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Chapter 6

Incorporation of daily goals in daily care planning does not shorten length of stay in the intensive care unit

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Abstract

Objective: We hypothesized that incorporation of daily goals into daily care planning has the potential to shorten length of stay in the Intensive Care Unit (ICU).
Design: A prospective before-after study.
Setting: Four University hospitals in the Netherlands, two study “daily goal” ICUs and two control hospitals.
Participants: All patients with sufficient data admitted to the participating ICUs were included in the study.
Intervention: Daily goals were integrated in the care plan for patients but not in the control hospitals. In the control period in the study hospitals, daily goals were also formulated by the attending physician but kept confidential from doctors and nurses caring for the patient.
Main Outcome Measures: The primary endpoint was length of stay in the ICU. Secondary endpoint was the type of formulated daily goals and the number of deviations from formulated daily goals.
Results: The before-after cohorts, including the control hospitals consisted of 2,790 and 3,310 patients, respectively. The median number of evaluated daily goals per patient was 4 (2 to 5) and 5 (2 to 14) in the two study periods. The implementation of daily goals was not associated with a change in ICU length of stay when corrected for gender, grouped APACHE II reason for ICU admission, restricted cubic splines of age and APACHE II score. The percentage of daily goals that was ‘*succesfully met’* was in the first study period 79%, and in the second study period 75%, RR 1.05 (95% CI 1.04 to1.08). The percentage of daily goals *‘not met with a documented reason’* was in the first and the second study period respectively 3% (123/3757) and 15% (1499/9842), RR 0.25 (95% CI 0.21 to 0.30). Daily goals *‘not met without a documented reason’* decreased between the first and second study period from 18% (664/3757) to 8% (789/9842), RR 2.2 (95% CI 2 to 2.43).
Conclusions: Incorporation of daily goals in daily care planning does not shorten ICU-LOS of stay of mixed medical–surgical ICU patients but does improve documentation of care.

Introduction

Care for the critically ill depends, at least in part, on the quality of planning and communicating daily care. A strategy of defining and checking explicitly formulated patient-specific treatment targets, so-called ‘daily goals’, during each clinical round of the Intensive Care Unit (ICU) team, has been found to improve communication within ICU teams. [1] So far, there is a small body of evidence for the clinical advantage of daily goals. Recently a study, performed across 69 ICU’s in the United States, reported a strong association between the use of daily goals and a lower ICU mortality. [2] The first study to report the advantage of daily goals was a single-center study in a North–American ICU specialized in oncologic surgery. [3] This study showed a significant decrease of ICU length of stay of one day after implementation of daily goals and the use of daily goal forms. Moreover, the understanding of the goals of care for patients by residents and nurses increased from 10% to more than 95%. It is uncertain whether these findings are generalizable, i.e., whether similar effects can be found in ICUs outside North–America that serve a mixed medical-surgical patient population.

We hypothesized that the incorporation of daily goals in daily care planning improves care for the critically ill in mixed medical-surgical ICUs and, hence, reduce ICU Length of stay (ICU-LOS). First, we analyzed the effect of incorporating daily goals on the ICU-LOS in ICUs in two “daily goal” and two control tertiary university hospitals. Secondly, we evaluated type of formulated daily goals and deviations from daily goals in the two “daily goal” ICUs in tertiary University hospitals.

Patients and Methods

Study design

This was a before-after design with two different analyses with respect to the first study aim: First, we analyzed the primary endpoint, ICU-LOS, in two mixed medical-surgical ICUs in tertiary University hospitals before implementation (study period 1) and after implementation (study period 2) of daily goals. Secondly, we compared ICU-LOS in the two study periods of the “daily goal” ICU’s with ICU-LOS in two control hospitals. With respect to the second aim, we evaluated type of formulated daily goals and deviations from formulated daily goals in both study periods in the “daily goal” hospitals.

Outcomes

The primary endpoint was ICU-LOS. Secondary endpoint was the type of formulated daily goals and the number of deviations from formulated daily goals.

Daily goal evaluation

The daily goals were described on a pre-defined list, which contained 17 categories and were evaluated in two ICUs in tertiary University hospitals. Before the start of the study all attending ICU staff members were instructed and trained in formulating daily goals.

To be able to discern whether the essential part was (a) formulating daily goals, or (b) involving the whole team, or (c) actually meeting the formulated goals during the course of 24 hours, the daily goal evaluation consisted of study period 1 and study period 2 (e.g. in a before and after study design).

