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Predicting one-year mortality in heart failure using the 'Surprise Question': a prospective pilot study.

Sam Straw MB[1]
Rowenna Byrom RN[2]
John Gierula PhD[2]
Maria F Paton MSc[2]
Aaron Koshy MB[2]
Richard Cubbon PhD[2]
Michael Drozd MB[2]
Mark Kearney MD[2],
Klaus K Witte MD[2]*

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[1] Department of Cardiology, Leeds Teaching Hospitals NHS Trust, Leeds, UK
[2] Leeds Institute of Cardiovascular and Metabolic Medicine, University of Leeds, Leeds, UK

*Corresponding author
Dr Klaus K Witte
Division of Cardiovascular and Diabetes Research,
Multidisciplinary Cardiovascular Research Centre (MCRC),
Leeds Institute of Cardiovascular and Metabolic Medicine,
LIGHT Building, University of Leeds,
Clarendon Way, Leeds, LS2 9JT,
UK.
Phone: (+44) 113 3926108
Email: k.k.witte@leeds.ac.uk

Abstract

Background: The Surprise Question: “would you be surprised if this patient were to die within the next year?” has been shown to predict mortality in patients with chronic kidney disease and cancer. This prospective study aimed to determine whether the Surprise Question could identify heart failure patients with a prognosis of less than one year, and whether the Surprise Question can be used by different healthcare professionals.

Methods and results: 129 consecutive patients admitted with decompensated heart failure were included. Doctors and nurses were asked to provide a ‘surprised’ or ‘not surprised’ response to the Surprise Question for each patient. Patients were followed up until death or one year following study inclusion. The sensitivity, specificity, positive predictive value and negative predictive value of the Surprise Question were assessed. Cox-regression was used to determine covariates significantly associated with survival. The Surprise Question showed excellent sensitivity (0.85) and negative predictive value (0.88) but only fair specificity (0.59) and positive predictive value (0.52) when asked of cardiologists. There were similar levels of accuracy between doctors and specialist nurses. The Surprise Question was significantly associated with all-cause mortality in multivariate regression analysis (HR 2.8,1.0-7.9, p=0.046).

Discussion: This study demonstrates that the Surprise Question can identify heart failure patients within the last year of life. Despite over-classification of patients into the ‘not surprised’ category, the Surprise Question identified nearly

all patients who were within the last year of life, whilst also accurately identifying those unlikely to die.

Abstract word count: 242

Key words: Surprise Question, heart failure, palliative care

Abbreviations list:

UK – United Kingdom

eGFR – estimated glomerular filtration rate

mg – miligrams

LVEF – left ventricular ejection fraction

ONS – Office of National Statistics

Manuscript text

Background

The 'Surprise Question' has been proposed as a screening tool that may identify patients within the last year of life. It aims to guide future care planning and where appropriate, prompt earlier referral to specialist palliative care services[1-4]. Although clinician predicted prognosis is simple and convenient, it may lack accuracy due to a tendency to overestimate survival[5-7]. The Surprise Question aims to redress this tendency by asking whether it is possible rather than probable that a patient might die[8]. It does not require the clinician to provide an estimate of prognosis in time, rather it poses a reflective question: "would you be surprised if this patient were to die within the next year?".

The Surprise Question forms part of the Gold Standards Framework tool in the United Kingdom (UK) and is recommended as a first step to aid recognition that patients are nearing the end of life[9, 10]. It is also included in the National Institute of Health and Clinical Excellence guidance on end of life care[11]. The recent European Guidelines on the diagnosis and treatment of chronic heart failure describe the importance of end-of-life care in people with heart failure [12]. Despite increasing awareness and a clear need, only a small proportion of patients with advanced heart failure receive early access to specialist palliative care services[13].

The Surprise Question has been validated in patients with cancer and in those with and without dialysis-dependent chronic kidney disease in whom it reliably and accurately predicts survival[2, 14-23]. Although decompensation of heart

failure requiring hospitalisation is a poor prognostic sign, many patients subsequently have long periods of relative stability, and it is this characteristic non-linear trajectory of heart failure which casts doubt as to whether the Surprise Question is an appropriate tool.

