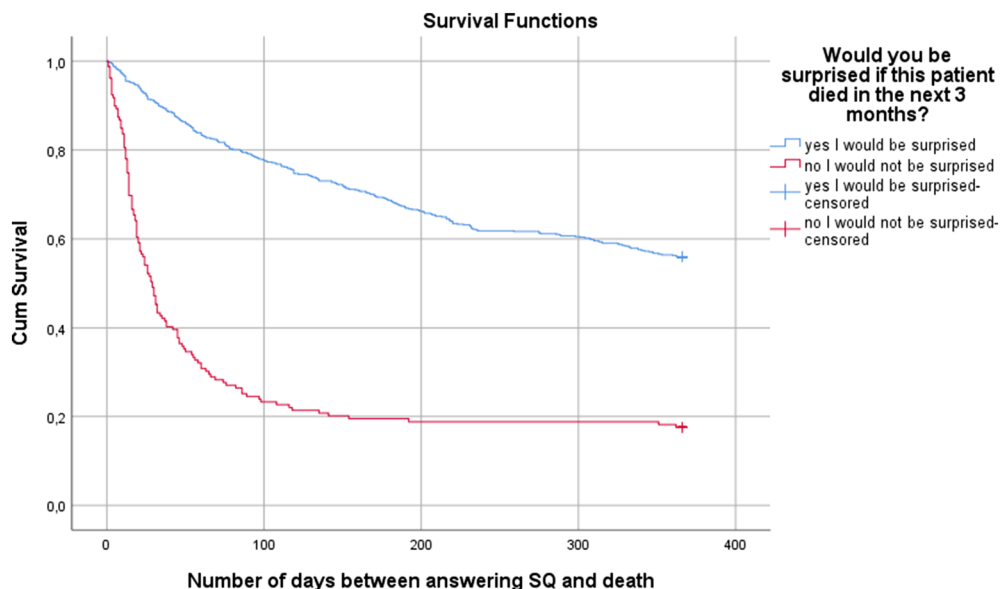


**FIGURE 1** Kaplan Meier survival curve for patients for whom the 12-month surprise question was answered with 'yes' and 'no' ( $n = 783$ )

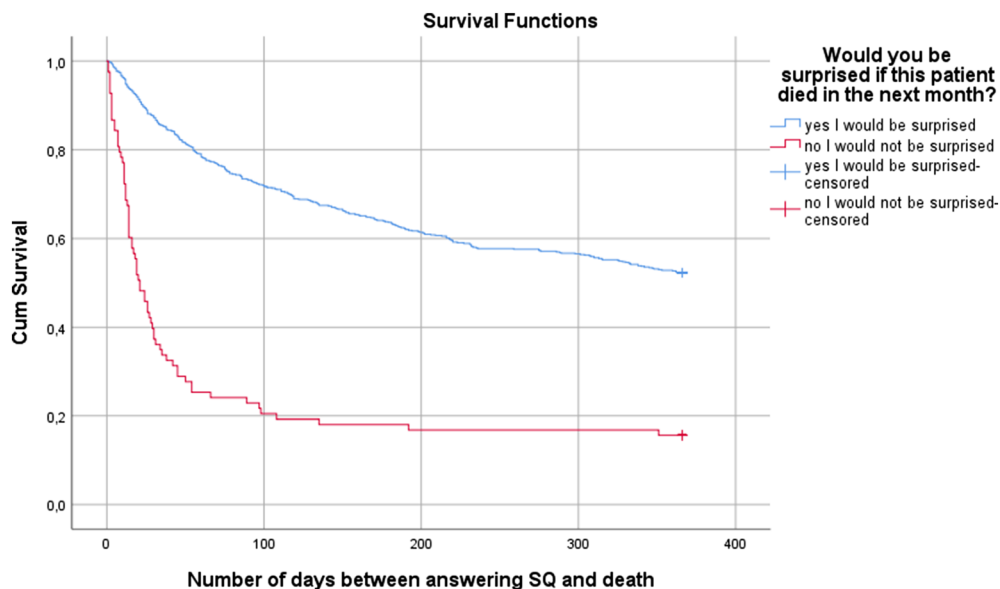
**FIGURE 2** Kaplan Meier survival curve for patients for whom the 6-month surprise question was answered with 'yes' and 'no' (n = 767)



**FIGURE 3** Kaplan Meier survival curve for patients for whom the 3-month surprise question was answered with 'yes' and 'no' (n = 767)



**FIGURE 4** Kaplan Meier survival curve for patients for whom the 1-month surprise question was answered with 'yes' and 'no' (n = 757)



