Table 1 The alarm information consisted of the parameter causing the alarm and the alarm message

Devices	Threshold alarm	Arrythmia alarm	Technical alarm
ECG	Bradycardia Tachycardia	Asystole ST(II) change Ventricular fibrillation Ventricular tachycardia Ventricular premature contraction run	Check electrodes cannot analyse
Oxygen saturation (SpO_2)	SpO_2		Not connected Check probe Check probe site Cannot detect pulse
Direct measurement of arterial pressure (ART)	ART (systolic) ART (diastolic) ART (mean)		Not connected Check sensor Check label
Non-invasive blood pressure (NIBP)	NIBP (systolic) NIBP (diastolic) NIBP (mean)		Cuff occlusion Not connected Module failure Mead time-out Cannot detect pulse
Capnometer	$ETCO_2$ CO_2 (APNEA)		Not connected Check sensor
Thermometer	Tblad T2		Not connected Check sensor
Central venous pressure monitor			Check sensor
Ventilator	VENT		Check sensor
Other			System failure

$ETCO_2$, end-tidal carbon dioxide; Tblad, bladder temperature.

the above criteria were considered *technically true*. All technical evaluations that could not be determined from the relevant monitor's waveform recording were defined as *indeterminable*. For temperature alarms, all upper and lower limits of the temperature alarms were defined as *technically true*. Finally, for non-invasive blood pressure (NIBP) determinations, if an apparently abnormal value was obtained for the NIBP measurement, the patient's movements and concurrent procedures were also considered. Other values, for example, ART or SpO_2 were also referenced as they may have triggered the upper and lower limit alarms. In such instances, these alarms were considered *technically false*.

Clinical annotations

After the technical analyses, the two physicians divided the alarms into three types. These types were relevant alarms, helpful alarms that were not relevant and irrelevant alarms; these were classified by referring to the video and medical records. In this study, an alarm was defined as relevant when an immediate clinical examination plus diagnostic or therapeutic decision (eg, ECG, echocardiography or drug administration) were necessary. When the situation required clinical examination but did not require a diagnostic or therapeutic decision, it was classified as a helpful alarm but not relevant. Intensivists determining the clinical relevance could see the result of technical validity.

Statistical analyses

All included patient characteristics were described using means and SDs for continuous variables, along with medians and ranges. After obtaining the descriptive statistics regarding the alarm counts and their proportions, the bivariate relationship of the alarms (the total number of alarms and the proportions of relevant alarms) to patient (SOFA) scores was examined by fitting cross-sectional, time-series models for panel data. Alarms from different monitoring devices were examined separately and together. In a preliminary analysis, the numbers and proportions of alarm types were regressed against SOFA scores by fitting either fixed-effects or random-effects models, using the Hausman test. The Hausman test indicated that the random-effects estimates were consistently more appropriate than the fixed-effects estimates.[16] Therefore, the results obtained by the random-effects model were adopted. The interpretation of the statistical significance of relationships was made following multiple comparisons using the Bonferroni method.[17] The NIBP data were not suited for univariate analysis because the amount of data and statistical power were inadequate.

Table 2 Study population baseline characteristics

Subject description (n=18)	Mean±SD	
Age	69.2±14.0	
Male/female	10/8 (55.6%/44.4%)	
	ICU admission	ICU discharge
APACHE score	18.5±8.3	
SOFA score	6.2±3.8	4.1±3.2
The equipment rate of monitoring devices		
Direct measurement of arterial pressure (%)	77.8	33.3
Electrocardiogram (%)	100	100
Oxygen saturation (%)	100	100
End-tidal CO_2 ($ETCO_2$) (%)	61.1	44.4
Bladder temperature (%)	100	94.4
Indirect blood pressure measurement (%)	100	100

APACHE, acute physiology and chronic health evaluation; SOFA, sequential organ failure assessment.

The intraobserver and interobserver variabilities between the two physicians performing the clinical annotations of alarms, and the two nurses performing the technical annotations of the alarms were judged by a κ test.[18] To evaluate the intraobserver variability, 300 alarm situations were reannotated by the same observer after a period of approximately 6 months. Statistical analyses were conducted using STATA Special Edition V.12.1 (StataCorp, College Station, Texas, USA).

RESULTS

Patient characteristics

Between January and February 2012, a total of 15 229 alarms were recorded for 20 patients. Two patients were excluded because of their poor clinical condition at the time of admission and of their families' lack of expected benefit from invasive treatment. Therefore, a total of 11 591 alarms for 18 patients were included in this study, corresponding to 2697 person-monitored hours. The observation time for the cases averaged 150±113 h. Table 2 describes patient characteristics on admission. During their treatment in the ICU, 66.7% of the patients improved (SOFA scores decreased), while 22.2% deteriorated (SOFA scores increased). The ECG, SpO_2 and NIBP devices were attached to all ICU patients throughout their time in the ICU.

The interobserver variabilities in the technical and clinical annotations, as estimated by the κ coefficient, were 0.98 and 0.68. Similarly, the intraobserver validities were 0.95 and 0.73. These values are within the range of substantial (0.61–0.80) or almost perfect (0.81–1.00) agreement.

In addition, false-negative situations were not recorded during the 2697 patient-monitored hours.

Alarm classifications

A total of 11 591 alarms were included in the analysis, classified as *technically true* (71%), *technically false* (21.4%) and *indeterminable* (7.7%) alarms (figure 1 and table 3). The overall contribution of each alarm type to the 11 591 alarms is shown in table 3. Only 6.4% of all alarms were relevant, whereas 32.8% were helpful alarms but not relevant, and 60.8% of all alarms were irrelevant. During an 8 h shift, on average, ICU nurses would hear a total of approximately 32 alarms, of which only two were relevant.

The monitoring devices that triggered alarms the most often were ART (33.5%), SpO_2 (24.2%) and ECG (22.9%; figure 2). The numbers of relevant alarms were 12.4% (ART), 2.4% (SpO_2) and 5.3% (ECG).

Effect of patient status on the alarms

The results of the cross-sectional time-series analysis are shown in table 4. ART demonstrated a positive correlation between the SOFA score and the proportion of relevant alarms, as well as between the SOFA score and the total number of alarms, and also between the SOFA score and the total number of relevant alarms. The SpO_2 and ECG monitors demonstrated positive

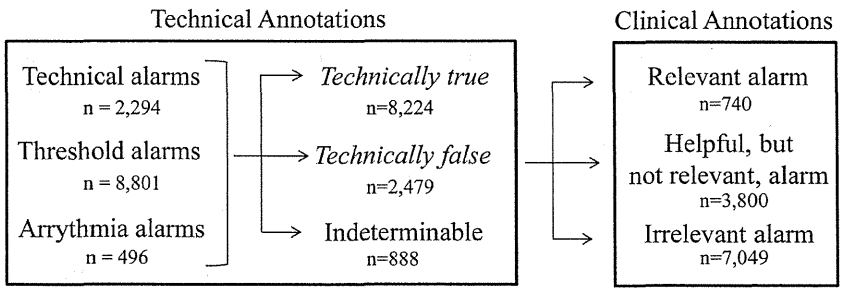

Figure 1 Technical and clinical annotations. After an evaluation of the technical relevance was made by two nurses, an evaluation of clinical relevance was made by two intensivists.

Table 3 The total number of all alarms and the number occurring every 8 h

Alarms (/overall period: 2697 patient-monitored hours)	n	Per cent of total
Total numbers	11 591	
Technical annotation		
Technically true	8224	71.0
Technically false	2479	21.4
Indeterminable	888	7.7
Clinical annotation		
Relevant alarm	740	6.4
Helpful, but not relevant, alarm	3800	32.8
Irrelevant alarm	7049	60.8
Indeterminable	2	0.02
Alarms (count/8 h)	Mean±SD	Median (ranges)
Total numbers	31.8±28.6	23.5 (1–200)
Relevant alarm	2.0±7.7	0 (0–60)
Helpful, but not relevant, alarm	10.4±13.3	6 (0–178)
Irrelevant alarm	19.4±20.9	13.5 (0–96)
Indeterminable	0.005±0.1	0 (0–2)

correlations only between the SOFA score and the proportion of relevant alarms.