The aims of this study were firstly to determine whether the Surprise Question could identify heart failure patients with a prognosis of less than one year, and secondly whether the Surprise Question can be used by different healthcare professionals involved with their care.

Methods

Consecutive patients hospitalised through the cardiology admissions unit at the Leeds General Infirmary between 23/05/2016 and 17/11/2016 were assessed for study inclusion. Inclusion and exclusion criteria were deliberately kept minimal to reflect clinical practice. Eligibility required a primary diagnosis of decompensated heart failure with clear and objective evidence of cardiac dysfunction. Patients with a primary admission diagnosis other than heart failure and those with heart failure consequent to an acute coronary syndrome at admission were excluded. We also excluded patients in whom active medical treatment had been withdrawn due to an existing decision to provide only palliative care.

Each healthcare professional agreeing to participate was informed of the project prior to commencing the study, provided with an information sheet and offered the opportunity to provide informed written consent. Healthcare

professionals were provided with the opportunity to opt out of the study and were advised they did not need to provide reasons for doing so, however none did. Participants for each patient included the responsible cardiologist (specialist physician), the non-specialist trainee-grade doctor (between zero and four year's clinical experience), the heart failure nurse specialist and non-specialist nurse assigned to the patient in question. On each occasion, for each group we sought to identify the individual most familiar with the patient's case. For cardiologists, this was the named cardiologist in charge of the patient's case; for trainee-grade doctors, the doctor who had most recently reviewed the patient's case; for heart failure specialist nurses, the heart failure nurse who had reviewed the patient's case during their admission and for non-specialist nurses, the nurse assigned to the patient on the day in question.

Healthcare professionals were approached individually and asked the question "would you be surprised if this patient were to die within the next year?" and asked to provide a 'surprised' or 'not surprised' response. Respondents were blinded to answers given by other healthcare professionals and not required to justify their answer. No time restrictions were stipulated, nor were participants required to review any of the patient's medical history, laboratory results or imaging, but neither were they blinded to them.

In addition to responses to the Surprise Question, we collected patient demographics including age, sex, comorbidities and medications, baseline characteristics including blood results (serum haemoglobin, eGFR, albumin), most recent echocardiogram, peripheral oedema (clinical diagnosis) or

pulmonary oedema (rales on auscultation, radiological evidence of congestion or both), primary diagnosis (as stipulated by the cardiologist in charge of the patient's care) and not-for-resuscitation decision at time of study inclusion. Medications were those prescribed prior to admission as recorded in the medical record, and were considered as categorical, except for the dosage of loop diuretic which was calculated as furosemide dosage equivalent over 24-hours, where either 40mg of furosemide or 1mg of bumetanide was assigned a value of 40.

Patients were followed up until death or one year following study inclusion. Outcomes data were obtained from the Leeds Teaching Hospitals NHS trust electronic health record, which updates mortality events daily directly from the UK Office of National Statistics (ONS) database. The ONS records all births and deaths within the UK. Where possible, dates of death were confirmed from the hospital medical record.

Continuous variables are expressed as means and standard deviation, categorical as number and percentages. Simple statistical analysis by 2x2 tables was conducted to determine sensitivity, specificity, positive predictive value, and negative predictive value. The sensitivity was the probability of patients being identified as 'not surprised' who subsequently died, specificity the probability of patients being identified as 'surprised' who survived. The positive predictive value was the probability of death in patients identified as 'not surprised' and the negative predictive value was the probability of survival in those identified as 'surprised'.

Further statistical analysis was conducted using SPSS Statistics 23 for Windows. Unadjusted survival determined by Kaplan-Meier analysis with difference in survival calculated by log-rank. Baseline characteristics that were significantly different between 'surprised' and 'not surprised' response and all-cause mortality or survival were determined by t-tests or chi-squared testing for continuous and categorical variables respectively. Multivariable regression was then conducted by Cox-regression analysis for characteristics significantly associated with one-year survival. Age and sex were included in all models, and a *p* value of less than 0.05 was regarded as statistically significant. Kappa agreement statistics were calculated for cases with responses from all participants, values were graded as poor agreement (<0), slight (0 – 0.2), fair (0.21 – 0.4), moderate (0.41 – 0.6), substantial (0.61 – 0.8) or near perfect 0.81 – 1)[24].

