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Record reviewing with a priori patient selection:

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Record reviewing with a priori patient selection

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Keywords: PUBLIC HEALTH, Length of Stay , Colorectal cancer , Record reviewing , Adverse events < THERAPEUTICS, trigger tool

Article Summary

Article focus

- Record reviewing in order to identify adverse events is time-consuming.
- A priori selection of patient records on the basis of Unexpectedly Long Length of Stay (UL-LOS) can be an efficient way to increase the chance of finding adverse events.

Key message

- Selection of patient records with the UL-LOS and use of the Global Trigger tool appear to be a powerful way of finding a majority of adverse events while limiting the number of patient records to be reviewed and thereby saving the reviewing physicians' valuable time.

Strengths and limitations

- This is the first study to look at the effectiveness of UL-LOS
- A limitation of the study is that is was investigated in only one group of patients. Future research should investigate the effectiveness of UL-LOS in other diagnostic groups

Author's statement: The authors declare that there are no competing interests, the research did not receive any funding and there are no additional unpublished data from the study. The study did not involve human subjects and the design of the study does not require ethical approval.

Abstract

Objectives: To investigate whether a priori selection of patient records using Unexpectedly Long Length of Stay (UL-LOS) leads to detection of more records with adverse events (AEs) compared to non-UL-LOS.

Design: To investigate the opportunities of the UL-LOS, we looked for AEs in all records of patients with colorectal cancer. Within this group, we compared the number of AEs found in records of patients with a UL-LOS with the number found in records of patients who did not have a UL-LOS.

Setting: Our study was done at a general hospital in the Netherlands The hospital is medium sized with approximately 30,000 admissions on an annual basis. The hospital has two major locations in different cities where both primary and secondary care is provided.

Participants: The patient records of 191 patients with colorectal cancer were reviewed.

Primary and secondary outcome measures: Number of triggers and adverse events were the primary outcome measures.

Results: In the records of patients with colorectal cancer who had a UL-LOS, 51% of the records contained one or more AEs compared to 9% in the reference group of non-UL-LOS patients. By reviewing only the UL-LOS group with at least one trigger, we found in 84% (43 out of 51) of these records at least one adverse event.

Conclusions: A priori selection of patient records using the UL-LOS indicator appears to be a powerful selection method which could be an effective way for healthcare professionals to identify opportunities to improve patient safety in their day-to-day work.

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Introduction

Diminishing the number of patient-related adverse events is one of the top priorities for hospitals. A common way to achieve this is to learn from incidents and take action to prevent recurrence. To identify the adverse events, retrospective patient record review has become the 'gold standard' internationally(1-5). By retrospectively reviewing patient records, healthcare professionals are able to identify adverse events that occurred during the care process. Several studies on retrospective patient record review in different countries have shown a wide range of incidences of adverse events, varying from 2.9% to 16.6% with a median overall incidence of adverse events of 9.2%(6-8). This implies that, with random selection from all hospital records, a healthcare professional has to review 6 to 34 records to find one adverse event. These results show that although record reviewing has been proved very advantageous in finding adverse events, there is an important disadvantage: record reviewing is very time-consuming. Although most Dutch hospitals want to analyse their patient records for adverse events in order to identify patient safety opportunities, many hospitals are not able to mobilise enough physicians who can spend many hours reviewing patient records.

Looking for more efficient ways to organise patient record reviewing, we investigated how to increase the chance of finding adverse events. Previous research has shown strong relationships between adverse events and outcomes of quality indicators at patient and hospital level(9-11). For instance, one study identified a relationship between complications and increased mortality and length of stay (LOS)(12). A more recent study on the United States Veterans Health Administration data replicated these relationships between adverse events and patient safety indicators of the Agency for Healthcare Research and Quality(14).

Several other studies have indicated that adverse events often lead to prolonged LOS, and prolonged LOS could signal safety issues(15-24). Silber et al for instance showed that LOS can be used to reflect how well hospitals and providers deal with complications and adverse events(25).

The above mentioned studies suggest that negative results on quality indicators could be attributed to adverse events. In the current study, we hypothesize that records of patients with an Unexpectedly Long Length of Stay (UL-LOS) will show more adverse events. This patient safety indicator is already three years in use by Dutch hospitals and derived from administrative medical data. If so, the indicator could be used for selecting patient records in order to find more adverse events and save the valuable time of those reviewing patient records.

To test the hypothesis that looking for adverse events can be done efficiently by selecting patient records using UL-LOS, we conducted a pilot study with a retrospective review of patient records in Tergooiziekenhuizen, a general hospital in the Netherlands. This article describes the pilot study. The results of this study might help hospitals organise their record-reviewing process in the most efficient way possible by using the quality indicator that already is available to them through existing registries.

Methods

The quality indicator UL-LOS

In our study, we used the quality indicator UL-LOS 2009 to make the a priori selection. The UL-LOS is based on the data from the National Medical Registration (LMR). The LMR contains demographical patient information, admission related hospital data such as diagnosis, and surgical procedures (26). UL-LOS is generated by indirect standardisation on three patient characteristics: age, primary diagnosis, and the main procedure that the patient underwent. Age of the patient is divided into 5 classes of 0, 1-14, 15-44, 45-64, and 65 and older. For the primary diagnoses we used the diagnosis that led to the admission which includes approximately 1,000 diagnoses classified by the ICD9 in three digits. Finally, the main procedure is determined by the Dutch Classification System of Procedures and is considered to depend on the diagnosis of the patient. On average it includes five main procedural groups. Together, these three parameters resulted in 5 x 5 x 1,000 = 25,000 cells. For each cell the mean length of stay has been taken as the expected length of stay. Then the ratio between the actual length of stay and the expected length of stay is taken to calculate the UL-LOS. We define the UL-LOS as a LOS that is more

than 50% longer than expected. Patients who died in the hospital are excluded. In addition, UL-LOS is a quality indicator Dutch hospitals use for their quality-improvement programmes and the Dutch Health Care Inspectorate uses UL-LOS in its supervision of hospital care.

