

Direct and delayed admissions to ICU in older medical patients

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Abstract

The aims of this retrospective cohort study were to retrieve characteristics and outcomes of older (65+) medical patients who are directly admitted to ICU from the ED and to compare these with those admitted to ICU from a ward. Of 1396 patients, 21 (1.5%) were directly admitted to ICU and 54 (3.9%) after a delay. Blood pressure was lower and respiratory rate higher in the direct than in the delayed group. The direct group had lower mortality (28-day: 19.0 vs. 38.9%, $p=0.14$; 1-year: 42.9 vs. 66.7%; $p=0.06$), shorter length-of-stay and returned more frequently to independent living than the delayed group.

Only a fraction of older patients are admitted to ICU; directly admitted patients tend to have better outcomes.

Keywords

older patients, critical care, mortality, intensive care, emergency care

Key points

- Only a fraction of older medical patients are admitted to ICU
- There are few differences in premorbid condition between directly admitted patients and those admitted to ICU from the ward
- Outcomes of directly admitted patients tend to be better than of those admitted from the wards
- After ICU admission, most older patients do not return to independent living

Introduction

The number of older patients (≥ 65 years) who visit the emergency department (ED) is increasing.¹⁻³ These older patients are more often seriously ill at presentation than younger patients,²⁻⁵ but, to date, little is known about critical care in these older patients and about recognizing these critically ill patients.

In an ageing population, it is likely that the number of critically ill older patients who need to be admitted to an Intensive Care Unit (ICU) after evaluation at the ED will increase.^{6,7} The number of older patients who need to be admitted to ICU after initial admission from the ED to a general ward will probably also rise.⁸ In several studies, adult patients, who had been admitted to ICU directly after evaluation at the ED, had a lower mortality than those who had been admitted to ICU from general wards (after a delay of 2 hours–6 days).⁹⁻¹²

As far as we know, the outcome of older patients who are directly admitted to ICU has not been compared to that of those who are admitted to ICU after a delay. We hypothesize that for older patients outcome will be better in those who are directly admitted than in those admitted to ICU after a delay and that this might (at least in part) be explained by underestimating the severity of disease at the ED.

The aims of this retrospective study were to analyse the number, characteristics and outcome (mortality, length of stay and discharge destination)

of older medical patients who are admitted from the ED to ICU, and to compare these patients with those who were admitted after a delay. We further aimed to investigate whether danger signs (disturbed vital signs/elevated lactate) were present at the ED in those who were admitted to ICU after a delay, and if so, whether this influenced outcome.

Methods

Study design and setting

This retrospective cohort study took place at the Maastricht University Medical Centre (MUMC+). The Maastricht area is one of the fastest ageing regions in the Netherlands (18.3% of the inhabitants are older), which equals the fastest ageing regions of Europe.¹³ The MUMC+ is a 715-bed medical centre in the Netherlands. As this hospital is the only in the city of Maastricht, it is both a secondary and tertiary care centre. The ICU has a capacity of 27 beds. The ED has an average of 23,000 patients each year of whom 5,500 are assessed/treated by acute internists or their (supervised) residents. Most patients are referred by a general practitioner except for some high-emergency patients and self-referrals (for more details on the organization of acute care in the Netherlands, see¹⁴). Both at the ED and wards, decisions on admitting a patient to ICU are supervised by internists and intensivists. This study was approved by the Medical Ethics Committee of the MUMC+.

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Study population

We reviewed the ED charts of all older (≥ 65 years) patients who were assessed by an internist at the ED from 1-1-2011 till 1-1-2012. Data were retrieved in more detail for all patients who were subsequently admitted to ICU via either ED (direct group) or ward (delayed group). A delayed admission was defined as an admission to ICU after initial admission through the ED to the ward, irrespective of the time spent on that ward.

Data collection

All data were retrieved from ED charts and hospital records using a standardized data collection form. For all decisions on categories on main reason for admission (to hospital or ICU), weekly meetings were held by three investigators to review coding rules and to achieve agreement on the correct classification.