The study was sponsored by the University of Leeds and received ethical approval from the Health Research Authority following proportionate review by the North East – Tyne and Wear South Research Ethics Committee (IRAS 182067), who agreed that patient consent was not required. No specific funding was provided for the completion of this project.

Results

During recruitment we collected information and responses on 129 consecutive patients admitted with heart failure, whose vital status was followed until death or one year following study inclusion. One patient admitted with

decompensated heart failure was not included in the study due to an immediate appreciation upon hospitalisation of being within the last days of life, leading to a documented decision to provide only palliative care (Supplementary figure 1). Table 1 shows baseline demographics of these 129 patients, who had an average age of 71 ± 14 years and 81 (63%) of whom were male. Left ventricular ejection fraction (LVEF) was preserved (50-70%) in 21 cases (16%), mildly impaired (40-49%) in 23 (18%), moderately impaired (30-39%) in 25 (19%) and severely impaired (<30%) in 60 (47%). The mean number of admissions in the previous year was 0.95 ± 1.4 and the length of stay was 14 ± 13 days. None of the patients in the present series received intubation, inotropes or were admitted to the intensive care unit. At the time of inclusion, 17 patients were in NYHA class II, 101 in class III and 10 in class IV.

Complete follow-up was available for all patients. All-cause mortality at one year was 34% (n=44). Baseline characteristics predicting all-cause mortality at one year were advanced age, poor renal function, anaemia, low serum albumin, higher dosage of diuretic on admission, ischaemic heart disease, history of current or previous malignancy and not-for-resuscitation status at time of study inclusion. LVEF was not significantly associated with all-cause mortality in these hospitalized patients (Table 1).

The overall response rate to the Surprise Question by cardiologists was 114 (88%). Cardiologists were able to identify those within the last year of life with a sensitivity of 0.85 and were also able to identify those who were unlikely to die within a year, with a high negative predictive value of 0.88. The positive

predictive value of a ‘not surprised’ response was 0.52 and the specificity 0.59 (Table 2). However, a ‘not surprised’ response was associated with reduced survival and this was statistically significant in unadjusted survival analysis (Figure 1).

Respondents were not required to justify their response to the Surprise Question, although ‘not surprised’ responses from cardiologists were associated with advanced age, poor renal function, anaemia and low serum albumin but not with left ventricular ejection fraction (Table 1).

In regression analysis, a ‘not surprised’ response from cardiologists was significantly associated with reduced survival (HR 4.6, 95% CI 1.8-11.8, p=0.001) as were a lower eGFR, haemoglobin, serum albumin, history of cancer and not-for-resuscitation decision; whilst a presentation with pulmonary oedema was associated with increased survival (Table 3). When adjusted for important clinical covariates (age, sex, eGFR, albumin, furosemide equivalent dose), the association between a ‘not surprised’ response to the Surprise Question and survival remained significant (HR 2.8, 95% CI 1.0-7.9, p=0.046) (Table 4).

Response rates amongst other participants were: trainee-grade doctors 128 (99%), heart failure specialist nurses 89 (69%) and non-specialist nurses 123 (95%). There were similar rates of accuracy across all four groups of healthcare professionals with high sensitivity and negative predictive values although

overall there was an over-classification of patients as ‘not surprised’ (Table 2 and Supplementary Table 1).

The probability of death was increased when there was concordance between participants (Table 2). When all participants answered ‘not surprised’, patients were far more likely to die, but this approach reduced the sensitivity. With a trade-off between increasing confidence of a prognosis of less than one year, and the possibility of not identifying patients at risk of deterioration.

Agreement was substantial between cardiologists and heart failure nurses (Kappa = 0.69, 95% CI 0.52 – 0.86), and moderate with trainee-grade doctors (Kappa = 0.57, 95% CI 0.39 – 0.75). Agreement between trainee grade doctors and heart failure nurses was moderate (Kappa = 0.44, 95% CI 0.25 – 0.63). Agreement between non-specialist nurses was fair with cardiologists and trainee-grade doctors (Kappa = 0.40, 95% CI 0.23 – 0.58 and 0.30, 95% CI 0.09 – 0.50 respectively) and lowest with heart failure specialist nurses (Kappa = 0.21, 95% CI 0.03 – 0.39) (table 5).