Setting

The study was done in 2010 and 2011 at Tergooiziekenhuizen, a general hospital with nearly 30,000 clinical admissions a year. We used data and patient records from 2009. The hospital board gave us permission to use the data.

Reference groups

To assess the impact of the indicator UL-LOS, we selected records with the UL-LOS and compared these records with the reference group consisted of comparable patients who were treated at Tergooiziekenhuizen without a UL-LOS.

Analysis with the IHI Global Trigger Tool

A nurse used the IHI (Institute for Healthcare Improvement) Global Trigger Tool to search all selected patient records for triggers(27). Triggers may contain clues for identifying possible adverse events. This instrument adapts the classification from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Errors. Although originally developed for categorising medication errors, these definitions can be easily applied to any type of adverse event. The IHI Global Trigger Tool was developed to count adverse events, determine the harm to the patient, and whether the adverse event was the result of a commission. According to the IHI, only cases of commission should be counted. However we also counted cases of omission, as these are also a valuable source of possible quality improvement(5, 28).

Accordingly, the tool excludes the categories A to D from the NCC MERP Index, because these categories describe incidents that do not cause harm. We used the categories E to I, which do describe harm that may have contributed to or resulted in:

- temporary harm to the patient and required intervention (Category E);
- temporary harm to the patient and required initial or prolonged hospitalisation (Category F);
- permanent patient harm (Category G);
- intervention required to sustain life (Category H); and
- contributed to patient death (Category I).

A surgeon and an internist-nephrologist investigated and looked for adverse events in the patient records in which the nurse had found triggers. The physicians and nurses were trained according to the IHI Trigger Tool implementation programme. The patient records were randomly divided between the physicians. They analysed these records in the same room in order to discuss difficult cases and make use of each other's expertise. If necessary, they consulted other physicians in the hospital to make their judgments as accurate as possible. The harm caused by an adverse event was categorised according to the NCC MERP Index as indicated above. They also classified the adverse events into five categories: care, operation, medication, intensive care (IC), and other.

A priori record selection with UL-LOS

We selected all records of patients with an admission for colorectal cancer in 2009. Patients with colorectal cancer are generally considered to be a homogenous population in terms of LOS, and are relatively vulnerable to adverse events(29). We excluded duplicated records, records of palliative patients, and patients who died in the hospital. Then we selected patient records with a UL-LOS. A nurse screened all these selected records for the presence of triggers with the Trigger tool. Patient records with triggers were forwarded to the physicians to be investigated for adverse events and the possible harm to patients. We categorised all records on the basis of the ratio between actual and expected LOS, into four groups:

1) actual LOS equal or less than 50% longer than expected;
2) actual LOS 50% - 99% longer than expected;
3) actual LOS 100% - 199% longer than expected;

4) actual LOS 200% or more above the expected LOS.

The last three categories together form the patient group with a UL-LOS. The first category is the patient group we call non-UL-LOS which is at the same time the reference group.

Results

UL-LOS-based record selection

In 2009, the hospital in our study admitted, treated, and discharged 191 patients with colorectal cancer. From this group, we excluded the duplicated patient records and patients who were admitted for palliative care which resulted in 129 unique patient records. From this group, we selected 85 patients with a UL-LOS (66%). Screening by our nurse with the trigger tool revealed that 51 of these UL-LOS records contained one or more triggers. Thus, 27% of 191 records remained to be reviewed by our physicians. Of these records, 43 patient records included one or more adverse events: 27 records contained one adverse event; 10 records contained two adverse events; 4 records contained three adverse events; and 2 records contained four adverse events (see Figure 1).

<<Figure 1>>

In Table 1, we present the physicians' classification. The adverse events were classified mainly as operation-related (45%); 60% of the adverse events were considered to have resulted in temporary harm to the patient, and required initial or prolonged hospitalisation (category F).

Table 1. Number, type, and severity ratings of adverse events found in records of patients admitted with colorectal cancer and a UL-LOS

		Type of adverse event						
		Care	Medical	Operation	IC	Other	Total	
Severity rating of adverse event	E: temporary harm to the patient and required intervention	7	2	3	1	4	17	**25%**
	F: temporary harm to the patient and required initial or prolonged hospitalisation	9	4	21	2	4	40	**60%**
	G: permanent patient harm	0	0	4	0	1	5	**7%**
	H: intervention required to sustain life	1	0	1	0	0	2	**3%**
	I: contributed to patient death	1	0	1	0	1	3	**4%**
	Total	18	6	30	3	10	67	
		27%	**9%**	**45%**	**4%**	**15%**		**100 %**

The reference group: non-UL-LOS patients

Table 2 shows the number of adverse events compared between UL-LOS and non-UL-LOS patients. In the non-UL-LOS group, in 9% (4 out of 44) of the reviewed records, at least one adverse event was found, compared to 51% (43 out of 85) in the UL-LOS group. We also compared three categories within the UL-LOS (table 2).