All the devices demonstrated that the SOFA scores had statistically significant positive coefficients when regressed against the total number of relevant alarms ($p<0.0001$), as well as against the total number of alarms ($p=0.0061$) and the proportion of relevant alarms ($p<0.0001$). The results indicated that as the SOFA score decreased, the number of alarms, the number of relevant alarms and the proportion of relevant alarms decreased; the converse was also true.

The inclusion of a regression variable that indicated whether an event occurred during a day or night shift, in the time-series model, indicated that the time of the alarm did not demonstrate a statistically significant relationship with the SOFA score.

Technical validity

Relevant alarms comprised those that were *technically true* and those that were *indeterminable*, but did not include those that were *technically false*. Thus, the irrelevant alarms could be reduced by 21.4% by evaluating their technical relevance.

DISCUSSION

General statement

ICU patients are surrounded by medical devices that regularly sound alarms, but most of the alarms are not clinically relevant.[1–3] These irrelevant alarms cause a lower quality of patient care by distracting the medical staff[4–7] and contributing to patient delirium.[9 10] Thus, attempts to reduce the number of clinically irrelevant alarms are important as solutions for this national problem are sought.[19] The present study demonstrated that (1) the devices that alarm the most frequently are ART, SpO_2 and ECG; (2) the proportion of relevant alarms decreases as patient status improves and (3) the irrelevant alarms can be reduced by combining the data for the waveforms or pulse rates of each device.

Prior to this study, Siebig *et al*[13] were the first to record data with a 24 h video monitor, with the help of two physicians, to evaluate the clinical relevance of alarms. This technique reduced the possible bias introduced by bedside evaluations. The same method of evaluation was used in this study, with the added evaluation of alarm frequency for each device, and the determination of the fluctuations in alarm relevance and clinical severity for individual patients.

Alarm types and their relevance

The vast majority of alarms triggered in the ICU is either false alarms or are irrelevant for patient treatment. The present study shows that only 6.4% of all

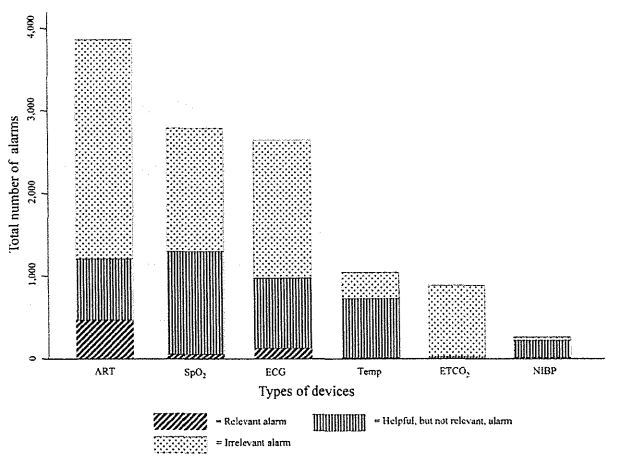

Figure 2 The numbers and types of different alarms. The monitoring devices that triggered alarms the most often were the ART, ECG and SpO_2 monitors. ART, direct measurement of arterial pressure; SpO_2, oxygen saturation; Temp; bladder temperature; $ETCO_2$, end-tidal carbon dioxide; NIBP, non-invasive blood pressure.

Table 4 Relationship of patient condition with alarm numbers and relevance

Alarm types	Regression coefficients of severity score (SOFA)†‡ Total number of alarms	p Value	Total number of relevant alarms	p Value	Percentage of relevant alarms	p Value
Direct measurement of arterial pressure	1.8±0.5	0.0001*	0.6±0.2	<0.0001*	2.2±0.6	0.0003*
Electrocardiogram	−0.4±0.4	0.3018	0.1±0.1	0.066	2.4±0.4	<0.0001*
Oxygen saturation	0.1±0.3	0.7191	0.05±0.03	0.167	0.7±0.2	0.0018*
Bladder temperature	0.4±0.2	0.0166	0.002±0.01	0.8704	−0.1±0.4	0.7307
End-tidal CO_2	−0.02±0.2	0.9363	0.004±0.004	0.4143	0.4±0.2	0.0726

*Attained statistical significance ($p<0.05$) after the adjustment for multiple comparisons by Bonferroni method.
†Only the regression coefficients of severity scores on the (numbers and proportions of) alarms are shown, which were obtained by the cross-sectional time-series analyses (analysis conducted for each kind of alarm).
‡Constant terms were included in the random effect models obtained, but they are not shown.
SOFA, sequential organ failure assessment.

alarms triggered in the ICU were relevant. These data are similar to the results of multiple prior studies from various institutions, which indicated that approximately 10% of alarms are relevant.[1–3 20] The number of alarms that were technically annotated as being *indeterminable* was 7.7%. When the amplitude of waveforms was small or when the arrhythmia indications and noises were mixed, the technical annotations were difficult.

The ART alarms had a positive correlation between the SOFA score and the number and proportion of relevant alarms. In contrast, the SpO_2 and ECG alarms only showed positive correlations between the SOFA score and the number of alarms. These findings indicate that the SpO_2 and ECG alarms sound regardless of the clinical severity. Therefore, the SpO_2 and ECG alarms are the primarily clinically irrelevant alarms, especially in patients with decreasing SOFA scores. However, this study revealed that the ECG and SpO_2 devices were attached to all ICU patients, for safety reasons, from the time of their ICU admission. Therefore, establishing criteria for removing these devices would be difficult.

How can we reduce the noise in the ICU?

We demonstrated that clinically irrelevant alarms were reduced by 21.4% by evaluating their theoretical technical relevance. When evaluating technical relevance, two nurses combined the data for waveforms or pulse rates for each device. After annotation, their intraobserver and interobserver correlations demonstrated almost perfect agreement and the relevant alarms comprised those that were *technically true* and *indeterminable*, but not those that were *technically false*. Thus, manufacturers can decrease the number of *technically false* alarms by combining the data from each device. In particular, the ART monitor is often used in the ICU setting, and a reduction in the number of clinically irrelevant alarms might be possible by combining the ART waveform with the data from the SpO_2 monitor and ECG.

The number of ART monitor alarms and the proportion of relevant alarms that were associated with the patient SOFA scores implied that there should be a criterion established to remove this device when the SOFA score has decreased to some appropriate level. We found that when the SOFA scores were ≤2, there were no relevant ART alarms. Thus, when the SOFA scores are ≤2 and the patient's condition is not likely to change suddenly, the ART device may be removed. As a general rule, if the sensitivity and specificity of a given test are constant, the positive predictive value (PPV) is assumed to increase as the (true) prevalence/incidence becomes higher. According to this rule, if alarms are being triggered constantly, then PPV is higher when the patient illness severity is higher. Thus, as the patient illness severity increases, the number of alarms increases, and these alarms include a large number of relevant alarms. In contrast, as the patient illness severity decreases, the number of alarms decreases, but these alarms include only a small number of relevant alarms. If the significance of medical treatment, measured by the alarms, is constant, the PPV would be more desirably held constant regardless of the patient's condition. Thus, when the patient illness severity is low, an increase in PPV is important, strictly according to the standards of sensitivity and specificity.

Why has this problem not resolved over the past decade?