Discussion

The results presented here demonstrate that for patients hospitalised with heart failure the Surprise Question predicted all-cause mortality at one year, and did so independently of important clinical variables known to be associated with poor outcomes in this group. Overall, there was also substantial or moderate agreement between groups of participants, with the exception of comparison of

medical and specialist team members with non-specialist nurses, where agreement was fair.

Overall, characteristics which predicted mortality were consistent with those associated with a 'not surprised' response, perhaps reflecting an awareness amongst specialists of the predictors of poor outcomes in this patient population (Table 1). In the present study, pulmonary oedema was associated with a favorable outcome compared to those admitted with peripheral oedema, and NYHA class was not associated with survival. That patients who were comfortable at rest had a worse prognosis goes against conventional thinking, however is consistent with other studies[25]. Our mortality is higher than in most contemporary interventional studies: our patients had high rates of renal dysfunction and were older than those in many datasets[26, 27]. The present prospective study was an investigation of the prediction of mortality with a view to potentially providing additional health and social care and was *a priori* not designed to assess cause of death.

To date, four studies have reported on the accuracy of the Surprise Question for patients with cardiac diagnoses including heart failure. One study reported the accuracy of the Surprise Question from a large cohort of general practice patients and found that the Surprise Question had a sensitivity of 79% and specificity of 61%[28]. One community-based study investigated whether fulfilling the Gold Standards Framework criteria for end of life care (at least two indicators out of: a 'not surprised' response to the Surprise Question, NYHA III or IV symptoms, repeated hospitalization, symptoms despite maximally

tolerated therapy) predicted survival at one year. This study assessed responses from heart failure nurses and found that the Surprise Question greatly overestimated the mortality rate in this patient cohort, explained by an appreciation that patients with heart failure are at risk of unpredictable deterioration[29]. A further study including heart failure specialist nurses reported data for patients who prompted a 'not surprised' response, but did not report the accuracy of responses for patients who generated a 'surprised' response[30]. One study assessed the Surprise Question in hospitalized patients initially admitted with an acute coronary syndrome, meaning it is unlikely to be generalisable to the chronic heart failure population[31].

Whether the Surprise Question can be used by different healthcare professionals has been infrequently reported. One study looked at responses by consensus within a multidisciplinary team, but did not test responses from individuals independently[32], whilst another study recorded responses by doctors and nurses independently, finding that physicians were more likely to record a 'not surprised' response, and that where physicians and nurses agreed upon a 'not surprised' response this was highly predictive of a poor prognosis[21]. These studies were consistent with the findings here, in that specialists were more likely to be pessimistic about patient prognosis and agreement improves accuracy.

Our study is the first to investigate the predictive power of the Surprise Question for patients hospitalized with heart failure whilst assessing responses from a number of allied healthcare professionals. Of the patients who died within one

year, 85% had been identified by the Surprise Question, and patients for whom there was a 'surprised' response were far less likely to die. Cardiologists were on balance better at identifying patients within the last year of life and where there was consensus with other healthcare professionals the accuracy was superior. However, there was a trade-off between higher levels of accuracy and not identifying patients within the last year of life, which in clinical practice is undesirable. Agreement between participants was moderate or substantial, except for comparisons with non-specialist nurses[24]. The highest agreement was between cardiologists and heart failure nurses, perhaps reflecting a shared perspective between healthcare professionals who spend the most time managing heart failure patients. The lowest agreement was between heart failure nurses and non-specialist nurses, who were less likely to classify patients as 'not surprised' and therefore identify patients in the last year of life.

Overall there was an over-classification of patients into the 'not surprised' category, with only half of patients identified as such dying within one year. This perhaps reflects the unpredictable trajectory of heart failure[8, 33]. It could be argued that prognostication is less important here, as those patients identified as 'not surprised' are still likely to benefit from a palliative approach, or the inclusion on a specialist palliative care registry regardless of survival at one year[34]. When engaging with patients and families regarding future care planning discussions would need to address this limitation of the Surprise Question.