**TABLE 2** Surprise questions response and outcomes ( $n = 783$ )

	Physicians' response:	Patient died	Patient survived	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
12-month surprise question	No or not surprised	319	128	0,79 (0.75–0.83)	0,66 (0.62–0.71)	0,71 (0.67–0.76)	0,75 (0.70–0.79)
	Yes or surprised	85	251				
6-month surprise question	No or not surprised	198	91	0,62 (0.57–0.67)	0,80 (0.76–0.84)	0,69 (0.63–0.74)	0,75 (0.70–0.79)
	Yes or surprised	121	359				
3-month surprise question	No or not surprised	120	39	0,49 (0.42–0.55)	0,93 (0.90–0.95)	0,76 (0.69–0.82)	0,79 (0.76–0.82)
	Yes or surprised	127	483				
1-month surprise question	No or not surprised	52	31	0,38 (0.30–0.46)	0,95 (0.93–0.97)	0,63 (0.52–0.73)	0,87 (0.85–0.90)
	Yes or surprised	86	590				

Abbreviations: NPV, negative predictive value; PPV, positive predictive value.

Variable	Odds ratio	95% CI	<i>p</i> -value
Age	1.00	0.99–1.01	0.91
Female gender	Ref		
Male gender	0.87	0.60–1.27	0.48
Type of cancer			
Gastro-intestinal cancer	Ref		
Urogenital cancer	1.72	0.52–5.69	0.37
Breast cancer	0.83	0.45–1.54	0.56
Lung cancer	1.32	0.79–2.20	0.29
Other	1.70	1.10–2.63	0.02
Comorbidities			
No comorbidities	Ref		
1 comorbidity	1.00	0.67–1.50	0.99
>1 comorbidities	1.23	0.77–1.95	0.39
WHO-performance status	1.20	1.01–1.42	0.04
Hospital admission was:			
Planned	Ref		
Unplanned	1.78	1.21–2.63	<0.01
Treatment status at time of admission:			
Patient receives antitumour therapy	Ref		
Patients will possibly receive at in the future	1.44	0.85–2.46	0.18
No further options for antitumour therapy	3.35	1.91–5.85	<0.01
Curative treatment/remission	0.51	0.22–1.19	0.12
Other	1.95	0.62–6.13	0.25
Physician would be surprised if the patient would die within 12 months	Ref		
Physician would <b>not</b> be surprised if the patient would die within 12 months	3.93	2.70–5.71	<0.01

**TABLE 3** Multivariable logistic regression analysis for death within 12 months ( $n = 783$ )

**TABLE 4** Baseline characteristics of patients for whom the resident answered the 6-month surprise question ( $n = 767$ )

	Physician would not be surprised if the patient would die within 6 months $n = 288$ $n$ (%)	Physician would be surprised if the patient would die within 6 months $n = 479$ $n$ (%)	$p$ -value
Age (mean, sd)	67 (12.0)	60 (16.0)	<0.01 <sup>a</sup>
Female gender	163 (57)	206 (43)	<0.01 <sup>b</sup>
Male gender	123 (43)	271 (57)	
Type of hospital			
General hospital	219 (76)	354 (74)	0.51 <sup>b</sup>
Academic hospital	69 (24)	125 (26)	
Type of cancer			
Gastro-intestinal cancer	66 (23)	185 (39)	<0.01 <sup>b</sup>
Urogenital cancer	10 (4)	7 (2)	
Breast cancer	39 (14)	54 (11)	
Lung cancer	51 (18)	83 (17)	
Other	121 (42)	148 (31)	
Comorbidities			
No comorbidities	115 (40)	225 (47)	<0.01 <sup>b</sup>
1 comorbidity	91 (32)	163 (34)	
>1 comorbidities	82 (29)	91 (19)	
WHO performance status			
0 - asymptomatic	46 (16)	201 (43)	<0.01 <sup>b</sup>
1 - symptomatic but completely ambulatory	60 (21)	158 (34)	
2 - symptomatic, <50% in bed during the day	57 (20)	79 (17)	
3 - symptomatic, >50% in bed but not bedbound	84 (29)	26 (6)	
4 - bedbound	39 (14)	6 (1)	
Hospital admission was:			
Planned	62 (22)	195 (41)	<0.01 <sup>b</sup>
Unplanned	223 (78)	277 (59)	
Treatment status at time of admission:			
Patient receives antitumour therapy	117 (41)	345 (74)	<0.01 <sup>b</sup>
Patients will possibly receive antitumour therapy in the future	37 (13)	47 (10)	
No further options for antitumour therapy	124 (44)	33 (7)	
Curative treatment/remission	2 (1)	32 (7)	
Other	5 (2)	7 (2)	

<sup>a</sup>T-test.<sup>b</sup>Chi-square test, number of missings varied between 0 and 34.