Table 2 Number of adverse events compared between UL-LOS and non-UL-LOS patients and within the UL-LOS categories

	N records	N records containing at least 1 trigger	N (and % of) records containing at least 1 adverse event
Non-UL-LOS patients	44	6	4 (9%)
All patients with a UL-LOS	85	51	43 (51%)
- Of which patients with 50%-99% longer-than-expected LOS	33	14	9 (27%)
- Of which patients with 100%-199% longer-than-expected LOS	32	22	20 (63%)
- Of which patients with 200% and above longer-than-expected LOS	20	15	14 (70%)

Discussion

With a priori selection using the UL-LOS indicator, we found adverse events in 51% of the records, compared to 9% in the non-UL-LOS group. By reviewing only the UL-LOS group with at least one trigger, we found in 84% (43 out of 51) of these records at least one adverse event. The fact that almost all records including one or more adverse events can be found by concentrating on records of patients with a UL-LOS and triggers is encouraging for hospitals struggling with a sparse capacity of reviewing physicians.

The percentages of records in which adverse events were identified in the different categories of UL-LOS show that the present formal quality indicator used by the Dutch Health Care Inspectorate identifies most adverse events. Our results show a rise in the percentage in which at least one adverse event was found from 50% longer LOS onwards. However, it also rises from 100% onwards. A more detailed study is needed to determine the appropriateness of the 50% threshold. These results apply to colorectal cancer. Future research could also investigate

whether this threshold is appropriate for all diagnostic groups or whether we need varying percentages.

An interesting finding is that only 45% of the adverse events in a group of surgical patients such as those with colorectal cancer is related to the classification 'operation'. It seems that quality of care is determined by the whole chain of care, not only by the quality of the organisation in the operating room or the professionals performing the operation.

Limitations

An important limitation of this study is that we identified the number of adverse events in only one group of patients and in only one hospital. Future research should show whether identifying adverse events in more patient records, also from other patient groups in more hospitals, gives comparable results.

Another limitation is the fact that, although we chose to have two physicians analyse the patient records together, both of them reviewed different records with consulting each other intensively. Therefore we could not measure the interrater reliability. Our main concern was to organise the review process as efficiently as possible. Therefore, we chose parallel record reviewing. However, further research should show whether parallel analysis is reliable enough compared with consecutive analysis, which still contends with poor reliability (27, 28).

The results of this study are encouraging in showing that hospitals can and will use quality indicators based on administrative data for patient safety policy. This type of hospital data is usually easily available without an extra administrative burden for hospitals. Earlier research has shown the reliability of using administrative data in relation to clinical data(30). However, the reliability of indicators such as UL-LOS depends on the quality of coding in hospitals(31). Also in the Netherlands, the quality of administrative hospital data is subject to debate. If the quality of data coding in hospitals were to improve, the selection efficiency of quality indicators such as UL-LOS would probably be more accurate.

Conclusion

Easily available selection methods such as UL-LOS and the Global Trigger tool may be a powerful way of finding a majority of adverse events while limiting the number of patient records to be reviewed and thereby saving the reviewing physicians' valuable time. This could help hospitals to organise their patient safety policy as efficiently as possible.

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Data sharing: There are no additional unpublished data from the study

Competing Interests: None

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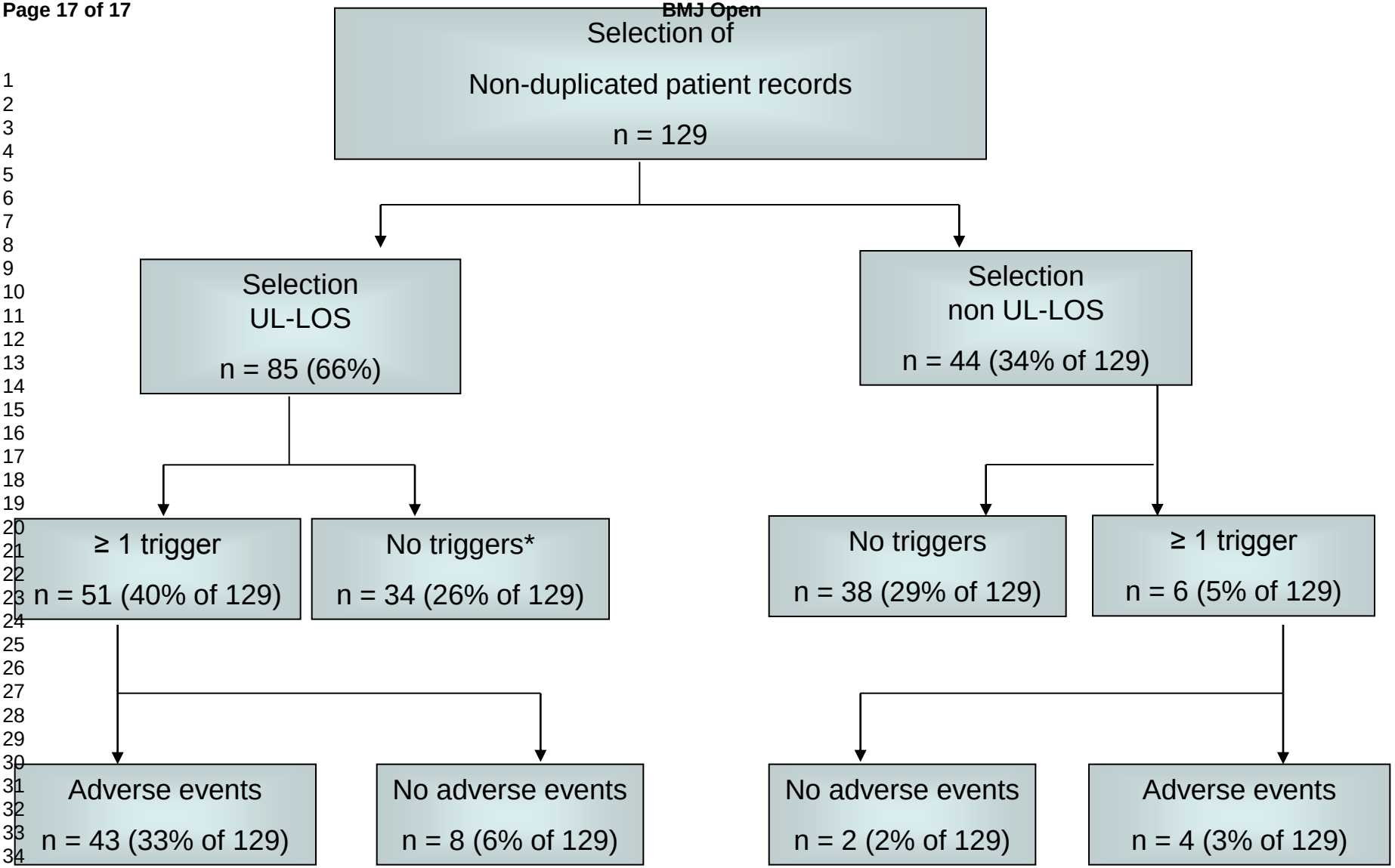