For all patients, data on demographics and pre-morbid condition (co-morbidity, medication, living situation, cognitive function and functional status) were retrieved. Co-morbidity was assessed using the Charlson Co-morbidity Index (CCI).¹⁵ In addition to the categories of the CCI, information on cardiovascular, neurological or psychiatric co-morbidity, the use of immunosuppressive therapy and substance abuse were retrieved as were the number of medications that patients used before admission. Living situation was categorized as independent or assisted living (care or nursing home). Cognitive function was categorized as impairment being present or absent prior to admission. Functional status was assessed by retrieving information from the patient or caretakers about the performance in activities of daily living (ADL) and instrumental activities of daily living (IADL) prior to hospitalization and was categorized as dependent or independent.

We further retrieved the following data at the ED: triage category, vital signs and laboratory values. The triage category at the ED was classified using the Manchester Triage System.¹⁶ We combined 2 categories 'urgent' (requiring assessment within 60 minutes) and 'standard/non urgent' (within 120/240 minutes) because these groups were too small for separate analysis.

We defined 'danger signs' as one or more of the following: systolic blood pressure (SBP) ≤ 90 mmHg or mean arterial pressure (MAP) ≤ 65 mmHg, shock index > 1.0 , oxygen saturation $< 90\%$ without or $< 95\%$ with supplemental oxygen, tachypnea (≥ 20 /min), coma (GCS ≤ 8) or serum lactate ≥ 4.0 mmol/l. The following laboratory values were retrieved: glucose, C-reactive protein, urea, creatinine, lactate and arterial blood gas analysis.

The main reason for hospital admission was categorized using the ICD-10 classification.¹⁷ The

following categories were combined into the group 'miscellaneous': diseases of the musculoskeletal system, neoplasm, infection of skin/subcutaneous tissue. The main reasons for admission to ICU were divided into 8 categories (hemodynamic instability, monitoring/observation, respiratory insufficiency, electrolyte disturbance, renal insufficiency, neurological problems, admission to undergo an intervention and 'other'). When patients were admitted to ICU solely for monitoring for life threatening complications, the category 'monitoring/observation' was chosen. Patients could be admitted to ICU for more than one reason.

Outcome measures were: length of hospital stay (LOS), mortality and discharge destination. For the analysis of LOS, we excluded patients who died during hospital stay. Mortality was assessed at two different moments: within 28 days and within one year after presentation at the ED. The discharge destination was scored as either 'independent' or as 'assisted living'.

Data analysis

The direct and delayed group were compared regarding baseline characteristics, vital signs and laboratory values present during stay at the ED, and outcome (mortality, LOS and discharge destination).

In addition, we analysed whether danger signs were present at the ED in the delayed group and whether 28 day- and/or one-year mortality of the patients with danger signs differed from that of those without danger signs.

Statistics

All statistical analyses were performed using IBM SPSS statistical software version 20 (Chicago, Illinois, USA). Continuous data were reported as means with standard deviation (SD) and compared using Students' T test, or as medians with interquartile ranges (IQR) and compared using the Mann Whitney U test, depending on the distribution of the data (normal, not normal, resp.). Categorical data were reported as absolute numbers and as valid percentages (to correct for missing data). Categorical data were compared using chi-square and Fisher exact tests, when appropriate. Differences in mortality were calculated using the Kaplan-Meier method and the log-rank test. A p-value < 0.05 was considered statistically significant.

Results

Patients

In the one-year study period, 1396 older patients (≥ 65 years) were assessed by an internist at the ED and subsequently admitted to the hospital (Figure

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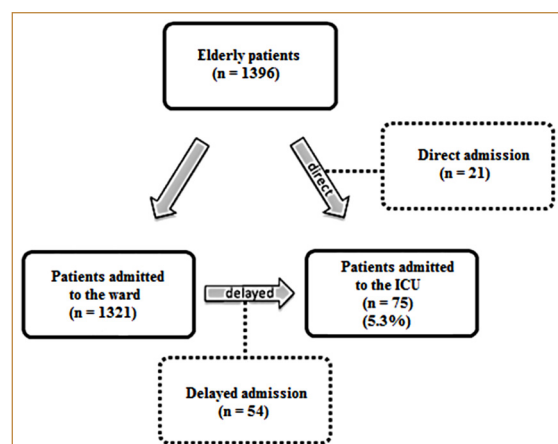


Figure 1. Flowchart

1). Of these patients, 75 (5.3%) were admitted to ICU either via direct or via delayed admission. The direct group consisted of 21 (28.0%) and the delayed group of 54 patients (72.0%). In the delayed group, the median time between the day of admission to the hospital and admission to ICU was 3.5 days (range: 1-12 days).