## 4 | DISCUSSION

In our study we assessed the accuracy of the SQ for different time-frames. We found a sensitivity of the 12-month SQ of 0.79, a specificity of 0.66, a positive predictive value of 0.71 and a negative

predictive value of 0.75. In our study the 12-month SQ sensitivity and positive predictive value were higher compared with most other studies, whereas the specificity and negative predictive value were lower (Downar et al., 2017; White et al., 2017). In a recent study among patients with metastasized or incurable cancer who were admitted to

**TABLE 5** Baseline characteristics of patients for whom the resident answered the 3-month surprise question ( $n = 767$ )

	Physician would not be surprised if the patient would die within 3 months $n = 159$ $n$ (%)	Physician would be surprised if the patient would die within 3 months $n = 608$ $n$ (%)	$p$ -value
Age (mean, sd)	66 (13.0)	62 (15.0)	<0.01 <sup>a</sup>
Female gender	98 (58)	278 (46)	<0.01 <sup>b</sup>
Male gender	66 (42)	327 (54)	
Type of hospital			
General hospital	121 (76)	452 (74)	0.65 <sup>b</sup>
Academic hospital	38 (24)	156 (26)	
Type of cancer			
Gastro-intestinal cancer	32 (20)	218 (36)	<0.01 <sup>b</sup>
Urogenital cancer	6 (4)	11 (2)	
Breast cancer	22 (14)	71 (12)	
Lung cancer	29 (18)	105 (17)	
Other	70 (44)	200 (33)	
Comorbidities			
No comorbidities	66 (42)	274 (45)	0.15 <sup>b</sup>
1 comorbidity	48 (36)	206 (34)	
>1 comorbidities	45 (28)	128 (21)	
WHO performance status			
0 - asymptomatic	16 (10)	231 (39)	<0.01 <sup>b</sup>
1 - symptomatic but completely ambulatory	21 (13)	196 (33)	
2 - symptomatic, <50% in bed during the day	23 (15)	114 (19)	
3 - symptomatic, >50% in bed but not bedbound	61 (38)	49 (8)	
4 - bedbound	38 (24)	7 (1)	
Hospital admission was:			
Planned	23 (15)	234 (39)	<0.01 <sup>b</sup>
Unplanned	134 (85)	366 (61)	
Treatment status at time of admission:			
Patient receives antitumour therapy	41 (26)	421 (71)	<0.01 <sup>b</sup>
Patients will possibly receive antitumour therapy in the future	15 (10)	69 (12)	
No further options for antitumour therapy	98 (62)	59 (10)	
Curative treatment/remission	1 (1)	33 (6)	
Other	2 (1)	10 (2)	

<sup>a</sup>T-test.<sup>b</sup>Chi-square test, number of missings varied between 0 and 34.

an emergency department of an academic centre, a higher sensitivity (89%) was found, probably related to the specific population (Verhoef et al., 2020). Patients for whom the physician answered the 12-month SQ with 'no' differed on several characteristics from patients for whom the physician answered 'Yes', as was found in the study by

Moss et al. (Moss et al., 2010). In the multivariable analyses the 12-month SQ remained significantly associated with 1-year mortality together with the WHO performance status, having no further options for antitumour therapy, having an unplanned hospitalisation and type of cancer. In other studies, 1-year mortality was also



**TABLE 6** Baseline characteristics of patients for whom the resident answered the 1-month surprise question ( $n = 757$ )

	Physician would not be surprised if the patient would die within 1 month $n = 83$ $n (%)$	Physician would be surprised if the patient would die within 1 month $n = 674$ $n (%)$	$p$ -value
Age (mean, sd)	64 (13.0)	62 (15.0)	<0.36 <sup>a</sup>
Female gender	48 (58)	316 (47)	0.07 <sup>b</sup>
Male gender	35 (42)	354 (54)	
Type of hospital			
General hospital	53 (64)	510 (76)	0.02 <sup>b</sup>
Academic hospital	30 (36)	164 (24)	
Type of cancer			
Gastro-intestinal cancer	17 (21)	230 (34)	0.17 <sup>b</sup>
Urogenital cancer	2 (2)	15 (2)	
Breast cancer	12 (15)	80 (12)	
Lung cancer	18 (22)	114 (17)	
Other	34 (41)	232 (35)	
Comorbidities			
No comorbidities	38 (46)	300 (45)	0.94 <sup>b</sup>
1 comorbidity	26 (31)	224 (33)	
>1 comorbidities	19 (23)	150 (22)	
WHO performance status			
0 - asymptomatic	5 (6)	239 (36)	<0.01 <sup>b</sup>
1 - symptomatic but completely ambulatory	5 (6)	208 (31)	
2 - symptomatic, <50% in bed during the day	10 (12)	127 (19)	
3 - symptomatic, >50% in bed but not bedbound	34 (41)	75 (11)	
4 - bedbound	29 (35)	15 (2)	
Hospital admission was:			
Planned	12 (15)	242 (36)	<0.01 <sup>b</sup>
Unplanned	70 (85)	423 (64)	
Treatment status at time of admission:			
Patient receives antitumour therapy	15 (18)	442 (67)	<0.01 <sup>b</sup>
Patients will possibly receive antitumour therapy in the future	5 (6)	77 (12)	
No further options for antitumour therapy	60 (72)	95 (15)	
Curative treatment/remission	1 (1)	33 (5)	
Other	2 (2)	10 (2)	