Despite an appreciation of the unpredictability of prognosis for patients diagnosed with heart failure, there seemed to be a low rate of not-for-resuscitation decisions made during this study. With only 7 out of 64 patients cardiologists identified as 'not surprised' having a do-not-attempt-resuscitation decision at time of study inclusion, although this may have changed later during their admission following further discussions with patients and relatives about their prognosis.

Our study provides strong evidence, consistent with other literature that clinicians are good at identifying patients who will survive, suggesting that it is unlikely specialist palliative care services would be withheld from those who need this if the Surprise Question were to be used to aid decision making. Furthermore, active treatment for patients with severe heart failure is largely symptomatic and therefore complimentary to palliative care. Patients with decompensated heart failure syndrome are frequently hospitalized during crisis periods. However, where resources permit, interventions such as intravenous diuretic therapy and monitoring of renal function could be delivered in the community. Perhaps for patients identified as 'not surprised', this approach would be complimentary with what is primarily palliative, symptom guided therapy.

Limitations

Prognostication is not the only concern when considering referral to specialist palliative care services, and the present study does not investigate when it is appropriate to adopt a palliative approach. Even if the Surprise Question could

reliably predict time to death, this is only one factor involved in such a decision. The focus should be on palliative care needs, patient preferences and social circumstances, rather than simply predicted life expectancy. Whilst we collected data on pulmonary congestion and NYHA class during the recruitment phase, factors such as frailty and fatigue were not assessed. However, such an holistic assessment is likely to be encapsulated within healthcare professionals' responses to the Surprise Question. We have previously shown that for patients with heart failure, prognosis is not dependent on the predominant symptom, rather it's severity[35].

European guidelines recommend an early consideration of a symptom focused approach, and point towards indicators such as repeated hospitalization and frailty as drivers for such decisions[12]. Up to a quarter of patients hospitalised with heart failure may require specialist palliative care services, and a short remaining life span remains a major driver in their delivery[13, 36-38]. The effect of the Surprise Question on the delivery and impact on specialist palliative care services was not assessed by this study. Prospective, randomized studies are required to investigate whether predictive mortality models can improve patient access to specialist palliative care services without unfavourably influencing the management of patients identified as 'not surprised' but still alive at one year. However, patients with heart failure and ongoing symptoms should receive palliation of those symptoms with a range of treatments, including ACE-inhibitors, beta-blockers and diuretics. Therefore, identifying patients as 'not surprised' is unlikely to be detrimental to their care.

This study was limited by a small sample size and small number events. Another limitation was the possible confusing phrasing of the Surprise Question. To address this concern, we offered participants an information sheet and gave a verbal explanation of the question prior to response. The study also did not assess participants attitudes towards the question, however previous qualitative research has demonstrated that the question is feasible and acceptable amongst healthcare professionals and families[39]. Furthermore, our patient focus group found the question acceptable and were actively engaged in the design of this study.

The predictive power of the Surprise Question compared to other inpatient prediction tools was not assessed by the current study. Being simple, intuitive and quick to do, the Surprise Question might have an advantage over more complex inpatient tools, although this requires assessment in future studies. Having described the accuracy of the Surprise Question in a cohort of heart failure patients, it would be intriguing to compare the utility and ease of use of this simple approach against more complex tools in a large patient cohort. Furthermore, whether the Surprise Question may allow a structured method for all members of the multidisciplinary team to contribute to advanced care planning would have to be tested in prospective studies.

Conclusion

The Surprise Question might be a useful adjunct to assist in the care planning of patients with heart failure who may be entering the last year of life. In our cohort, the Surprise Question identified nearly all patients who were in the last

year of life. There was however, an over-classification of patients into the ‘not surprised’ category, with only around half dying within one year. If validated, the Surprise Question could be used by all members of the multidisciplinary team, such that any member could prompt discussions around resuscitation status, establishing goals of care and, where appropriate, referral to specialist palliative care services.

Disclosures and acknowledgements

Disclosures

There are no conflicts of interest for any authors.

Authorship

SS and KKW researched the topic and devised the study.

SS collected the data and undertook primary statistical analysis.

SS and KKW produced the first draft of the manuscript.

All other co-authors contributed equally to manuscript preparation.