During study period 1 daily goals were formulated by the attending ICU physician without involvement of other ICU team members. These goals were kept confidential during clinical rounds and were not part of care planning so that these goals would not influence daily care planning and execution. For each patient the formulated goals were placed in sealed envelopes. Before the start of study period 2, the whole team was instructed how to formulate daily goals and to clearly state the reasons for abandoning a goal in the electronic Patient Data Management System (PDMS).

In study period 2, the daily goals were formulated and communicated during morning clinical rounds by the attending ICU physician in close corporation with all other ICU team members. Furthermore, the attending ICU physician and all other ICU team members were involved in execution and evaluation of the daily goals. Clinical rounds were done three times per twenty-four hours by the ICU team to discuss diagnosis and therapy, according to the closed format of these ICUs.

For both study periods, we evaluated compliance with daily goals in 10 randomly selected patients per week. In the first study period we choose 10 envelopes which contained the formulated goals of 10 patients. In the second study period, all daily goals were formulated in the electronic Patient Data Management System (PDMS) and we randomly choose 10 patients with their formulated goals using random tables based on the numbering of ICU beds. The randomization was managed by a member of the research team, not involved in daily clinical care. A member of the research team carefully checked for all the selected patients in the electronic PDMS whether daily goals were *'successfully 'met'*, *'not met but with a documented reason in the medical chart'* or '*not met without a documented reason'*.

During the two-year daily goal evaluation (in both study periods), there were no major changes in ICU staffing of both ICUs, neither in medical staff, nor in nursing staff. Full-time intensivists, fellows and residents staffed both ICUs. Nurse to patient ratios were one nurse to two patients, but typically with a one to one ratio in case of more severely ill patients. In addition, there were no major changes in local protocols regarding hemodynamic therapy, fluid regimens, ventilation strategies, sedation strategies and sepsis treatment, and in both periods step down facilities were available to facilitate ICU discharge.

Data source

The ICU staff from the two control hospitals gave permission to use their data from the Dutch National Intensive Care Evaluation (NICE) registry, a voluntary quality registry that contains all consecutive admissions to participating hospitals. [4] In the Netherlands, consent from individual patients is not needed when registry data obtained from routine care and without patient-identifying data are used. The NICE registry is officially registered according to the Dutch Personal Data Protection Act.

Inclusion and exclusion criteria

We included admissions between 1st August 2006 and 31st July 2007 and between 1st January and 31st December 2008 to both "daily goals" hospitals and one control hospital. We included admissions between 1st January and 31st July 2007 and between 1st January and 31st December 2008 to the other control hospital, as this hospital starting participating in the NICE registry on 1st January 2008.

We excluded patients aged under 18 years on ICU admission, patients who were believed to be braindead and admitted to the ICU only for organ donation and patients for whom admission type, gender, age, APACHE II reason for ICU admission or ICU or hospital length of stay were unknown. In addition, we excluded patients admitted to the ICU following planned surgery, as these patients have a short anticipated ICU length of stay.

Power calculation

The power to detect a significant difference in the primary outcome was based on an hypothesized reduction in ICU-LOS of 15%. We would need 2,684 patients to have 80% power to detect a difference in ICU–LOS of 15% with a 0.05 two-sided significance level.

Statistical analysis

We present categorical data as number and percentage observed with Newcombes Hybrid Score confidence intervals for the differences in percentage between study periods. We present continuous data as median and interquartile ranges. We defined differences between study periods as the median difference between all possible pairs of individuals and obtained confidence intervals for these differences by inverting the Wilcoxon rank sum test statistic for independent groups. We performed linear regression with the natural logarithm of ICU length of stay as the dependent variable. We corrected for gender, APACHE II grouped reason for ICU admission, restricted cubic splines of age and APACHE II score and factors indicating whether an admission was (I) in study period 1 or study period 2 and (II) to a control or "daily goal" ICU. Our main focus was on the interaction term between these factors.

We did not correct for the clustering of admissions within hospitals, because the introduction of a fixed or random effect per hospital would have hindered the estimation of the effects of main interest in this manuscript. We regarded p-values less than 0.05 as statistically significant and made no corrections for multiple testing. We performed the analysis in R version 3.1.0.

Study approval and informed consent

The institutional review board of the Academic Medical Center (AMC), Amsterdam, and the Leiden University Medical Center (LUMC), Leiden, The Netherlands approved the study protocol and statistical analysis plan, and waived the need for individual patient informed consent. The study was financed and endorsed by The Dutch Organisation for Health Research and Development (Zorgonderzoek Medische Wetenschappen, ZonMW, The Hague, The Netherlands) who had no influence on study design, data analysis or reporting.

Results

Inclusion of patients is shown in Table 1.