<sup>a</sup>T-test.<sup>b</sup>Chi-square test, number of missings varied between 0 and 34.

associated with the 12-month SQ, recurrent disease and more than two lines of chemotherapy (Rauh et al., 2020) and stage of cancer (Moss et al., 2010).

This is one of the first studies to assess the accuracy of the SQ to estimate the likelihood that a patient dies within 6 months, 3 months,

or 1 month. Assessment of these shorter survival periods may be useful for health care professionals, for instance, to determine whether or not a patient is eligible for admission in a hospice. The sensitivity and PPV decreased as the timeframe for the SQ decreased, whereas the specificity and NPV increased. The finding that sensitivity decreases

**TABLE 7** Multivariable logistic regression analysis for death within 6 months ( $n = 783$ )

Variable	Odds ratio	95% CI	<i>p</i> -value
Age	1.01	1.00–1.03	0.15
Female gender	Ref		
Male gender	0.91	0.62–1.35	0.64
Type of cancer			
Gastro-intestinal cancer	Ref		
Urogenital cancer	1.15	0.35–3.72	0.82
Breast cancer	1.24	0.66–2.32	0.51
Lung cancer	1.97	1.16–3.35	0.01
Other	1.78	1.14–2.80	0.01
Comorbidities			
No comorbidities 1	Ref		
1 comorbidity	1.09	0.72–1.65	0.69
>1 comorbidities	1.22	0.76–1.95	0.41
WHO-performance status	1.19	1.00–1.41	0.05
Hospital admission was:			
Planned	Ref		
Unplanned	2.12	1.40–3.21	<0.01
Treatment status at time of admission:			
Patient receives antitumour therapy	Ref		
Patients will possibly receive at in the future	1.53	0.90–2.62	0.12
No further options for antitumour therapy	3.60	2.14–6.05	<0.01
Curative treatment/remission	0.65	0.25–1.72	0.39
Other	1.63	0.48–5.54	0.43
Physician would be surprised if the patient would die within 12 months	Ref		
Physician would <b>not</b> be surprised if the patient would die within 6 months	3.18	2.14–4.72	<0.01

as the timeframe for the SQ decreased might imply that it is difficult to identify patients who are going to die on a shorter time frame. It could also be that physicians are more hesitant to answer the SQ with the shorter time frames with 'no' on because being wrong then may have a bigger undesirable impact (Elliott & Nicholson, 2017; Haydar et al., 2017). A study by Hamano et al. (2015) including 2361 patients with advanced cancer reported a high sensitivity for the 30-day SQ (95.6%) and for the 7-day SQ (84.7%) (Hamano et al., 2015). This may be associated with the specific settings in which patients were recruited: hospital-based palliative care teams, palliative care units and home-based palliative care services (Hamano et al., 2015).

Studies have shown that physicians tend to overestimate the survival of patients with advanced cancer (Christakis & Lamont, 2000). Failure to adequately estimate such patients' prognosis may lead to a delay in communication and in identifying patients' values and wishes for subsequent treatment, which may include a preference for palliative care instead of or alongside other therapies (Moss et al., 2010).

However, as stated by Costantini et al. (2017), prognosis (alone) should not be the driver for referral to palliative care: assessment of the physical, social, psychological and spiritual needs of the patient are crucial (Costantini et al., 2017). The SQ can be used as a tool to ensure that patients who are at the end of life and who can benefit from (specialist) palliative care are identified in a timely manner. A 'no' answer to the SQ may raise awareness in physicians that a multi-dimensional screening for symptoms, problems and needs is warranted and that (referral to specialist) palliative care may be indicated. A tool such as the Edmonton Symptom Assessment System may be useful for such screening (Hui & Bruera, 2017).