*Only trigger: increased length of stay

n=number of patient records

% is of total selection of patient records

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Introduction

Within health services research, increased attention is focusing on patient outcomes. This results from the need to improve care and the need to reduce costs. As studies increasingly evaluate patient care, the need exists to identify adverse outcomes within patient medical records. This is a major challenge because medical records are usually extensive and sometimes difficult to evaluate. In the United States, this subject is being addressed by computer algorithms such as the Potentially Preventable Complications and the Potentially Preventable Readmissions software. These algorithms use hospital discharge abstract data to identify adverse outcomes in large populations. The development of these algorithms has been a long and resource intensive process[1]. The current research addresses this important subject by developing a tool for identifying adverse outcomes in the Netherlands. The research involved patients at a medium sized hospital where the volume of inpatients makes the identification of specific patients with adverse outcomes a challenging undertaking.

Furthermore, diminishing the number of patient-related adverse events became one of the top priorities for Dutch hospitals. A common way to achieve this is to learn from incidents and take action to prevent recurrence. To identify the adverse events, retrospective patient record review has become the 'gold standard' (inter)nationally[2-6]. By retrospectively reviewing patient records, healthcare professionals are able to identify adverse events that occurred during the care process. Several studies on retrospective patient record review in different countries have shown a wide range of incidences of adverse events, varying from 2.9% to 16.6% with a median overall incidence of adverse events of 9.2%[7-9]. This implies that, with random selection from all hospital records, a healthcare professional has to review 6 to 34 records to find one adverse event. These results show that although record reviewing has been proved very advantageous in finding adverse events, there is an important disadvantage: record reviewing is very time-consuming. Although most Dutch hospitals want to analyse their patient records for adverse events in order to identify patient safety opportunities, many hospitals are not able to mobilise enough physicians who can spend many hours reviewing patient records.

Looking for more efficient ways to organise patient record reviewing, we investigated how to increase the chance of finding adverse events. Previous research has shown strong relationships between adverse events and outcomes of quality indicators at patient and hospital level[10-12]. For instance, one study identified a relationship between complications and increased mortality and length of stay (LOS)[13]. A more recent study on the United States Veterans Health Administration data replicated these relationships between adverse events and patient safety indicators of the Agency for Healthcare Research and Quality[14]. Several other studies have indicated that adverse events often lead to prolonged LOS, and prolonged LOS could signal safety issues[15-24]. Silber et al for instance showed that LOS can be used to reflect how well hospitals and providers deal with complications and adverse events[25].

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demographical patient information, admission related hospital data such as diagnosis, and surgical procedures[26]. UL-LOS is generated by indirect standardisation on three patient characteristics: age, primary diagnosis, and the main procedure that the patient underwent. Age of the patient is divided into 5 classes of 0, 1-14, 15-44, 45-64, and 65 and older. For the primary diagnoses we used the diagnosis that led to the admission which includes approximately 1,000 diagnoses classified by the ICD9 in three digits. Finally, the main procedure is determined by the Dutch Classification System of Procedures and is considered to depend on the diagnosis of the patient. On average it includes five main procedural groups. Together, these three parameters resulted in 5 x 5 x 1,000 = 25,000 cells. For each cell the mean length of stay has been taken as the expected length of stay. Then the ratio between the actual length of stay and the expected length of stay is taken to calculate the UL-LOS. We define the UL-LOS as a LOS that is more than 50% longer than expected. Patients who died in the hospital are excluded. In addition, UL-LOS is a quality indicator Dutch hospitals use for their quality-improvement programmes and the Dutch Health Care Inspectorate uses UL-LOS in its supervision of hospital care.

Setting

The study was done in 2010 and 2011 at Tergooiziekenhuizen, a general hospital with nearly 30,000 clinical admissions a year. We used data and patient records from 2009. The hospital board gave us permission to use the data.

Reference groups

To assess the impact of the indicator UL-LOS, we selected from 191 colorectal admissions, records with the UL-LOS and compared these records with the reference group consisting of comparable patients from the same specialty population, who were treated at Tergooiziekenhuizen without a UL-LOS.

Analysis with the IHI Global Trigger Tool

A nurse used the IHI (Institute for Healthcare Improvement) Global Trigger Tool to search all selected patient records for triggers[27]. The nurse that did the screening of triggers for this study

was experienced with the use of the Global Trigger Tool. Triggers may contain clues for identifying possible adverse events. This instrument adapts the classification from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP[28]) Index for Categorizing Errors. Although originally developed for categorising medication errors, these definitions can be easily applied to any type of adverse event. The IHI Global Trigger Tool was developed to count adverse events, determine the harm to the patient, and whether the adverse event was the result of a commission. According to the IHI, only cases of commission should be counted. However we also counted cases of omission, as these are also a valuable source of possible quality improvement[6, 29].