The most serious problem encountered with these alarms was that although they provided PPVs (relevant alarms/all alarms), their sensitivity and specificity cannot be ascertained. These data cannot be ascertained because the evaluation of false negatives and true negatives are not possible in cases where the monitor does not alarm in clinical practice. Therefore, manufacturers need to produce alarmed devices that have higher sensitivities in order to avoid medical accidents. In this study, we did not detect false-negative situations. According to studies by Tsien[3] and Siebig *et al*[13] the sensitivity of the current alarms is close to 100%. However, their specificity, which is important for medical staff, could not be determined. Another reason for the failure to reduce the number of clinically irrelevant alarms is that physicians may be relatively insensitive to alarm problems because they do not stand by patient beds as often as nurses. Thus, physicians,

nurses, researchers and medical companies need to establish an evidence-based practice model and find a mutually acceptable solution to this matter.

Study limitations

his study has several limitations. The first is that the sample size was small, with only 18 patients. The second limitation is that although a determination could be made regarding whether an alarm was *technically true* or *false*, a strict definition of the clinical annotations was more difficult. There are relevant alarms that require clinical examination, plus diagnostic or therapeutic decision, but this annotation may differ from a definition considered by intensivists. Finally, we did not analyse ventilator and infusion pump alarms, because detailed ventilator alarm messages were not recorded by our system; thus, annotation of their clinical relevance could not be performed. In addition, infusion pump alarms could not connect our system. These irrelevant alarms also need to be decreased,[21] and should be the subject of a future study.

CONCLUSION

Excessive alarms in clinical settings are linked to lower medical attentiveness and poorer treatment environments. Manufacturers should work to decrease the number of *technically false* alarms by combining waveform data with the device measurement, especially for ART. Physicians should remove ART when patient conditions improve sufficiently and they are not likely to change suddenly.

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Acknowledgements The authors are deeply grateful to Yugo Tamura for collecting data, and would like to thank Yohei Hashimoto, Kikuo Furuta and Hiroko Hagiwara for their support. The authors would also like to thank all participating intensive care unit members at the University of Tokyo Hospital for their support.

Contributors RI conceived of the study, RI and HS designed the analysis plan and performed the statistical analyses. RI wrote the first draft of the study, RI, YN, ME, AT, TI, TM, KD, MG, TH, KN, YK, SN and NY contributed to patient management. KS, MU, and NY critically reviewed the manuscript. All authors contributed to the design, interpretation of results and critical revision of the article for intellectually important content.

Funding This work was supported by a Grant-in-Aid for Young Scientists (C) (127100000424), and a Health Labour Sciences Research Grant.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The technical appendix, statistical code and dataset are available from the corresponding author at Dryad repository; a permanent, citable and open access home for the dataset will be provided.

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This overview is for:

- **Acute**
- Mental Health
- Community Care
- Commissioning
- Social Care

Unscheduled Care Overview

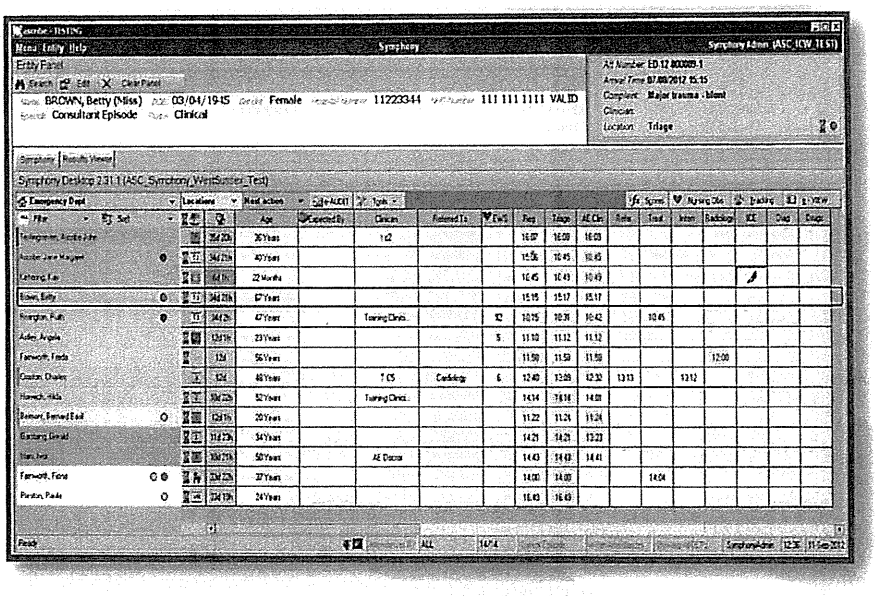
Unscheduled care defines any unplanned contact with health care services by a person requiring or looking for care, help or advice. The demand for such contact can occur at any time, and healthcare services (which includes urgent care and emergency care) must be available to meet this demand 24 hours a day.

Ascribe Symphony

This solution is for:

- **Acute**
- Mental Health
- Community Care
- Commissioning
- Social Care

> We chose Ascribe Symphony as the ED clinical information management system for several reasons. We were impressed with the ease of access to, and clarity of important clinical and patient tracking information. The ability for us to easily customise screens and format printed matter means Symphony has the potential to be highly configurable to meet the needs and demands of our practice locally.
>
> Keith Joe
> Emergency Physician and
> Clinical Lead for ED
> The Royal Melbourne Hospital



Ascribe Symphony, is the UK market leading Emergency and Unscheduled Care information system providing benefits to patients, clinicians and Trust managers.

Over 30 million patients are recorded on Ascribe Symphony with the system supporting over seven million attendances per annum. Ascribe provides the clinician with a simple to use graphical interface that delivers real time clinical management of patients in the unscheduled care setting.

Ascribe Symphony supports the everyday practices of the Emergency, Minor Injuries and Admission departments and matches the data collection processes to current patient workflows.

The Ascribe Symphony system fully supports the delivery of all the complex information needs for Unscheduled Care departments including the delivery of information to support the Department of Health and College of Emergency Medicine Clinical Quality Indicators for Emergency Departments (EDs).

Benefits

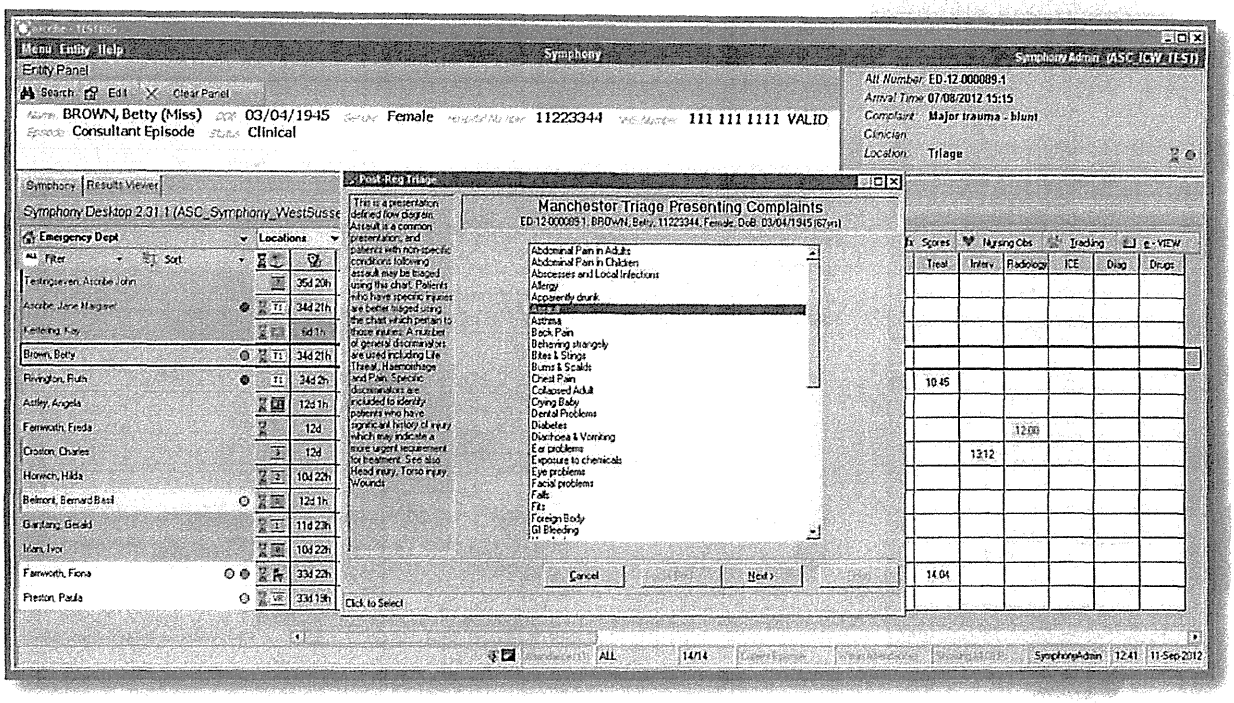
- Only asks for patient details once – improving the patient experience by knowing who your patient is, where they are, and what they are waiting for.
- Robust and reliable data capture system supporting clinical workflows, allows for proactive management of the ED.
- Real time information – knowing where patients are and what they are waiting for provides more time for care. Clinical alerts always available to support care of patient and ensure clinical safety.
- Supports all mandated data sets and provides Payment by results from supporting HRG 4 data. Real time management of KPIs for ED attendance 4 hour target and management of patients waiting for admission. Generate data to support national quality standards for A&E.
- Supports Australian VEMD (Victorian Emergency Medicine Dataset) standard.