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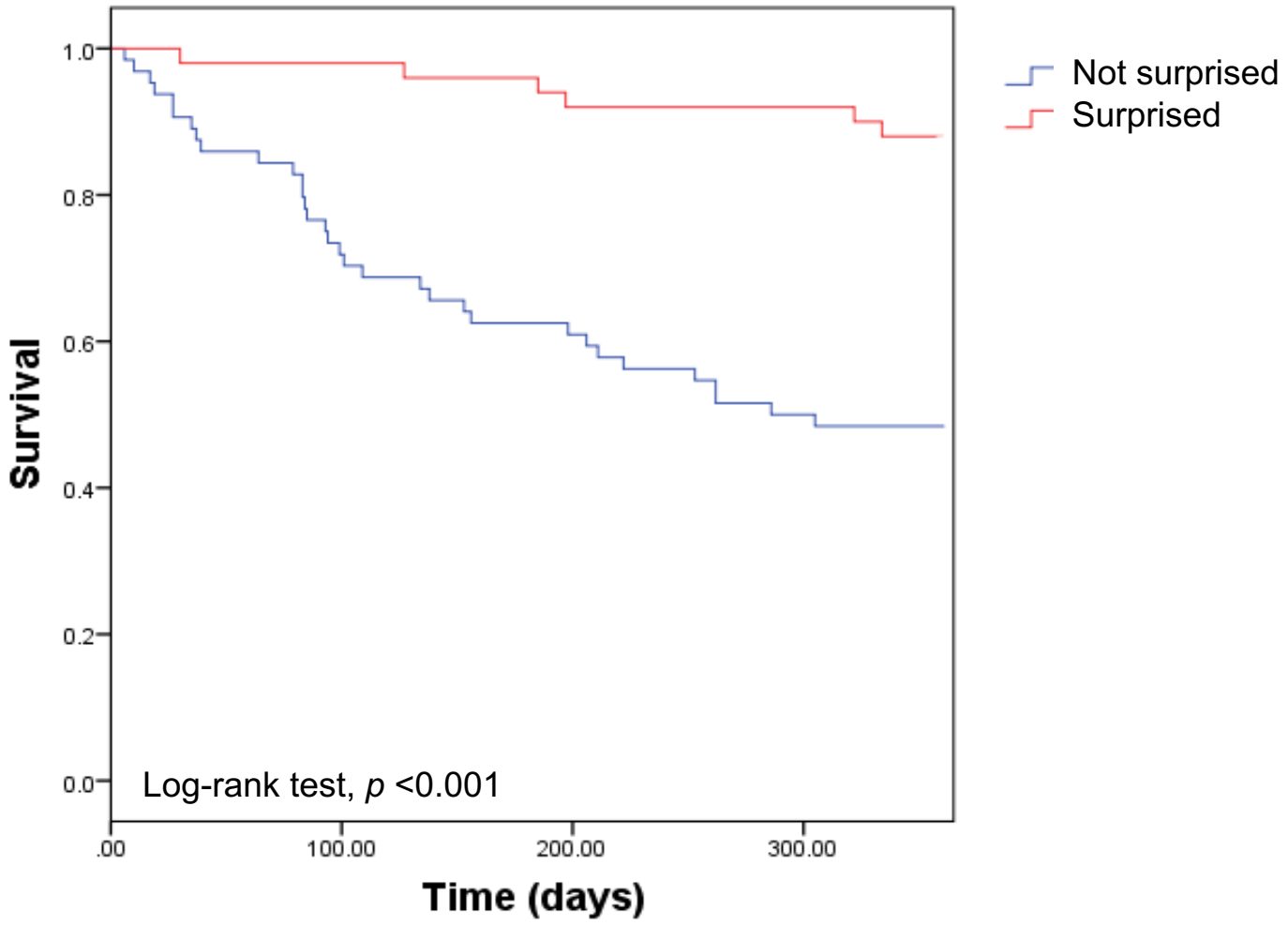
Figure



Time (days)	0	100	200	300
'Surprised'	50	49	46	46
'Not surprised'	64	46	39	32

Figure titles and legends

Figure 1.