The mean age of patients admitted to ICU was 74.1 (SD $\pm$ 7.1) years and 21.3% were $\geq$ 80 years of age (Table 1). No differences regarding demographic characteristics were found between the groups.

All percentages are valid percentages. *Patients could have more than one reason for admission to ICU.

Main reason for admission to the hospital and to ICU

The direct group more often had cardiopulmonary problems (38.1 vs. 9.3%, $p=0.01$) as reason for admission to the hospital (Table 1). In addition, as reason for admission to ICU, the direct group more often had hemodynamic (57.1 vs. 25.9%, $p=0.01$) or renal problems (23.8 vs. 5.6%, $p=0.03$) than the delayed group. Once admitted to the ICU, the direct group less often needed mechanical ventilation than the delayed group (42.9 vs. 77.8%, $p<0.001$).

Pre-morbid condition: co-morbidity, medication, living situation, cognitive and functional status

There were no differences in co-morbidity (CCI: 2.0 (IQR: 1.5-4.5) vs. 2.5 (IQR: 1.0-4.3), $p=0.85$).

Table 1. Co-morbidity, medication, living situation and functional status before admission

n (%) or median (IQR)	Direct admission n = 21		Delayed admission n = 54		p-value
Charlson co-morbidity index - median (IQR)	2.0	(1.5-4.5)	2.5	(1.0-4.3)	0.85
0-2	11	(52.4%)	27	(50.0%)	0.85
3-5	7	(33.3%)	20	(37.0%)	0.76
≥ 6	3	(14.3%)	7	(13.0%)	1.00
Number of medications - median (IQR)	6.0	(5.0-11.5)	6.0	(4.0-9.0)	0.58
<5	4	(19.0%)	12	(25.5%)	0.76
≥ 5	17	(81.0%)	35	(74.5%)	0.76
Missing	0		7		
Living situation					
Independent	17	(81.0%)	53	(98.1%)	0.02
Assisted living	4	(19.0%)	1	(1.9%)	0.02
Cognitive functioning					
No impairment	18	(85.7%)	40	(75.5%)	0.37
Impaired	3	(14.3%)	13	(24.5%)	0.53
Missing	0		1		
ADL					
Independent	5	(26.3%)	21	(39.6%)	0.30
Dependent	14	(73.7%)	32	(60.4%)	0.30
Missing	2		1		
IADL					
Independent	4	(21.1%)	21	(39.6%)	0.15
Dependent	15	(78.9%)	32	(60.4%)	0.15
Missing	2		1		

The represented percentages are valid percentages

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Table 2. Laboratory values and blood gas analysis

n (%) or median (IQR)	Direct admission n = 21		Delayed admission n = 54		p-value
Serum glucose (mmol/L)	8.1	(6.1-9.5)	8.2	(6.3-9.3)	0.65
< 3.1	1	(4.8)	0		0.30
>7.8	13	(40.9)	18	(40.9)	0.06
Available	21		42		
C-reactive protein (mg/L)	78.0	(15.0-155.5)	63.3	(10.8-85.5)	0.33
10-100	10	(47.6)	24	(57.1)	0.60
>100	7	(33.3)	8	(19.0)	0.21
Available	21		42		
Serum urea (mmol/L)	13.7	(8.5-25.5)	11.9	(6.1-14.2)	0.03
>8.0	16	(76.2)	25	(55.6)	0.06
Available	21		45		
Serum creatinine (μmol/L)	148	(69-557)	106	(86-162)	0.22
High (♀:>100; ♂:>110)	14	(66.7)	26	(54.2)	0.33
Available	21		48		
Blood gas analysis available	19	(90.5)	16	(29.6)	0.00
pH	7.31	(7.26-7.45)	7.42	(7.36-7.48)	0.07
<7.35	10	(52.6)	4	(25.0)	0.10
>7.45	4	(21.2)	7	(43.8)	0.15
pCO ₂ (kPa)	4.5	(4.0-6.5)	5.3	(4.1-6.4)	0.93
<4.5	9	(47.4)	7	(43.8)	0.83
>5.9	5	(26.3)	5	(31.3)	1.00
pO ₂ (kPa)	10.9	(7.9-14.8)	8.7	(7.1-10.5)	0.15
<8.7	7	(36.8)	8	(50.0)	0.43
Bicarbonate (mmol/L)	21.8	(13.9-26.3)	24.9	(20.3-27.7)	0.23
<22	10	(52.6)	6	(37.5)	0.37
>28	3	(15.8)	3	(18.8)	1.00
Lactate (mmol/L)	2.8	(1.9-5.0)	2.2	(1.0-2.9)	0.07
≥4.0	5	(35.7)	1	(11.1)	0.34
Available	14		9		