eTriage

This solution is for:

- **Acute**
- Mental Health
- Community Care
- Commissioning
- Social Care

Unscheduled Care



Emergency Triage™ version 2 is an update to the acclaimed publication from the Manchester Triage Group and published by Wiley Publishing.

Ascribe continues their long relationship with the Manchester Group and Wiley publishers and have signed an agreement to deliver Emergency Triage version 2 as an optional application within the Ascribe Symphony suite of products.

The system provides a simple and intuitive interface that allows the clinician to follow the Emergency Triage protocols whist at the same time maintaining clinical independence.

The Emergency Triage protocols have been implemented in many hospitals worldwide and are seen by many in the NHS as the de facto standard for Triage.

Benefits

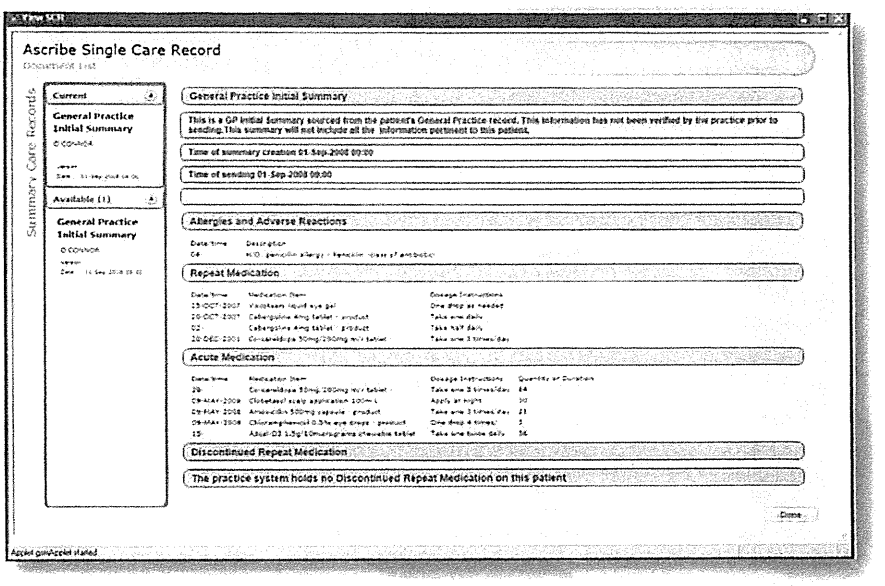
- Supports the clinical staff in the decision making process when assigning a clinical priority to a patient.
- Supports patient safety and clinical governance, tried and tested protocols matched with an auditable process.
- Provides a robust mechanism for ensuring that patients are appropriately managed in an emergency care setting.
- Delivers a standard of care that it reproducible, supporting the Trust delivery of targets for waiting times.
- Supports a number of the care quality indicators including time for assessment.
- Provides a tested method for streaming patients without a full clinical assessment.

Summary Care Record

This solution is for:

- **Acute**
- **Mental Health**
- **Community Care**
- Commissioning
- Social Care

> "I was first introduced to the SCR by our local primary care trust (Bury). I immediately saw the possible benefits this would bring to patient care, especially when patients are unable to provide accurate information about their medicines on admission to hospital. At the hospital, it can sometimes be difficult to obtain an accurate patient medication history because most of the patient arrivals are unscheduled and many are confused due to illness or do not know their medications to inform the clinical staff."
>
> Dr Kassim Ali, Emergency Department Consultant, Fairfield General Hospital



The NHS Summary Care Record (SCR) in England supports patient treatment in emergency and unscheduled care settings, by providing information about the patient where that information is not currently held, and at times when the GP records cannot be easily accessed.

The Ascribe Summary Care record solution provides direct access to a patient's Summary Care Record from within the Ascribe applications.

In order to provide this functionality, Ascribe systems allow the user to see when a record is available and access it directly, without any further login or searching. The viewed SCR becomes part of the contemporaneous patient record, supporting clinical audit and providing evidence for treatment and intervention decisions.

Benefits

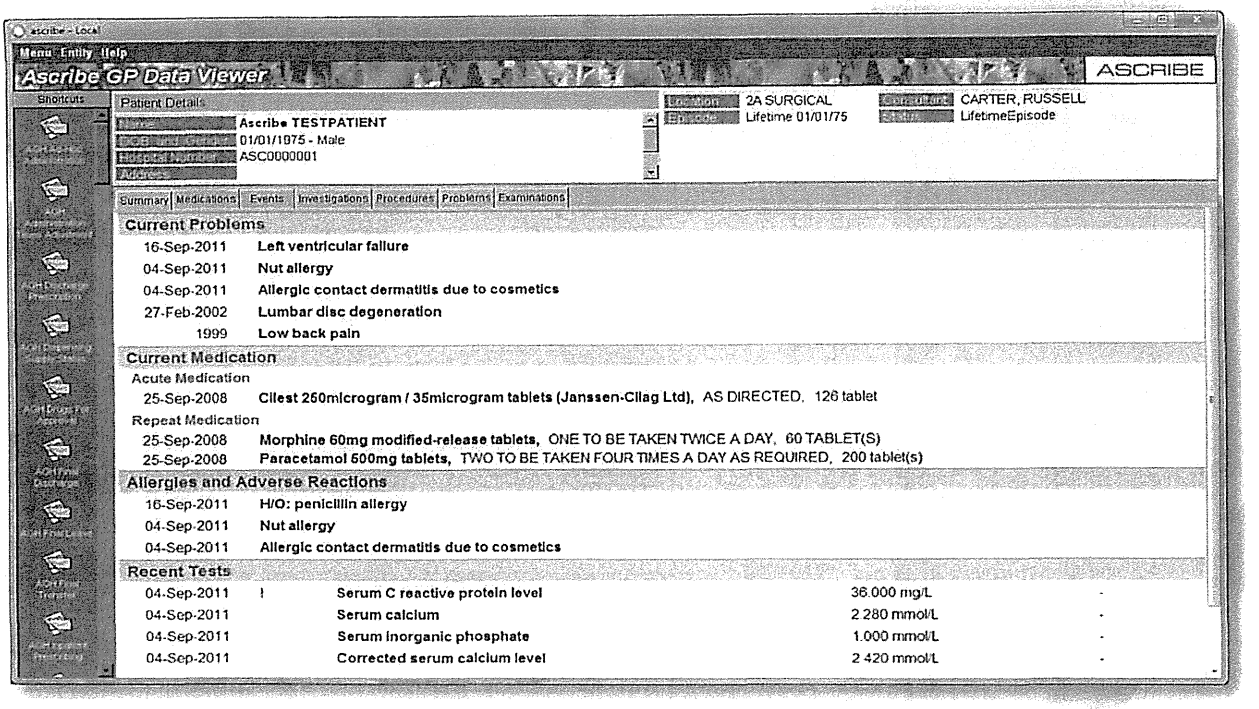
- Improved Quality of Patient Care - Access to the Ascribe SCR informs clinical decision making, diagnostic and therapeutic choices and onward referral decisions, allowing appropriate care to be delivered in the most appropriate setting.
- Improved Patient Safety - Access to the SCR identifies contra indications to medications, or allergies to medications and reduces the risk of prescribing errors and adverse reactions to prescribed drugs.
- Efficiency & Effectiveness - Reducing time, effort and resource required to share information across different NHS organisations, for example, medicines reconciliation in hospital pharmacy.