Title: Kaplan-Meier curve displaying whether cardiologists would be surprised by death at one year or not.

Caption: There is a statistically significant difference in survival in unadjusted analysis for patients identified as ‘surprised’ versus ‘not surprised’ by cardiologists.

Table 1. Baseline characteristics and associations with 'surprised' or 'not surprised' response from cardiologists, and survivorship.

Variable	All (n=114)	'Surprised' (n=50)	'Not surprised'' (n=64)	*p* value	Survivors (n=75)	Dead at one year (n=39)	*p* value
Age (years)	71 ± 14	64 ± 14	77 ± 11	**<0.001**	68 ± 15	77 ± 10	**0.004**
Male sex [*n* (%)]	73 (64)	33 (66)	40 (63)	0.67	52 (61)	29 (66)	0.37
eGFR (ml/min/1.73m^2)	56.4 ± 23.0	65.9± 18.9	49.1 ± 23.5	**<0.001**	61.4 ± 21.9	45.5 ± 21.6	**<0.001**
Haemoglobin (g/L)	121 ± 24	132.7 ± 21.3	112.3 ± 22.6	**<0.001**	127.6 ± 22.4	109.8 ± 22.3	**<0.001**
Serum albumin (g/L)	32.6 ± 5.4	33.5 ± 6.4	31.9 ± 4.6	0.14	33.8 ± 5.3	30.2 ± 4.8	**<0.001**
LVEF (%)	34.9 ± 15.1	32.2 ± 16.8	37.0 ± 13.5	0.096	34.2 ± 15.9	36.3 ± 13.9	0.47
NYHA class >2	97 (85)	41 (82)	56 (88)	0.41	65 (87)	32 (82)	0.51
Peripheral oedema [*n* (%)]	95 (83)	39 (78)	56 (87)	0.23	68 (80)	41 (93)	**0.039**
Pulmonary oedema [*n* (%)]	66 (58)	36 (72)	30 (47)	**0.006**	61 (72)	17 (39)	**0.001**
IHD [*n* (%)]	35 (31)	15 (30)	20 (31)	0.76	20 (24)	21 (48)	**0.005**
Diabetes [*n* (%)]	32 (28)	12 (24)	20 (31)	0.45	26 (31)	12 (27)	0.43
COPD [*n* (%)]	11 (10)	3 (6)	8 (12)	0.26	6 (7)	8 (18)	0.055
AF [*n* (%)]	60 (53)	27 (54)	33 (51)	0.97	45 (53)	23 (52)	0.55
Malignancy [*n* (%)]	7 (6)	1 (2)	6 (9)	0.39	2 (2)	6 (14)	**0.034**
DNACPR [*n* (%)]	8 (7)	1 (2)	7 (11)	**0.013**	2 (2)	10 (23)	**<0.001**
Furosemide equivalent dose (mg)	64± 71	52 ± 68	74 ± 73	0.1	43 ± 58	104 ± 78	**<0.001**
Thiazide diuretic [*n* (%)]	8 (7)	4 (8)	4 (6)	0.94	4 (5)	5 (11)	0.15
MRA [*n* (%)]	30 (26.3)	11 (22)	19 (30)	0.36	19 (22)	17 (39)	**0.041**
Anticoagulation [*n* (%)]	49 (43)	20 (4)	29 (45)	0.64	36 (42)	21 (48)	0.35
ACEI/ARB [*n* (%)]	57 (50)	27 (54)	30 (47)	0.58	40 (47)	23 (52)	0.35
Beta-blocker [*n* (%)]	67 (59)	29 (58)	38 (59)	0.28	50 (59)	29 (66)	0.28
Aspirin [*n* (%)]	34 (30)	13 (26)	21 (33)	0.54	23 (27)	17 (39)	0.13
Other antiplatelet [*n* (%)]	15 (13)	4 (8)	11 (17)	0.26	10 (12)	6 (14)	0.48
Insulin [*n* (%)]	9 (8)	4 (8)	5 (8)	0.99	5 (6)	5 (11)	0.22
Oral hypoglycaemic [*n* (%)]	21 (18)	10 (20)	11 (17)	0.37	18 (21)	8 (18)	0.44

Continuous data are presented as means and standard deviation, categorical as number [n] and percentage (%).
LVEF; left ventricular ejection fraction, eGFR; estimated glomerular filtration rate, NYHA; New York Heart Association class, IHD; ischaemic heart disease, COPD; chronic obstructive pulmonary disease, AF; atrial fibrillation, DNACPR; do not attempt cardiopulmonary resuscitation decision, MRA; mineralocorticoid receptor antagonist, ACEI; ACE inhibitor, ARB; angiotensin receptor blocker.