Table 1. Inclusion of patients

	Retained	Excluded
Total admissions	13217	
Aged ≥ 18 years	13093	124
Primary ICU admissions #	12033	1060
Known admission type *	11331	702
Medical or emergency surgery admissions ^	6100	5231

Readmissions are excluded * Exclusions of patients declared legally dead before ICU admission or unknown for: admission type; gender; age; APACHE II; reason for ICU admission and ICU or hospital length of stay ^ Excluded patients are elective surgical patients with a length of stay of 24 hours.

Patient characteristics are presented in Table 2. In the "daily goal" ICUs, patients in the second study period were significant older and showed higher Apache II scores compared to the first period. Control ICUs patients showed no differences between the two study periods.

Table 2. Patient descriptive for the two study periods for hospitals with daily goals and hospital with control patients

	Period 1	Period 2	Difference 95% CI, p value
	Hospitals with daily goals		
Total patients	1410	1539	
Male, % (n)	61 (857)	62 (957)	-1.4 (-4.9 to 2.1), *p* 0.43
Age, median (IQR) years	60 (46 to 71)	61 (47 to 72)	-1 (-3 to 2.6), *p* 0.05
Apache score, median (IQR)	20 (14 to 26)	21 (15 to 27)	-1 (-2 to -1), *p* <0.001
Medical admissions, % (n)	68 (954)	70 (1081)	-2.6 (-5.9 to 1), *p* 0.13
	Hospital as control		
Total patients	1380	1771	
Male, % (n)	61 (845)	59 (1052)	1.8 (-1.6 to 5.3), *p* 0.30
Age, median (IQR) years	59 (45 to 70)	59 (45 to 69)	1 (-1 to 2), *p* 0.28
Apache score, median (IQR)	18 (13 to 24)	18 (13 to 23)	1.8 (-6.1 to 10), *p* 0.37
Medical admissions, % (n)	71 (983)	73 (1293)	-1.8 (-5 to 1.4), *p* 0.27

ICU-LOS

In terms of outcome we found no reduction in ICU-LOS in "daily goal" hospitals or control hospitals between study period 1 and study period 2 (Table 3).

Following correction for gender, grouped APACHE II reason for ICU admission, restricted cubic splines of age and APACHE II score, the change in ICU-LOS between study periods 1 and 2 was similar in control (factor 1.01, 95% CI, 0.92 - 1.11, p-value=0.83) and "daily goal" hospitals (factor 0.93, 95% CI, 0.85 - 1.01, p-value=0.09, p=0.23 for the difference between 'daily goals' hospitals and control hospitals).

In a subgroup analysis on only medical ICU admissions and correcting for the same factors, ICU-LOS was similar in periods 1 and 2 in control (factor 1.01, 95% CI, 0.91 - 1.13, p-value =0.86) hospitals. However, in "daily goal" hospitals ICU-LOS was shorter in period 2 than 1 (factor 0.88, 95% CI, 0.79 - 0.98, p-value=0.02). When comparing control and "daily goal" hospitals, the implementation of daily goals was not associated with a change in ICU-LOS (factor 1.13, 95% CI, 0.97 - 1.32, p-value =0.12).

In a similar subgroup analysis on only emergency surgical ICU admissions, ICU-LOS was similar in periods 1 and 2 in control (factor 1.04, 95% CI, 0.88 - 1.22, p-value = 0.68) and "daily goal" hospitals (factor 1.03, 95% CI, 0.89 - 1.20, p-value=0.6851). When comparing control and "daily goal" hospitals, the implementation of daily goals was not associated with a change in ICU-LOS (factor 1.03, 95% CI, 0.82 - 1.29, p-value =0.79).

Table 3. Outcome measures for daily goals ICUs and control ICUs for study period 1 and 2

	Period 1	Period 2	Difference 95% CI, p value
	Hospitals with daily goals		
Total patients	1410	1539	
ICU-LOS, median (IQR)	2.4 (0.9-6.9)	2.4 (1.0-6.0)	0.04 (-0.11 to 0.19), *p* 0.61
ICU mortality, % (n)	21 (292)	19 (294)	1.6 (-1.3 to 4.5), *p* 0.28
Readmission 24 hours, % (n)	2 (23)	2 (34)	-0.1 (-1.6 to 0.4), *p* 0.25
Hospital LOS, median (IQR)	12 (5-28)	11 (4-23)	1 (0 to 2), *p* 0.02
Hospital mortality, % (n)	29 (410)	26 (403)	3 (-0.3 to 6.1), *p* 0.08
	Hospital as control		
Total patients	1380	1771	
ICU-LOS, median (IQR)	2.7 (1.0-7.3)	2.7 (1.0-8.2)	-0.04 (-0.20 to 0.12), *p* 0.66
ICU mortality, % (n)	19 (261)	17 (309)	-1.6 (-4.4 to 1.3), *p* 0.28
Readmission 24 hours, % (n)	2 (25)	2 (35)	-0.5 (-1.5 to 0.5), *p* 0.34
Hospital LOS, median (IQR)	14 (6-30)	14 (6-29)	0.22 (-1 to 1), *p* 0.59
Hospital mortality, % (n)	26 (360)	29 (444)	-3.3 (-6.5 to -0.1), *p* 0.04