#### 4.1 | Strengths and limitations

Strengths of this study are that this was a relatively large cohort of patients evaluated across five departments of three hospitals,

**TABLE 8** Multivariable logistic regression analysis for death within 3 months ( $n = 783$ )

Variable	Odds ratio	95% CI	p-value
Age	1.02	1.00–1.03	0.03
Female gender	Ref		
Male gender	0.80	0.53–1.22	0.30
Type of cancer			
Gastro-intestinal cancer	Ref		
Urogenital cancer	1.09	0.31–3.84	0.89
Breast cancer	1.33	0.68–2.58	0.41
Lung cancer	1.86	1.06–3.28	0.03
Other	1.73	1.06–2.80	0.03
Comorbidities			
No comorbidities	Ref		
1 comorbidity	0.95	0.61–1.48	0.82
>1 comorbidities	1.30	0.79–2.12	0.30
WHO-performance status	1.21	1.01–1.45	0.04
Hospital admission was:			
Planned	Ref		
Unplanned	2.10	1.32–3.34	<0.01
Treatment status at time of admission:			
Patient receives antitumour therapy	Ref		
Patients will possibly receive at in the future	1.68	0.96–2.97	0.07
No further options for antitumour therapy	2.73	1.63–4.55	<0.01
Curative treatment/remission	0.39	0.11–1.36	0.14
Other	1.28	0.35–4.70	0.71
Physician would be surprised if the patient would die within 12 months	Ref		
Physician would <u>not</u> be surprised if the patient would die within 3 months	4.60	2.77–7.66	<0.01

allowing for results to be more generalizable. However, the importance and usefulness of the different versions of the SQ may depend on the setting and specific circumstances. A limitation is that for three out of five departments, we were not able to collect data on the percentage of eligible patients enrolled in our study. These departments also admitted patients with other diagnoses than cancer, and we were not able to obtain the specific number of admitted patients with cancer. It may be that for some patients, especially during busy periods or out of office hours, physicians forgot or did not have time to fill in the questionnaire. If this was the case, this occurred probably 'at random' and may therefore not have led to selection bias.

**TABLE 9** Multivariable logistic regression analysis for death within 1 month ( $n = 783$ )

Variable	Odds ratio	95% CI	p-value
Age	1.03	1.01–1.05	0.02
Female gender	Ref		
Male gender	1.26	0.74–2.14	0.39
Type of cancer			
Gastro-intestinal cancer	Ref		
Urogenital cancer	3.09	0.81–11.80	0.10
Breast cancer	3.29	1.45–7.48	0.01
Lung cancer	1.49	0.71–3.13	0.29
Other	2.17	1.17–4.03	0.01
Comorbidities			
No comorbidities	Ref		
1 comorbidity	0.80	0.46–1.40	0.43
>1 comorbidities	1.35	0.75–2.42	0.32
WHO-performance status	1.35	1.09–1.67	<0.01
Hospital admission was:			
Planned	Ref		
Unplanned	1.98	1.06–3.70	0.03
Treatment status at time of admission:			
Patient receives antitumour therapy	Ref		
Patients will possibly receive at in the future	2.25	1.12–4.55	0.02
No further options for antitumour therapy	4.63	2.60–8.23	<0.01
Curative treatment/remission	0.61	0.13–2.90	0.54
Other	1.34	0.26–6.87	0.72
Physician would be surprised if the patient would die within 12 months	Ref		
Physician would <u>not</u> be surprised if the patient would die within 1 month	4.15	2.12–8.15	<0.01

## 5 | CONCLUSION

We conclude that the SQ is a relatively simple and rather effective tool to identify patients with cancer who are at risk of dying within 12, 6, 3 or 1 months, which can facilitate timely assessment of patients with palliative care needs.

## ETHIC STATEMENT

Data were collected anonymously. The research protocol was submitted to the Medical Ethical Research Committee of the Erasmus MC,

University Medical Center Rotterdam that declared that there were no objections to the performance of this study (MEC-2012-259).

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## CONFLICT OF INTEREST

All authors declare that they have no conflict of interest. The study was conducted independent from the funders. All authors have full access to all the data (including statistical reports and tables) in the study and take responsibility for the integrity of the data and the accuracy of the analysis. AvdH and AS designed the study and analysed the data. NG, JMT, YvdL, SL and AvdP were involved in collecting the data. AS and MA drafted the paper. DN gave advice regarding the statistical analysis. All authors made a substantial contribution to the interpretation of the data and revised the paper critically for important intellectual content.

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## DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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