This solution is for:

- **Acute**
- **Mental Health**
- Community Care
- Commissioning
- Social Care

GP Data Viewer

via Medical Interoperability Gateway (MIG)



Unscheduled Care

The Ascribe GP Dataviewer module allows users to view a summary of patient's details available on the Medical Interoperability Gateway (MIG). The patient details available are provided by their GP practice via their MIG compliant system including EMIS and In Practice Systems' GP management software.

The patient details will include summary information, medications and problems. The view will be available to all the Ascribe integrated products including Emergency Care, Pharmacy, ePrescribing and Mental Health.

Clinicians in all health care settings will be able to view primary care details for patients in real-time while the patient is in their clinical care, enabling clinicians to make more informed decisions, whilst delivering, safe, cost effective and meaningful patient care.

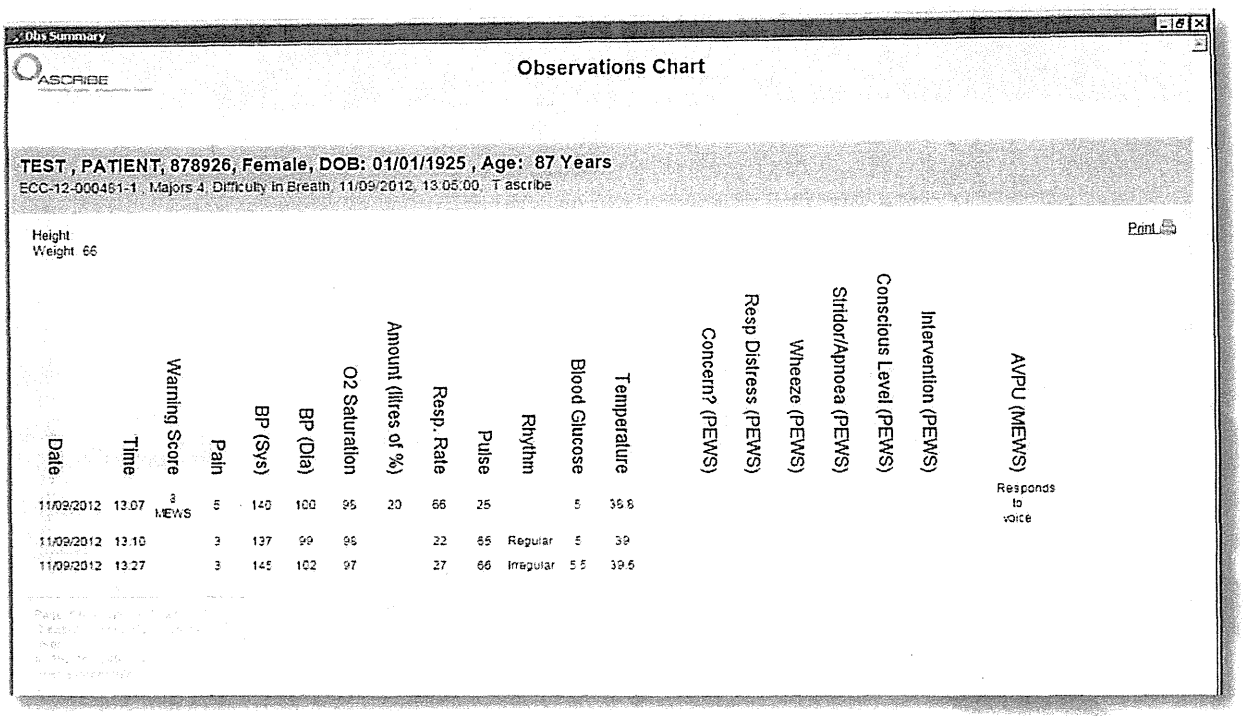
Benefits

- Primary Care details available real-time to Emergency Care clinicians, pharmacists etc.
- No phone calls to patient's GPs to get medication history.
- Only authorised staff will be able to access the information.
- No switching between systems to find the information.
- Prevention of unnecessary medication, admissions, and other decisions when insufficient information available from patient themselves.

Unscheduled Care Web Pages

This solution is for:

- **Acute**
- Mental Health
- Community Care
- Commissioning
- Social Care



Ascribe have developed the ability to display data held within their Unscheduled Care system, Ascribe Symphony on web pages. Using the SQL data tables held within your Ascribe system, it is possible to arrange and display this information on a web page that can be triggered in a number of ways from within the system.

A number of web pages are readily available to you now. Sites that are using the web pages find the ease of access to aggregated data on a single page reflects the workflow of the ED. Clinicians can gain easy access to data in a single click and the pages are easily printable for patient transfer purposes and inclusion in case notes.

Examples of data that can be displayed include: Patient Information Display; Patient Summary; Medications Charting, Observations Charting and eNotes display - including audit data.

The pages can be driven from the next action menu or automated as either a pop up before a Data Entry Screen or afterwards. The data can also be presented on a large display - such as the Patient Information screen that is used to display data on waiting times by category in the waiting area providing real time patient information. This is also used to display the departmental occupancy.

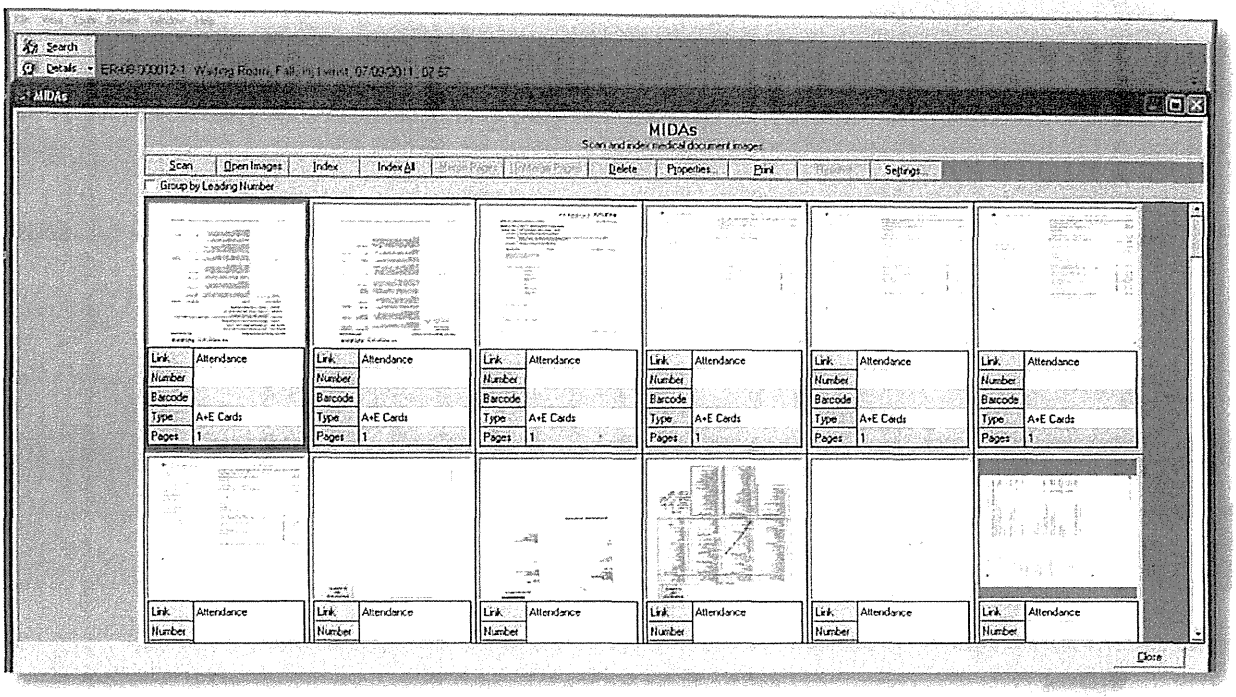
Benefits

- Can display data in a way that is more user friendly supporting information for patients.
- Device independent – can be used to display information on portable devices – providing key clinical information such as MEWS scores.
- Provides visible audit information supporting clinical safety and governance.
- Supports data and information provision to non Ascribe Emergency Care areas such as bed management.