The represented percentages are valid percentages

number of medication used (6 (IQR: 5-11.5) vs. 6 (IQR: 4-9), $p=0.58$), cognitive function (impaired: 14.3 vs. 24.5%, $p=0.53$) nor functional status (ADL/ IADL) between the direct and the delayed group (Table 1). The only difference in premorbid condition was that in the direct group, before admission, more patients lived in an assisted living situation than in the delayed group (19.0 vs. 1.9%, $p=0.02$).

Triage category, vital signs, laboratory values at the ED and danger signs

At presentation, the direct group was more often triaged in the highest urgency categories “immediate” (14.3 vs. 0%, $p=0.03$) and “very urgent” (52.4 vs. 23.8%, $p=0.02$, Table 2). In

addition, significantly more patients in the direct group had a low blood pressure (SBP≤90/ MAP≤65 mmHg; 42.9 vs. 8.2%, $p<0.001$) and more patients had an increased respiratory rate (68.8 vs. 41.7%, $p<0.001$) than the delayed group. We found a lower GCS-score (15 (95% CI: 4-15) vs. 15 (95% CI:10-15; skewed distribution, $p=0.01$) and a higher shock index (0.8 (95% CI: 0.6-1.1) vs. 0.7 (95% CI:0.6-0.9), $p=0.02$) in the direct than in the delayed group. No differences were found in other vital functions (heart rate, temperature, oxygen saturation) nor in laboratory values (Supplementary Table 2).

In the direct group, more patients had ≥1 danger signs at presentation (90.5 vs 27.8%, $p<0.001$) than in the delayed group (Table 2). More patients in

*Direct and delayed admissions to ICU in older medical patients***Table 3.** Outcomes

n (%) or median (IQR)	Direct admission group n = 21		Delayed admission group n = 54		p-value
Length of stay (days) -median (IQR)	14 (8-24)		25 (17-34)		0.08
Mortality #					
Within 28 days	4	(19.0%)	21	(38.9%)	0.14
Within 1 year	9	(42.9%)	36	(66.7%)	0.06
Discharge destination					
Independent	12	(57.1%)	18	(33.3%)	0.06
Assisted living	4	(19.0%)	10	(18.5%)	1.00

the direct group had a low blood pressure (42.9 vs. 8.2%, $p<0.001$) and an increased respiratory rate (68.8 vs. 41.7%, $p<0.001$) than in the delayed group. The median time between admission to the hospital and to ICU in the delayed group with danger signs was 1.5 day (IQR: 0.3-10 days).

Length of stay, mortality and discharge destination

The direct group had a shorter LOS (14 vs. 25 days, $p=0.08$) and lower mortality both within 28 days (19.0 vs. 38.9%, $p=0.14$) and within one year (42.9 vs. 66.7%, $p=0.06$) than the delayed group (Table 3). In addition, the direct group was more frequently discharged back to independent living (57.1 vs. 33.3%, $p=0.06$). All these differences were not significant.

In the delayed group with danger signs, mortality within 28 days (25.0 vs. 42.9%, $p=0.50$) and within one year (41.7 vs. 73.8%, $p=0.14$, data not shown) was lower than in the delayed group without danger signs, however, these differences were not significant either.