Accordingly, the tool excludes the categories A to D from the NCC MERP Index, because these categories describe incidents that do not cause harm. We used the categories E to I, which do describe harm that may have contributed to or resulted in:

- temporary harm to the patient and required intervention (Category E);
- temporary harm to the patient and required initial or prolonged hospitalisation (Category F);
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A surgeon and an internist-nephrologist investigated and looked for adverse events in the patient records in which the nurse had found triggers. The physicians and the nurse were trained extensively according to the IHI Trigger Tool implementation programme to make sure that they all worked according to the same IHI methodology. The patient records were randomly divided between the physicians. They analysed these records in the same room in order to discuss difficult cases and make use of each other's expertise. If necessary, they consulted other physicians in the hospital to make their judgments as accurate as possible. The harm caused by an adverse event was categorised according to the NCC MERP Index as indicated above. They

also classified the adverse events into five categories: care, operation, medication, intensive care (IC), and other.

A priori record selection with UL-LOS

We selected all records of patients with an admission for colorectal cancer in 2009. Patients with colorectal cancer are generally considered to be a homogenous population in terms of LOS, and are relatively vulnerable to adverse events[30]. We excluded duplicated records, records of palliative patients, and patients who died in the hospital. Then we selected patient records with a UL-LOS based on the calculations in the LMR discharge data. A nurse screened all these selected records for the presence of triggers with the trigger tool. Patient records with triggers were forwarded to the physicians to be investigated for adverse events and the possible harm to patients. We categorised all records on the basis of the ratio between actual and expected LOS, into four groups:

1) actual LOS equal or less than 50% longer than expected;
2) actual LOS 50% - 99% longer than expected;
3) actual LOS 100% - 199% longer than expected;
4) actual LOS 200% or more above the expected LOS.

The last three categories together form the patient group with a UL-LOS. The first category is the patient group we call non-UL-LOS which is at the same time the reference group. In sum, we pursued an approach to the record reviewing process by first making the selection on the basis of discharge abstract data and then working directly with patient medical records. In so doing, we have developed an effective tool which identifies adverse outcomes directly in hospital medical records that are being selected with the discharge abstract data.

Results

UL-LOS-based record selection

In 2009, the hospital in our study admitted, treated, and discharged 191 patients with colorectal cancer. From this group, we excluded the duplicated patient records and patients who were admitted for palliative care which resulted in 129 unique patient records. From this group, we

selected 85 patients with a UL-LOS (66%). Screening by our nurse with the trigger tool revealed that 51 of these UL-LOS records contained one or more triggers. Thus, 27% of 191 records remained to be reviewed by our physicians. Of these records, 43 patient records included one or more adverse events: 27 records contained one adverse event; 10 records contained two adverse events; 4 records contained three adverse events; and 2 records contained four adverse events (see Figure 1).

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In Table 1, we present the physicians' classification. The adverse events were classified mainly as operation-related (45%); 60% of the adverse events were considered to have resulted in temporary harm to the patient, and required initial or prolonged hospitalisation (category F).

Table 1. Number, type, and severity ratings of adverse events found in records of patients admitted with colorectal cancer and a UL-LOS

		Type of adverse event						
		Care	Medical	Operation	IC	Other	Total	
Severity rating of adverse event	E: temporary harm to the patient and required intervention	7	2	3	1	4	17	**25%**
	F: temporary harm to the patient and required initial or prolonged hospitalisation	9	4	21	2	4	40	**60%**
	G: permanent patient harm	0	0	4	0	1	5	**7%**
	H: intervention required to sustain life	1	0	1	0	0	2	**3%**
	I: contributed to patient death	1	0	1	0	1	3	**4%**
	Total	18	6	30	3	10	67	
		27%	**9%**	**45%**	**4%**	**15%**		**100 %**

The reference group: non-UL-LOS patients

Table 2 shows the number of adverse events compared between UL-LOS and non-UL-LOS patients. In the non-UL-LOS group, in 9% (4 out of 44) of the reviewed records, at least one adverse event was found, compared to 51% (43 out of 85) in the UL-LOS group. We also compared three categories within the UL-LOS (table 2).

Table 2 Number of adverse events compared between UL-LOS and non-UL-LOS patients and within the UL-LOS categories

	N records	N records containing at least 1 trigger	N (and % of) records containing at least 1 adverse event
Non-UL-LOS patients	44	6	4 (9%)
All patients with a UL-LOS	85	51	43 (51%)
- Of which patients with 50%-99% longer-than-expected LOS	33	14	9 (27%)
- Of which patients with 100%-199% longer-than-expected LOS	32	22	20 (63%)
- Of which patients with 200% and above longer-than-expected LOS	20	15	14 (70%)

Discussion

The effectiveness of the methodology developed in the current research is impressive, demonstrating that a large majority of the records identified, contained one or more adverse events. With a priori selection using the UL-LOS indicator, we found adverse events in 51% of the records, compared to 9% in the non-UL-LOS group. By reviewing only the UL-LOS group with at least one trigger (66%), we found in 84% (43 out of 51) of all the records with at least one adverse event in the colorectal patient group. Putting it another way, by reviewing only the UL-LOS group with at least one trigger, which is 40% of all patients, we found 91% of all records with at least one adverse event in the colorectal patient group. The fact that almost all records including one or more adverse events can be found by concentrating on records of patients with a UL-LOS and triggers is encouraging for hospitals struggling with a sparse capacity of reviewing physicians.