Table 2. Accuracy of the "surprise question" by response

	Cardiologist	Trainee-grade doctor	Heart failure nurse	Non-specialist nurse	≥2 'not surprised' responses	≥3 'not surprised' responses	All 'not surprised' responses
Sensitivity	0.85	0.75	0.90	0.66	0.82	0.70	0.52
Specificity	0.59	0.62	0.44	0.73	0.58	0.73	0.86
Positive predictive value	0.52	0.51	0.45	0.58	0.50	0.57	0.66
Negative predictive value	0.88	0.83	0.90	0.79	0.86	0.83	0.78

Number of responses to the Surprise Question from different groups of respondents, and the number who answered 'not surprised'.
The sensitivity, specificity, positive predictive value and negative predictive value of the 'surprise question' when either ≥2, ≥3 or all answered 'not surprised'.

Table 3. Survival analysis of baseline characteristics adjusted for age and sex

Variable	Hazard ratio	95% CI	*p* value
eGFR (per ml/min/1.73m^2)	0.98	0.96 – 0.99	**0.001**
Hb (per g/L)	0.98	0.97 – 1.0	**0.014**
Alb (per g/L)	0.90	0.84 – 0.96	**0.001**
Peripheral oedema	2.9	0.88 – 9.3	0.081
Pulmonary oedema	0.34	0.18 – 0.65	**0.001**
IHD	1.7	0.90 – 3.4	0.102
Malignancy	4.9	2.0 – 12.0	**0.001**
DNACPR	4.1	1.7 – 9.8	**0.002**
Furosemide equivalent dose (per 40mg)	1.5	1.3 – 1.7	**<0.001**
MRA	1.8	0.9 – 3.5	0.083
'Not surprised' cardiologist	4.6	1.8 – 11.9	**0.001**

CI, confidence interval; eGFR, estimated glomerular filtration rate; Hb, serum haemoglobin; Alb, serum albumin; IHD, ischaemic heart disease; Furosemide equivalent dose per 24 hours (40mg furosemide = 1mg bumetanide); DNACPR, do not attempt cardiopulmonary resuscitation decision; MRA, mineralocorticoid receptor antagonist.

Table 4. Multivariate survival analysis of important clinical covariates and the 'surprise question'

Variable	Hazard ratio	95% CI	*p* value
Age (per year)	1.0	1.0 – 1.1	0.063
Male sex	1.2	0.6 – 2.4	0.57
eGFR (per ml/min/1.73m^2)	0.99	0.98 – 1.0	0.30
Serum albumin (per g/L)	0.92	0.86 – 0.98	**0.010**
Furosemide equivalent dose (per 40mg)	1.3	1.1 – 1.6	**0.002**
'Not surprised' cardiologist	2.8	1.0 – 7.9	**0.046**

CI, confidence interval; eGFR, estimated glomerular filtration rate; Alb, serum albumin; Furosemide equivalent dose per 24 hours (40mg furosemide = 1mg bumetanide).

Table 5. Kappa coefficient for agreement between respondents to the Surprise Question

Agreement between		Kappa	Kappa SEM	95% CI
Cardiologist	Trainee-grade doctor	0.57	0.091	0.39 – 0.75
Cardiologist	Heart failure nurse	0.69	0.086	0.52 – 0.86
Cardiologist	Non-specialist nurse	0.40	0.09	0.23 – 0.58
Trainee-grade doctor	Heart failure nurse	0.44	0.096	0.25 – 0.63
Trainee-grade doctor	Non-specialist nurse	0.30	0.106	0.09 – 0.50
Heart failure nurse	Non-specialist nurse	0.21	0.09	0.03 – 0.39

SEM, standard error of the mean; CI, confidence interval.