Unscheduled Care Document Workflow

This solution is for:

- **Acute**
- Mental Health
- Community Care
- Commissioning
- Social Care



Ascribe's Unscheduled Care System – Symphony, is provided with an optional scanning module; MIDAs - the Ascribe Emergency Care Medical indexing and document access system.

This module allows for the real time management of paper documents in the Unscheduled Care Department. The process of scanning can be automated, with recognition of the document and auto-indexing the paper to match the attendance record for the patient.

Documents can be stored at the patient level against the Patient Master Index (PMI) or at the attendance level.

The system allows the authorised user viewing access to any associated documentation with the patient record, providing high speed retrieval without the need to search for paper in a filing area.

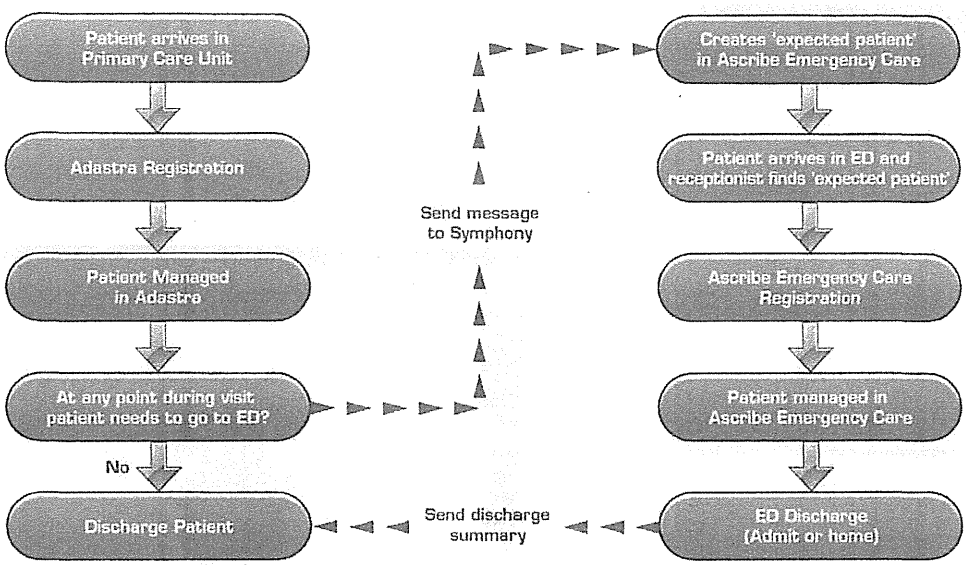
Benefits

- Huge savings on storage space. Consider the ability to store 20-30,000 attendance cards and other patient records on a small computer disk. Most departments would be able to hold five full year's records on 250Gb of storage.
- Avoids lost or mis-filed data. The ability to search for a record by all or part of a name, date of birth or episode number, and the fact that this is online for authorised personnel provides immeasurable savings in terms of staffing costs. The chances of a lost card are dramatically reduced with MIDAs.
- The effectiveness of this system means a huge saving in the time is takes for your staff to find the records, allowing them to concentrate on more important things to hand.
- Easily Accessible – ease of access to information for clinical staff is immeasurable.
- Security access controls – to gain access to a record, the user must have the right level of password access. The chance of information getting into the wrong hands is minimised.

Adastra Information Sharing

This solution is for:

- **Acute**
- Mental Health
- **Community Care**
- Commissioning
- Social Care



The Ascribe – Adastra interoperability system integrates your Out of Hours (OOH) and urgent care centres, with the acute hospital Ascribe Unscheduled Care system.

If a patient attends at an urgent care or OOH setting and the staff feel that an ED attendance is needed, the patient's clinical as well as demographic data, is sent to the Ascribe Unscheduled Care system so that the staff in the acute setting have all the details prior to the patient arriving.

Conversely, if a patient attends the acute setting, the clinical information can be sent to the OOH system and an appointment created for the patient to see a GP if that is a more appropriate route to treatment.

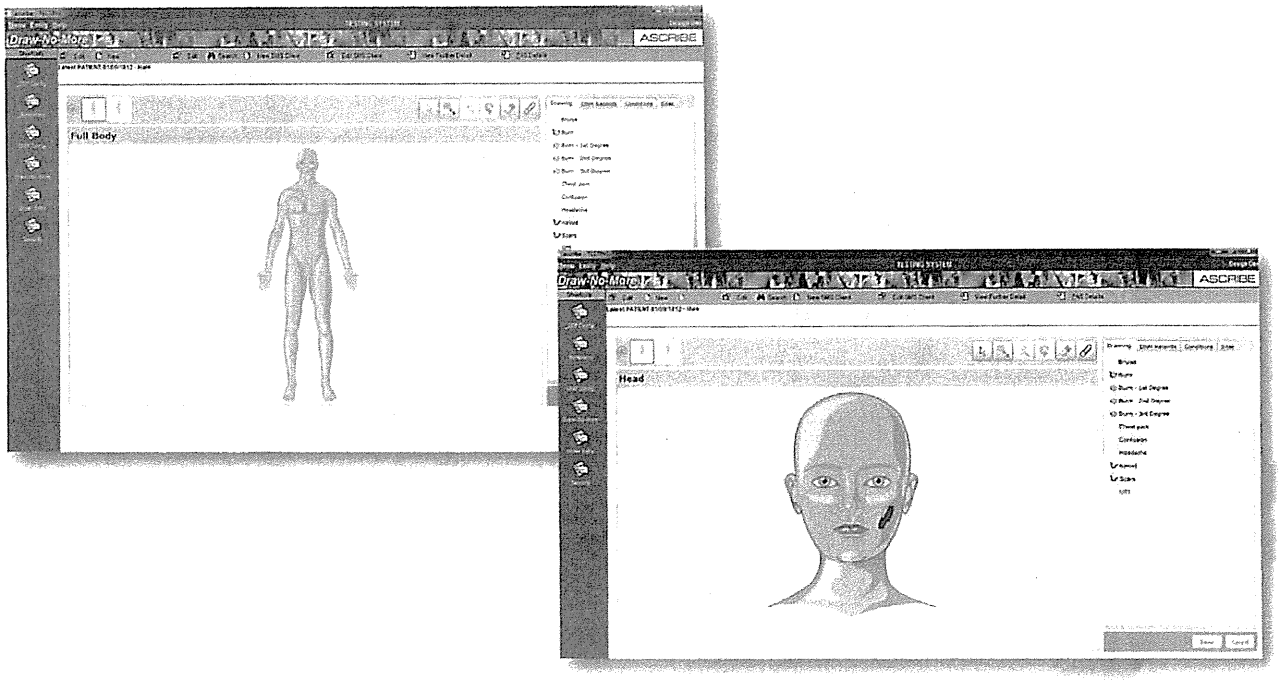
Benefits

- Improves the patient experience. The patient only gives their demographic information once in the spell of care.
- Better communication with patients, provides an appointment system giving an appointment time that is mutually acceptable to both the patient and clinician, for the provision of treatment at the point of entry into the hospital.
- Patient safety is enhanced by ensuring clinical data is shared between the care settings.
- OOH get clear notifications of patients attending, thereby improving workflow.
- Allows acute Trusts to provide more appropriate care and treatment for seriously ill patients whilst being able to offer the non-acute patient alternative healthcare facilities.