The percentages of records in which adverse events were identified in the different categories of UL-LOS show that the present formal quality indicator used by the Dutch Health Care

Inspectorate identifies most adverse events. Our results show a rise in the percentage in which at least one adverse event was found from 50% longer LOS onwards. However, it also rises from 100% onwards. A more detailed study is needed to determine the appropriateness of the 50% threshold. These results apply to colorectal cancer. Future research could also investigate whether this threshold is appropriate for all diagnostic groups or whether we need varying percentages.

An interesting finding is that only 45% of the adverse events in a group of surgical patients such as those with colorectal cancer is related to the classification 'operation'. It seems that quality of care is determined by the whole chain of care, not only by the quality of the organisation in the operating room or the professionals performing the operation.

Limitations

An important limitation of this study is that we identified the number of adverse events in a single specialty population and in only one hospital. Future research should investigate the validation on other populations and show whether identifying adverse events in more patient records, in more hospitals, gives comparable results.

Another limitation is the fact that, although we chose to have two physicians analyse the patient records together, both of them reviewed different records with consulting each other intensively. Therefore we could not measure the interrater reliability. Our main concern was to organise the review process as efficiently as possible. Therefore, we chose parallel record reviewing. However, further research should show whether parallel analysis is reliable enough compared with consecutive analysis, which still contends with poor reliability[27, 29]. Although current study shows that the spare time of physicians can be saved by efficient record selection and Global Trigger Tool, experienced nurses can also review the patient records for the existence of adverse events. Then the physicians only have to determine the nurse's findings and assess the severity of harm. Such a strategy can save the time of physicians even more.

The results of this study are encouraging in showing that hospitals can and will use quality indicators based on administrative data for patient safety policy. This type of hospital data is usually easily available without an extra administrative burden for hospitals. Earlier research has shown the reliability of using administrative data in relation to clinical data[31]. However, the reliability of indicators such as UL-LOS depends on the quality of coding in hospitals[32]. Also in the Netherlands, the quality of administrative hospital data is subject to debate. If the quality of data coding in hospitals were to improve, the selection efficiency of quality indicators such as UL-LOS would probably be more accurate. The use of such quality indicators in combination with effective methods as Global Trigger Tool be identify even more easily adverse events from the patient records[17, 33].

Conclusion

Easily available selection methods such as UL-LOS and the Global Trigger Tool may be a powerful way of finding a majority of adverse events while limiting the number of patient records to be reviewed and thereby saving the reviewing physicians' valuable time. This could help hospitals to organise their patient safety policy as efficiently as possible.

Acknowledgment We would like to thank A Jonkheim, who screened all of the patient files, and the physicians FC Henny and JW Juttmann of Tergooiziekenhuizen, who went through all of the selected patient files.

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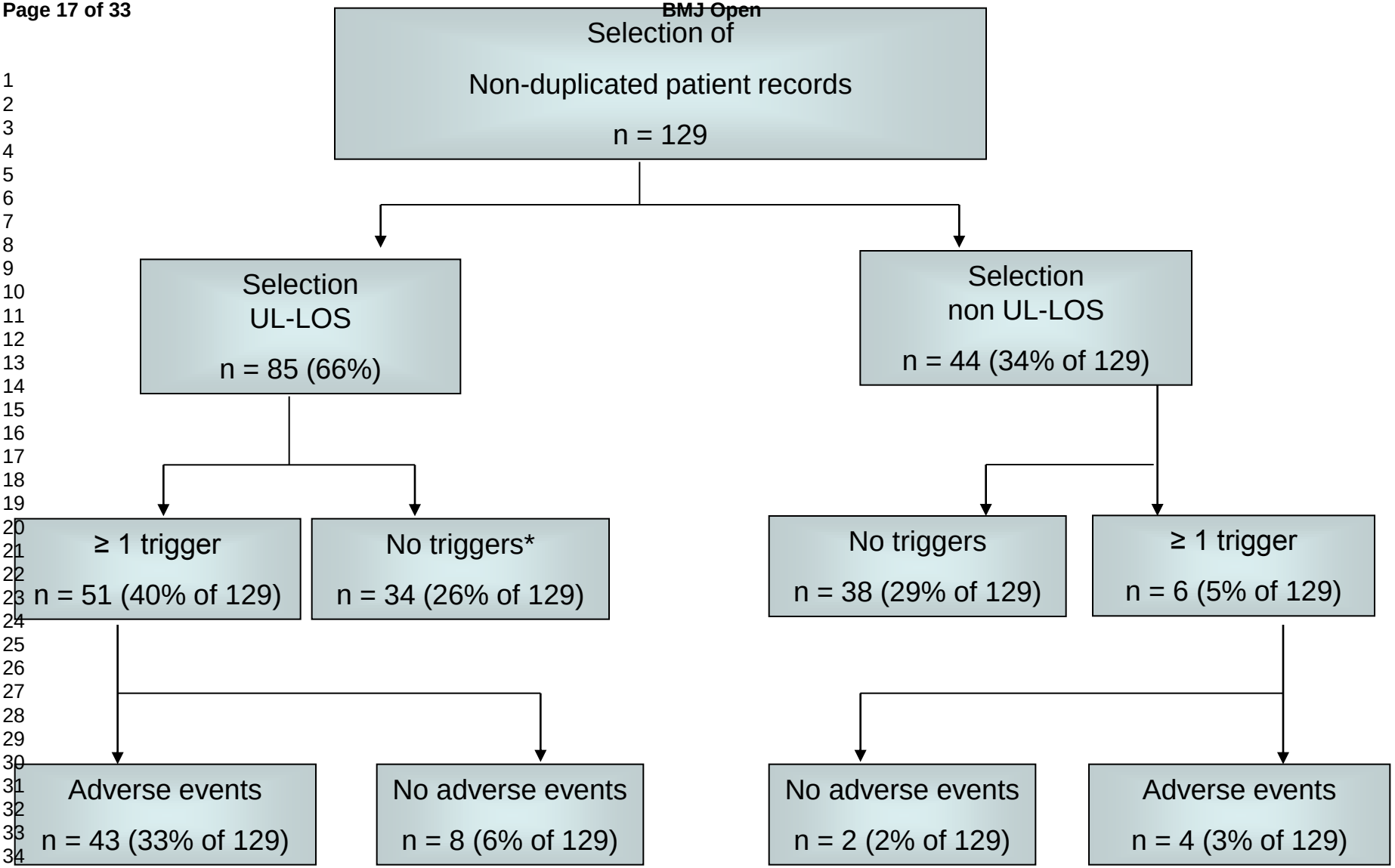