Daily goals evaluation

In the first study period daily goals were formulated blinded for the team caring for a patient and in the second period daily goals were formulated in the PDMS. In total 3920 daily goals in 1008 patients in the first study period and 16487 in 1246 patients in the second study period were evaluated. The median number of daily goals per patient was in the first study period 4 (2 to 5) and 5 (2 to 14) in the second study period.

The top six categories of formulated daily goals in the first and second study period were: (a) Pulmonal care, (b) Fluid balance, (c) Cardiac Care, (d) Pain/sedation, (e) Infection and (f) Gastrointestinal care (Table 4).

The percentage of daily goals that was '*succesfully met*' was in the first study period 79%, and in the second study period 75%, RR 1.05 (95% CI, 1.04 - 1.08). The percentage of daily goals *'not met* ***with*** *a documented reason'* was in the first and the second study period respectively 3% (123/3757) and 15% (1499/9842), RR 0.25 (95% CI, 0.21 - 0.30). Daily goals *'not met* ***without*** *a documented reason'* decreased between the first and second study period from 18% (664/3757) to 8% (789/9842), RR 2.2 (95% CI 2 to 2.43).

Table 4. Categories of daily goals applied to the ICU patients in study period 1 and 2

	Study period 1		Study period 2	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Pulmonal care	748	19.8	2983	18.1
Fluid balance	544	14.4	3437	20.8
Cardiac care	494	13.1	1737	10.5
Pain /sedation	430	11.4	1289	7.8
Infection	346	9.2	1005	6.1
Consults	264	7.0	687	4.2
Gastrointestinal care	256	6.8	1043	6.3
Renal care	182	4.8	634	3.8
DVT profylaxes	104	2.8	96	0.6
Family	100	2.6	444	2.7
Diagnostic procedures	86	2.3	664	4
Tubes and IV-lines	86	2.3	349	2.1
Discharge	52	1.4	488	3
Mobilization	32	0.8	386	2.3
Glucose regulation	20	0.5	58	0.4
Risk prevention	16	0.4	34	0.2
Inclusion in trials	14	0.4	14	0.1
Other and NAs	146	3.7	1139	6.9
Sum	3920	100.0	16487	100

Discussion

Statement of principal findings

The implementation of daily goals, when corrected for confounders, was not associated with a change in ICU length of stay. A secondary result, the improved administrative discipline, i.e. the recording of the reasons as to why a daily goals or a standard protocol were not accomplished is in favor of the daily goals implementation.

Study limitations

The before-after design of this study is associated with inherent limitations. First of all, time trends might have been influencing the outcome. Although we studied the effect of time by comparing length of stay of the two "daily goal" ICUs with control ICUs by using demographic and severity-of-illness data from the National Intensive Care Evaluation (NICE) registry, modelling ICU length of stay on these data is difficult. [5] Furthermore, although the two control and two "daily goal" hospitals were all academic hospitals, there still may have been differences in clinical practice or patient characteristics that have not been corrected for. Also, one control hospital contributed data for a shorter time period than the other hospitals. However, although a better approach might have been to randomize individual patients to having daily goals available or not available to nursing staff, still, this is a large multicentre cohort study comparing two study periods, adjusting for several confounders adding to the knowledge on daily goals implementation.

Other studies

A study by Pronovost to improve the effectiveness of communication during patient care rounds in the intensive care using daily goals forms (DGF) was reported in 2003. [3] This prospective cohort study was performed in a 16 bed surgical oncology ICU. In this before-after study the understanding of goals of care for the day by nurses and residents increased from an initial less than 10% to more than 95%. The implementation coincided with a reduction of ICU-LOS from a mean of 2.2 days to 1.1 days. However, due to the limited data collection a causal relation between the use of DGF's and the ICU-LOS remained inconclusive.