Discussion

We found that older (≥ 65 years) patients who have been admitted through the ED by internists are not frequently (5.3%) admitted to ICU and that most of them (72%) are admitted to ICU after a delay (3.5 days later). The direct and the delayed group were comparable regarding premorbid condition (comorbidity, medication, cognitive and functional status), apart from their living situation (more patients in the direct group lived in an assisted situation). At the ED, the direct group had a low blood pressure more frequently, a higher shock index, a lower GCS-score, and were more often tachypnoic than the delayed group. There were no differences in other vital signs nor in laboratory values, but patients in the direct group were more often admitted to ICU because of hemodynamic instability and renal insufficiency. There were no significant differences in outcome, but the LOS was shorter (14 vs. 25 days),

and mortality, both within 28 days (19.0 vs. 38.9%) and within one year (42.9 vs. 66.7%), was lower in the direct than in the delayed group. In addition, mortality within 28 days and within one year in the delayed patients with danger signs was lower than in those without danger signs (28-days: 25.0 vs. 42.9%, $p=0.50$; one year: 41.7 vs. 73.8%).

In our study, most patients (72%) who were admitted to the ICU came after a delay. This is in contrast with another study that found that less older general medical and surgical patients were admitted to ICU after a delay than directly from the ED (34 vs. 66%, respectively).¹⁸ In contrast with findings of others as well, we found a lower admission rate to ICU (5.3%) than the 26.8% reported in a study from the USA.¹⁹ This difference can be explained by patient selection, as the American study included coronary care, surgical and general medical patients, while we included medical patients only.

The delay (median 3.5 days) in admission to ICU may be the result of not appreciating the severity of illness at presentation or a lack of sensitivity of vital signs and/or laboratory values in detecting those at risk for deterioration. At presentation, most vital signs and laboratory results did not differ between the two groups. However, for part of our patients (22.2%), vital signs were abnormal at presentation at the ED, and yet no ICU admission was judged necessary/appropriate. In some patients of the delayed group, vital signs were not measured, which could also have resulted in missing those who were critically ill. A recent study showed that most of the unplanned ICU admissions occurred in patients whose deterioration was not noticed early due to inadequate monitoring of vital signs.²⁰ It is also possible that the residents, who assess many patients autonomously and are supervised by internists on a distance (by telephone and after accessing the electronic chart), lack the experience to do so correctly in all cases. However, this is common practice in many EDs, and therefore reflects clinical practice. Another explanation could be that direct

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group had other problems at presentation than the delayed group, as reflected by the difference in reasons for admission to ICU: the direct group was more often admitted because of hemodynamic instability (60 vs. 25.9%) and renal insufficiency (25 vs. 5.6%) than the delayed group. However, the majority was apparently stable at the ED, and their delayed admission to ICU probably resulted from their vulnerability and clinical deterioration despite (optimal) treatment during stay at the ward and not from misinterpretation of the severity of disease at the ED. This hypothesis is supported by a recent study that showed that older patients seem to be stable at the ward and then deteriorate acutely rather than slowly, which makes it difficult to recognize these critically ill patients.²¹

We found that pre-morbid condition did not differ between the direct and delayed group. This finding contrast other studies, which showed that co-morbidity, poor pre-morbid functional status and impaired cognitive functioning were associated with ICU refusal.²²⁻²⁴ The only – counterintuitive – exception in our study was that more patients in the direct group lived in assisted living situations than in the delayed group (19.0 vs. 1.9%). Possibly, at the ED, not all information was available to the decision makers, but it is also possible that information regarding pre-morbid status did not play a role in the decision whether or not to directly admit a patient to ICU.

Mortality was lower, both within 28 days and within one year, in the direct than in the delayed group. The trend in mortality (the difference was not significant) we detected is in agreement with an Australian study (23.3% (direct) vs. 34.9% (delayed)).¹⁰ In contrast to our study, in that study, the direct group was younger than the delayed group (53.3 vs. 63.7 years), which may explain (part of) the differences in outcome. In a British study, conducted in over 7000 adult patients, an association was found between the duration of hospitalization before admission to ICU and in-hospital mortality.¹¹ Stay on a ward prior to admission to ICU predicted mortality even when adjusted for risk factors, such as age and APACHE II score. We hypothesize that the reasons for this difference may be that these patients are admitted to ICU too late, because either doctors are reluctant to admit them to ICU or because the deterioration is recognized too late. Furthermore, it is possible that these patients do not respond well to intensive care/organ support because of limited organ reserves. In addition, it is possible that the reason for admission in the direct group were more easily treatable (we found more hemodynamic problems in the direct group).