*Only trigger: increased length of stay

n=number of patient records

% is of total selection of patient records

Article Summary

Article focus

- Record reviewing in order to identify adverse events is time-consuming.
- A priori selection of patient records on the basis of Unexpectedly Long Length of Stay (UL-LOS) can be an efficient way to increase the chance of finding adverse events.

Key message

- Selection of patient records with the UL-LOS and use of the Global Trigger tTool appear to be a powerful way of finding a majority of adverse events while limiting the number of patient records to be reviewed and thereby saving the reviewing physicians' valuable time.

Strengths and limitations

- This is the first study to look at the effectiveness of UL-LOS.
- A limitation of the study is that is was investigated in only one group of patients. Future research should investigate the effectiveness of UL-LOS in other diagnostic groups.

Author's statement: The authors declare that there are no competing interests, the research did not receive any funding and there are no additional unpublished data from the study. The study did not involve human subjects and the design of the study does not require ethical approval.

Objectives: To investigate whether a priori selection of patient records using Unexpectedly Long Length of Stay (UL-LOS) leads to detection of more records with adverse events (AEs) compared to non-UL-LOS.

Design: To investigate the opportunities of the UL-LOS, we looked for AEs in all records of patients with colorectal cancer. Within this group, we compared the number of AEs found in records of patients with a UL-LOS with the number found in records of patients who did not have a UL-LOS.

Setting: Our study was done at a general hospital in the Netherlands. The hospital is medium sized with approximately 30,000 admissions on an annual basis. The hospital has two major locations in different cities where both primary and secondary care is provided.

Participants: The patient records of 191 patients with colorectal cancer were reviewed.

Primary and secondary outcome measures: Number of triggers and adverse events were the primary outcome measures.

Results: In the records of patients with colorectal cancer who had a UL-LOS, 51% of the records contained one or more AEs compared to 9% in the reference group of non-UL-LOS patients. By reviewing only the UL-LOS group with at least one trigger, we found in 84% (43 out of 51) of these records at least one adverse event.

Conclusions: A priori selection of patient records using the UL-LOS indicator appears to be a powerful selection method which could be an effective way for healthcare professionals to identify opportunities to improve patient safety in their day-to-day work.

Word count abstract: 248

Introduction

Within health services research, increased attention is focusing on patient outcomes. This results from the need to improve care and the need to reduce costs. As studies increasingly evaluate patient care, the need exists to identify adverse outcomes within patient medical records. This is a major challenge because medical records are usually extensive and sometimes difficult to evaluate. In the United States, this subject is being addressed by computer algorithms such as the Potentially Preventable Complications and the Potentially Preventable Readmissions software. These algorithms use hospital discharge abstract data to identify adverse outcomes in large populations. The development of these algorithms has been a long and resource intensive process[1]. The current research addresses this important subject by developing a tool for identifying adverse outcomes in the Netherlands. The research involved patients at a medium sized hospital where the volume of inpatients makes the identification of specific patients with adverse outcomes a challenging undertaking.

Furthermore, ~~D~~diminishing the number of patient-related adverse events ~~is~~ became one of the top priorities for Dutch hospitals. A common way to achieve this is to learn from incidents and take action to prevent recurrence. To identify the adverse events, retrospective patient record review has become the 'gold standard' (inter)nationally[2-6]. By retrospectively reviewing patient records, healthcare professionals are able to identify adverse events that occurred during the care process. Several studies on retrospective patient record review in different countries have shown a wide range of incidences of adverse events, varying from 2.9% to 16.6% with a median overall incidence of adverse events of 9.2%[7-9]. This implies that, with random selection from all hospital records, a healthcare professional has to review 6 to 34 records to find one adverse event. These results show that although record reviewing has been proved very advantageous in finding adverse events, there is an important disadvantage: record reviewing is very time-consuming. Although most Dutch hospitals want to analyse their patient records for adverse events in order to identify patient safety opportunities, many hospitals are not able to mobilise enough physicians who can spend many hours reviewing patient records.

Looking for more efficient ways to organise patient record reviewing, we investigated how to increase the chance of finding adverse events. Previous research has shown strong relationships between adverse events and outcomes of quality indicators at patient and hospital level[10-12]. For instance, one study identified a relationship between complications and increased mortality and length of stay (LOS)[13]. A more recent study on the United States Veterans Health Administration data replicated these relationships between adverse events and patient safety indicators of the Agency for Healthcare Research and Quality[14]. Several other studies have indicated that adverse events often lead to prolonged LOS, and prolonged LOS could signal safety issues[15-24]. Silber et al for instance showed that LOS can be used to reflect how well hospitals and providers deal with complications and adverse events[25].