Draw No More

This solution is for:

- **Acute**
- **Mental Health**
- Community Care
- Commissioning
- Social Care



Unscheduled Care

Draw-No-More (DNM) is a drawing tool that can be used with Ascribe's integrated product suite.

As a replacement for paper-based drawings, Ascribe Draw-No-More enables clinicians to draw patient diagnoses effortlessly on an electronic canvas.

The system also provides the ability to attach photographs as an alternative to drawing, all of which are stored against a patient's electronic record.

The image is embedded into the electronic patient record so cannot be lost.

Benefits

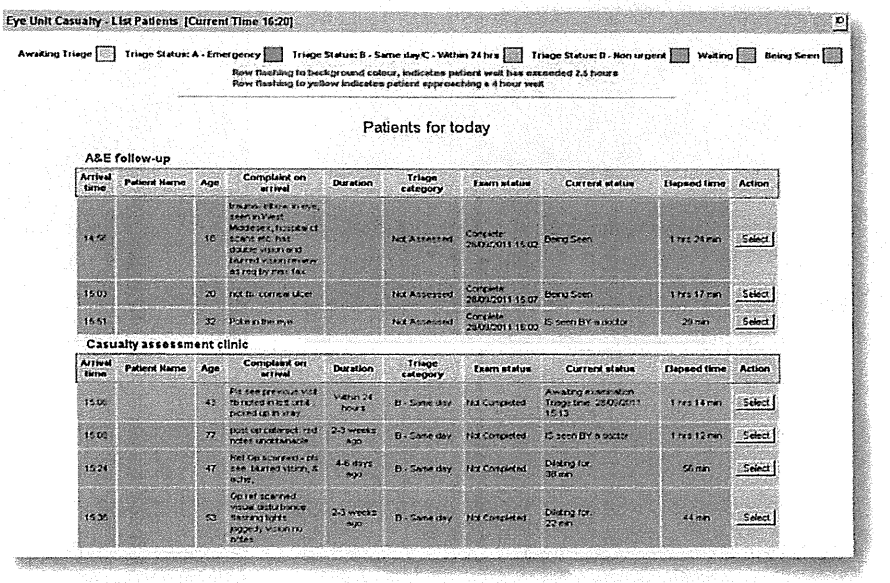
- A simple and rich graphical user-friendly interface.
- The ability to zoom in and out of the site(s).
- A navigation control to rotate, view & draw on anterior/posterior aspects.
- Permanent body marks for future use.
- The ability to calculate a patient's burn percentage from drawings.
- A coded list of diagnosis.
- Body image automatically displayed based on patient attributes, e.g. gender, age.
- Replaces numerous paper-based drawings.

Eye Casualty

This solution is for:

- **Acute**
- Mental Health
- Community Care
- Commissioning
- Social Care

> "The Ascribe Eye Casualty solution is far simpler, far more efficient and has completely changed the way that we work over the last five years."
>
> Julie Tillotson
> Nurse Consultant
> The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust



Ascribe Eye Casualty is a web-based departmental clinical management tool that allows members of the Eye Casualty team to intuitively and accurately record all assessment, triage, examination, treatment follow up and discharge information for their patients.

Ascribe Eye Casualty also enables attendances and re-attendances to be planned based on clinical need.

Benefits

- Remote initial assessment and advice can reduce the number of patient attendances.
- Mandatory data recording ensures complete data.
- Accurate data entry is facilitated by minimal use of free text.
- Trust wide license ensures the system can be accessed anywhere in the trust.
- Simple remote deployment and configuration ensures the system can be implemented quickly.

日本の救急外来における電子カルテシステム導入の現状調査

東京大学医学部附属病院　救急集中治療部
井口 竜太, 中島　勧, 小林　宏彰, 園尾　智弘, 和田　智貴,
土井　研人, 軍神　正隆, 中村 謙介, 比留間 孝広, 矢作 直樹
国立保健医療科学院　政策技術評価研究部
佐藤　元

先ず初めに
アンケートに参加して下さいました施設の
先生方に厚く御礼を申し上げます

背景

救急外来の特徴
～一般外来・病棟との違い～

救急外来は、一般外来と異なり
- 同時に多人数を診察する
- ほとんどが予約外受診
- 重症患者により診察が中断

ACEP. Emergency department information systems: primer for emergency physicians, nurses, and IT professionals. April 12, 2009

背景

救急外来の特徴を加味した電子カルテの開発

⇨ 諸外国では開発が進められている

補足

EDISの具体例

救急外来でよく使う処方セットを組み込む
容量が間違っている時の警告
自動トリアージシステム
来院中の患者さんの状態・待ち時間の表示
経過観察ベッドでの状態・待ち時間の表示
・・・
だがこの機能があればEDISという明確な定義はない
(Landman et al 2012)

背景

EDISは、電子カルテと同様に
- 医療ミスの減少
- 患者さんの安全を向上
- 診療効率の改善

とされているが、普及率を報告した論文は1つしかない
既に電子カルテを導入している施設がEDISを導入するに当たっての障害・促進となる要因を報告した論文は今までない

目的

日本の救急外来における

- 電子カルテの導入率
- 電子カルテを救急外来に導入後に改善した所、悪化した所
- 新しい電子カルテシステムを導入するに当たって障害・促進となる因子

方法

【対象】
日本救急医学会が指定している
救急科専門医指定施設466施設(2012年時点)
の救急部長に対してアンケート調査

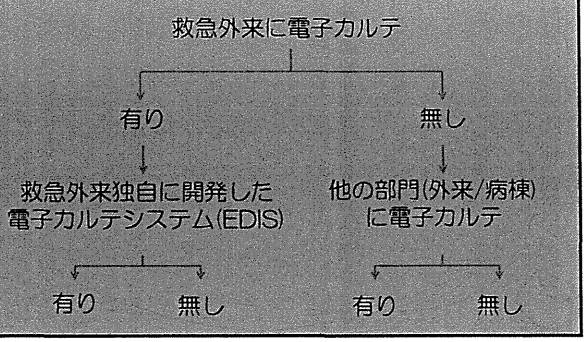
方法

～定義～

【EDISの定義】
EDISの定義は明確でないため、今回
一般外来や病棟の電子カルテとは異なり
独自で救急外来で開発したものをEDIS
と定義

方法

～電子カルテの導入率～



方法

～導入後の変化～

- カルテ記載時間
- 検査・画像オーダー時間
- 患者さんの過去の情報へのアクセス
- 患者さんの情報共有
- 全体的な安全性の向上

“改善” “変化なし” “悪化”の3つで評価

これらの中で差があるかKruskal Wallis testにて検定

方法

～新しい電子カルテを導入するに当たっての障害因子～

費用・維持に関して 導入資金 導入後の運用費用 導入後のサポート
導入に関して 救急部門医師から導入に対しての抵抗 看護師・技師等、他の職種から導入に対しての抵抗 導入後に診療効率が悪くなることの懸念
情報の漏洩に関して 患者情報が外部へ漏れる事の懸念 外部からハッキングされることへの懸念

2 “大きな障害となる” 1 “少し障害となる” 0 “障害とならない”
の3つで評価

結果

- 施設特性

救急外来のカルテ

- 電子カルテの導入率
- 電子カルテを救急外来に導入後に改善した所、悪化した所
- 新しい電子カルテシステムを導入するに当たって障害となる因子

	回答あり (N=215)	回答なし (N=251)	p value
病院規模			0.207
小規模病院 (<100 beds)	5(2.3)	2(0.8)	
中規模病院 (100-399 beds)	48(22.3)	74(29.5)	
大規模病院 (≥400 beds)	149(69.3)	188(74.9)	
設立母体			
国立病院	38(17.7)	N/A	
自治体病院	49(22.8)	N/A	
公的病院	47(21.9)	N/A	
私的病院	72(33.5)	N/A	
研修指定病院			
研修指定病院	185(86.0)	N/A	
非研修指定病院	10(4.7)	N/A	
施設種別			0.004
3次救急指定	130(60.4)	119(47.1)	
2次救急指定	82(38.1)	132(52.6)	

N/A not assessed.