The plausibility of these results are indirectly supported by earlier results of Donchin who investigated the nature and causes of human errors in the ICU and concluded that many of these errors could be attributed to problems of communication between the physicians and nurses. [6] A survey study (before-after comparison) showed that an explicit approach to clinical and educational responsibilities and to reporting assessments and plans during bedside rounds in the intensive care unit improved communication and satisfaction of health care providers. [7] The implementation of DGF's was evaluated by a questionnaire before implementation and after 6 weeks and 9 months in a medical ICU unit. [8] The questionnaire was designed to assess satisfaction with communication and the usefulness of the DGF. ICU-LOS was compared with the previous year for a period of 9 months. The questionnaire showed significant improvements in understanding of the goals of the day among nurses and physicians after 6 weeks and after 9 months. Nurses were willing to continue its use (71% before implementation and 93% after implementation) whereas physicians were less willing (100% before and 64% after implementation). Both nurses and physicians reported significant improvement in communication with each other. After the worksheet was implemented the mean length of stay declined from mean (SD) 6.4 (2.5) days during the pre-intervention period to mean 4.3 (0.63) days after implementation.

To investigate the perception of the communication from a nursing perspective before and after DGF's were implemented in a pediatric ICU, a questionnaire was used. [9] The majority of nurses (85%) felt that the daily goals form led to improved communications between nurses and physicians, and 73% also felt that the DGF improved communications among nurses between different shifts. Eighty-five percent of nurses expressed their impression that the use of DGF's improved the care.

So far three studies evaluated the implementation of DGF's. None of the studies provided sufficient information about the characteristics of the ICU unit over time nor gave insight in possible mechanisms beside improved communication leading to the beneficial effect of the formulation of daily goals. In our study we could not confirm the beneficial effect of daily goals on length of stay that was found in the earlier studies. One of the reasons could have been that we corrected as optimal as possible for time trends and it is a known fact that LOS-ICU has been decreasing in the past decades. Obviously we have to be aware that the implementation of daily goals actually did not have a large effect on length of stay. Possibly, since improvement of communication has received so much attention lately, there may have been already some implicit communication of goals in the control period, making it difficult for explicit implementation of daily goals in our ICUs to improve outcome and to shorten length of stay significantly.

Strikingly, in period two documentation in case of deviation from a formulated earlier goal, or deviate from a protocol increased significantly. Both findings may have been signals of improved transfer of knowledge in a non-verbal way and of the awareness of the importance to note deviations from planned care.

Although we could not find a decrease of length of stay with the implementation of daily goal, we still are of the opinion that daily goals, as a way to improve communication and structure the transfer of knowledge, within a whole care team taking care of critically ill patients, is extremely important. Thus, a format whereby the care team focuses daily on important goals for every patient individually should be standard practice, particularly on ICUs

Conclusion

Incorporation of daily goals in daily care planning does not shorten ICU LOS of mixed medical–surgical ICU patients, but the use of daily goals does improve documentation of care.

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Conflict of interest
All authors have declared no conflicts of interest.

References

1. Siegele P. Enhancing outcomes in a surgical intensive care unit by implementing daily goals tools. Crit Care Nurse 2009;29:58-69.
2. Checkley W, Martin GS, Brown SM, et al. Structure, process, and annual ICU mortality across 69 centers: United States Critical Illness and Injury Trials Group Critical Illness Outcomes Study. Crit Care Med 2014;42:344-56.
3. Pronovost P, Berenholtz S, Dorman T, Lipsett PA, Simmonds T, Haraden C. Improving communication in the ICU using daily goals. J Crit Care 2003;18:71-75.
4. van de Klundert N, Holman R, Dongelmans DA, de Keizer NF. Data Resource Profile: the Dutch National Intensive Care Evaluation (NICE) Registry of Admissions to Adult Intensive Care Units. Int J Epidemiol 2015;44:1850-1850h.
5. Verburg IW, de Keizer NF, de JE, Peek N. Comparison of regression methods for modeling intensive care length of stay. PLoS One 2014;9:e109684.
6. Donchin Y, Gopher D, Olin M, et al. A look into the nature and causes of human errors in the intensive care unit. Crit Care Med 1995;23:294-300.
7. Dodek PM, Raboud J. Explicit approach to rounds in an ICU improves communication and satisfaction of providers. Intensive Care Med 2003;29:1584-88.
8. Narasimhan M, Eisen LA, Mahoney CD, Acerra FL, Rosen MJ. Improving nurse-physician communication and satisfaction in the intensive care unit with a daily goals worksheet. Am J Crit Care 2006;15:217-22.
9. Phipps LM, Thomas NJ. The use of a daily goals sheet to improve communication in the paediatric intensive care unit. Intensive Crit Care Nurs 2007;23:264-71.