The LOS was shorter in the direct than in the delayed group (14 vs. 25 days, $p=0.08$). The same

was found in a study performed in a younger (mean age: 53.5 years in the direct group and 63.7 years in the delayed group) population of general medical and surgical patients.¹⁰

Regarding functional outcome: the direct group was more often discharged back to independent living than the delayed group (57.1 vs. 33.3%, $p=0.06$). It is important to realize that in our study, before admission, 93.3% of the patients lived independently, while after discharge, this was only the case in 40%. In a Dutch study, functional decline within one year of hospitalization was found in 33% of older non-critically ill patients who had not been admitted to ICU.²⁵ These numbers emphasize how fragile critically ill older are and reflect their poor prognosis. Even when they are discharged back home, most of them are dependent. The impact of ICU admission may explain that we found more functional decline in our study. This should be taken into account when taking care of and making important decisions concerning critically ill older patients. On the other hand, an important part of our older patients recovered without functional decline, which lends support to further investigations concerning the management of these patients. This is an interesting observation, because, compared to other studies our admission rate to the ICU was quite low. This in turn can be explained because advanced care planning (including restrictions) is often part of the assessment of the older patients in our practice. Preconceptions of doctors and patients (and their family) concerning the benefit of ICU admission for elderly patients could be a factor. The impact of these preconceptions of doctors is shown in a study in which admission rates of elderly patients to the ICU varied widely between several hospitals in Paris.²⁶

Limitations

Most differences in outcome (LOS, mortality, discharge destination) we found were not significant, which is probably due to a lack of power of our study. This, in turn, is the consequence of the small number of ICU admissions in our older patients. This study should therefore be seen a first exploration of this topic and should be repeated in a larger time frame and/or a multicentre setting to ensure inclusion of an older ICU population that is large enough to draw firm conclusions. Apart from this limitation, the retrospective design may have limited the quality of data collection regarding functional status and cognitive function. However, we expect no difference in quality of these data between the groups. Furthermore, information noted by doctors and nurses are easy to retrieve in our charts. Our results should further be seen in the context of local factors (e.g. specialty, number of

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ICU beds) and demographic situation (e.g. rapidly ageing population) and organization of the healthcare system. However, as our hospital is situated in one of the fastest ageing areas in Europe, our study can provide a look into the future for other hospitals. The study should be repeated in a larger time frame and/or a multi-centre setting to ensure inclusion of an older ICU population that is large enough to draw firm conclusions.

Conclusion

Only a small number of older patients are admitted to ICU, either directly from the ED or via the ward. At presentation at the ED, few differences were found

in pre-morbid state, although the direct group more often had abnormal vital signs. The direct group had lower mortality, shorter LOS and more frequently returned to independent living than the delayed group, but these differences were not significant. This study should be considered as a first step to gain insight in, and to improve the care for the growing number of critically ill older patients presenting to our ED.

Funding

None declared

Competing interest

none

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Direct and delayed admissions to ICU in older medical patients

Data collection form																	
Number				Remarks:													
Date of ED visit																	
Patient number																	
Date of birth																	
Age																	
Sex																	
Reason for referral																	
Triage colour																	
Type of transport	1 = ambulance						2 = other										
Residence	1 = care home				2 = nursing home				3 = others								
Reason for admission																	
Admission ward, name																	
Length of stay (days)																	
Time in the ED (length of stay)																	
Indication for admission IC																	
Conclusion consultation IC/ MC																	
Treatment at ED	1 = antibiotics				2 = painkillers												
Treatment at IC	1 = assisted ventilation				2 = inotropics				3 = dialysis								
No resuscitation/No artificial respiration/No IC	1= Yes	2 = No	NR	NB	NIC												
Discharge diagnosis																	
Comorbidity																	
Medication (names & number of total)																	
Cognitive disorders																	
Functional state	ADL						IADL										
Discharge to	1 = care home			2 = nursing home			3 = hospice			4 = other			5 = does not apply (deceased patients)				
Deceased	1 = in hospital				2 = < 28 days after discharge				3 = >28 days after discharge				Date of death:				
Last known follow-up moment																	
Vital signs	Respiratory rate			Temperature			Saturation			Glasgow coma scale							
										E M V							
										Total:							
Lab:	Hemo-globine	Platelets	Leuko-cytes	Glucose	C-reactive protein	Sodium	Potassium	Urea	Creatinine	MDRD	Ar1 pH	pCO2	PO2	HCO3	lactate	Albumin	Ca++