The above mentioned studies suggest that negative results on quality indicators could be attributed to adverse events. In the current study, we hypothesize that records of patients with an Unexpectedly Long Length of Stay (UL-LOS) will show more adverse events. This patient safety indicator is already three years in use by Dutch hospitals and derived from administrative medical data. If so, the indicator could be used for selecting patient records in order to find more adverse events and save the valuable time of those reviewing patient records.

To test the hypothesis that looking for adverse events can be done efficiently by selecting patient records using UL-LOS, we conducted a pilot study with a retrospective review of patient records in Tergooiziekenhuizen, a general hospital in the Netherlands. This article describes the pilot study. The results of this study might help hospitals organise their record-reviewing process in the most efficient way possible by using the quality indicator that already is available to them through existing registries.

Methods

The quality indicator UL-LOS

In our study, we used the quality indicator UL-LOS 2009 to make the a priori selection. The UL-LOS is based on the data from the National Medical Registration (LMR). The LMR contains

demographical patient information, admission related hospital data such as diagnosis, and surgical procedures[26]. UL-LOS is generated by indirect standardisation on three patient characteristics: age, primary diagnosis, and the main procedure that the patient underwent. Age of the patient is divided into 5 classes of 0, 1-14, 15-44, 45-64, and 65 and older. For the primary diagnoses we used the diagnosis that led to the admission which includes approximately 1,000 diagnoses classified by the ICD9 in three digits. Finally, the main procedure is determined by the Dutch Classification System of Procedures and is considered to depend on the diagnosis of the patient. On average it includes five main procedural groups. Together, these three parameters resulted in 5 x 5 x 1,000 = 25,000 cells. For each cell the mean length of stay has been taken as the expected length of stay. Then the ratio between the actual length of stay and the expected length of stay is taken to calculate the UL-LOS. We define the UL-LOS as a LOS that is more than 50% longer than expected. Patients who died in the hospital are excluded. In addition, UL-LOS is a quality indicator Dutch hospitals use for their quality-improvement programmes and the Dutch Health Care Inspectorate uses UL-LOS in its supervision of hospital care.

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All patients with a UL-LOS	85	51	43 (51%)
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- Of which patients with 100%-199% longer-than-expected LOS	32	22	20 (63%)
- Of which patients with 200% and above longer-than-expected LOS	20	15	14 (70%)

Discussion

The effectiveness of the methodology developed in the current research is impressive, demonstrating that a large majority of the records identified, contained one or more adverse events. With a priori selection using the UL-LOS indicator, we found adverse events in 51% of the records, compared to 9% in the non-UL-LOS group. By reviewing only the UL-LOS group with at least one trigger (66%), we found in 84% (43 out of 51) of all the records with at least one adverse event in the colorectal patient group. Putting it another way, by reviewing only the UL-LOS group with at least one trigger, which is 40% of all patients, we found 91% of all records with at least one adverse event in the colorectal patient group. The fact that almost all records including one or more adverse events can be found by concentrating on records of patients with a UL-LOS and triggers is encouraging for hospitals struggling with a sparse capacity of reviewing physicians.

The percentages of records in which adverse events were identified in the different categories of UL-LOS show that the present formal quality indicator used by the Dutch Health Care

Inspectorate identifies most adverse events. Our results show a rise in the percentage in which at least one adverse event was found from 50% longer LOS onwards. However, it also rises from 100% onwards. A more detailed study is needed to determine the appropriateness of the 50% threshold. These results apply to colorectal cancer. Future research could also investigate whether this threshold is appropriate for all diagnostic groups or whether we need varying percentages.

An interesting finding is that only 45% of the adverse events in a group of surgical patients such as those with colorectal cancer is related to the classification 'operation'. It seems that quality of care is determined by the whole chain of care, not only by the quality of the organisation in the operating room or the professionals performing the operation.

Limitations

An important limitation of this study is that we identified the number of adverse events in ~~only one group of patients~~a single speciality population and in only one hospital. Future research should investigate the validation on other populations and show whether identifying adverse events in more patient records, ~~also from other patient groups~~ in more hospitals, gives comparable results.

Another limitation is the fact that, although we chose to have two physicians analyse the patient records together, both of them reviewed different records with consulting each other intensively. Therefore we could not measure the interrater reliability. Our main concern was to organise the review process as efficiently as possible. Therefore, we chose parallel record reviewing. However, further research should show whether parallel analysis is reliable enough compared with consecutive analysis, which still contends with poor reliability[27, 29]. Although current study shows that the spare time of physicians can be saved by efficient record selection and Global Trigger Tool, experienced nurses can also review the patient records for the existence of adverse events. Then the physicians only have to determine the nurse's findings and assess the severity of harm. Such a strategy can save the time of physicians even more.

The results of this study are encouraging in showing that hospitals can and will use quality indicators based on administrative data for patient safety policy. This type of hospital data is usually easily available without an extra administrative burden for hospitals. Earlier research has shown the reliability of using administrative data in relation to clinical data[31]. However, the reliability of indicators such as UL-LOS depends on the quality of coding in hospitals[32]. Also in the Netherlands, the quality of administrative hospital data is subject to debate. If the quality of data coding in hospitals were to improve, the selection efficiency of quality indicators such as UL-LOS would probably be more accurate. The use of such quality indicators in combination with effective methods as Global Trigger Tool be identify even more easily adverse events from the patient records[17, 33].

Conclusion

Easily available selection methods such as UL-LOS and the Global Trigger Ttool may be a powerful way of finding a majority of adverse events while limiting the number of patient records to be reviewed and thereby saving the reviewing physicians' valuable time. This could help hospitals to organise their patient safety policy as efficiently as possible.

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