	回答あり (N=215)	回答なし (N=251)	p value
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N/A not assessed.

結果

救急外来のカルテ

- 電子カルテの導入率
- 電子カルテを救急外来に導入後に改善した所、悪化した所
- 新しい電子カルテシステムを導入するに当たって障害となる因子

結果

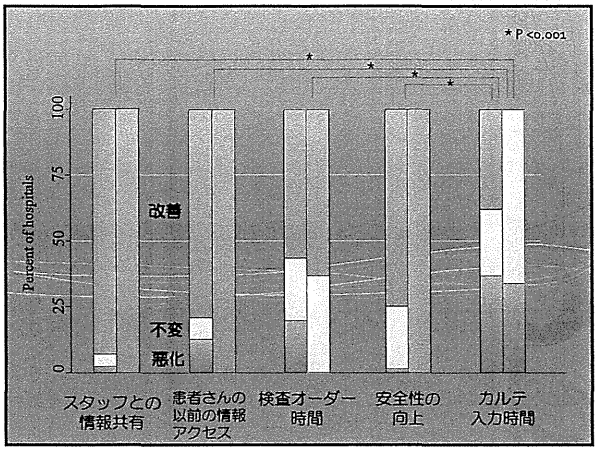
回答があった病院 (N=215)

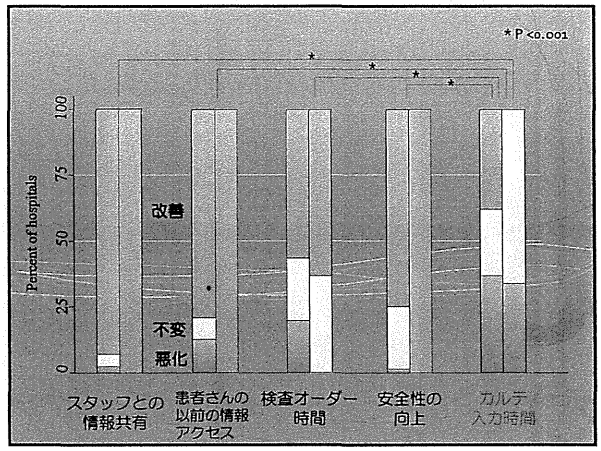
- 救急外来に電子カルテあり N=175 (81.4%)
  - 救急外来独自に開発した電子カルテシステム
    - 有り N=4 (1.9%)
    - 無し N=171 (79.5%)
- 救急外来に電子カルテ無し N=40 (18.6%)
  - 他の部門(外来/病棟)に電子カルテ
    - 有り N=13 (6.0%)
    - 無し N=27 (12.6%)

結果

救急外来のカルテ

- 電子カルテの導入率
- 電子カルテを救急外来に導入後に改善した所、悪化した所
- 新しい電子カルテシステムを導入するに当たって障害となる因子



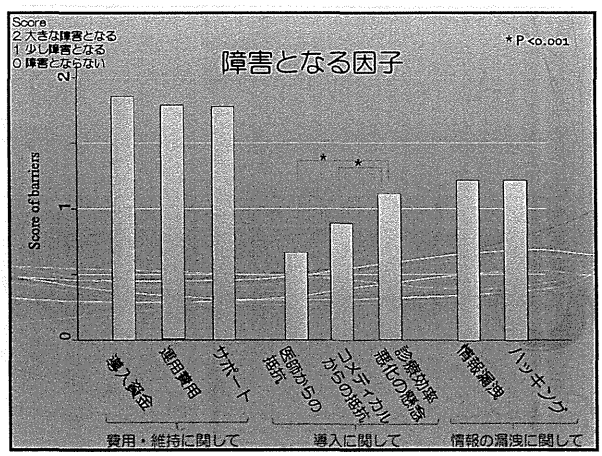


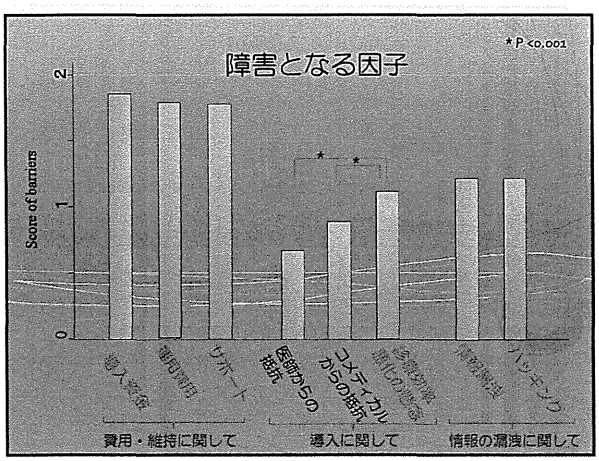
結果

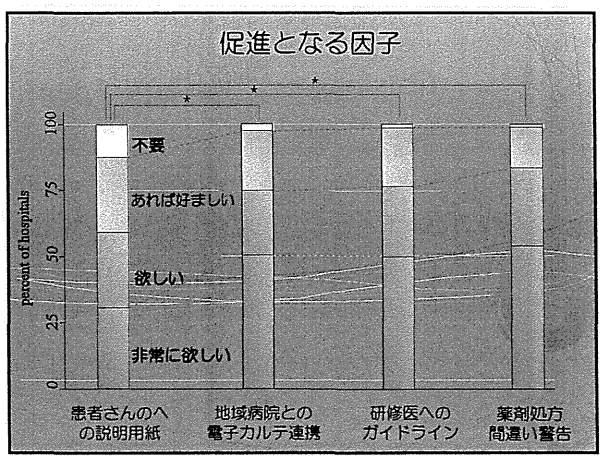
救急外来のカルテ

電子カルテを救急外来に導入後に改善した所、悪化した所

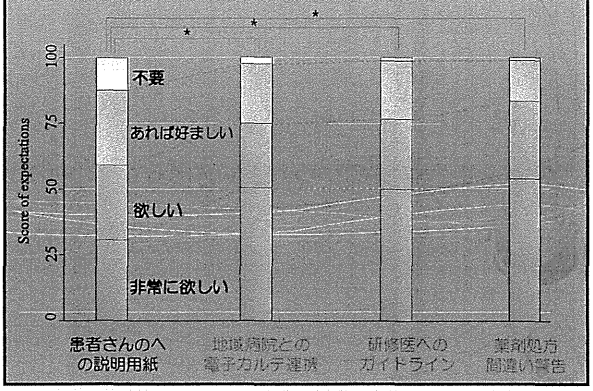
- 新しい電子カルテシステムを導入するに当たって障害・促進となる因子







促進となる因子



考察

回答率は46.6%。

215施設中電子カルテを導入している施設は175施設(81.4%)であった。

また、EDISを導入している施設は4施設(1.9%)であった。

➡ 2011年時点で日本全体400病床以上の病院では電子カルテの導入率は51.5%(Yoshida et al 2013)
救急科専門医指定施設の多くで電子カルテが普及していることが判明

考察

電子カルテ導入後は
- オーダー時間
- 情報共有
- 安全性　　を向上させているが、

カルテ入力時間は低減していない。

一般臨床医は電子カルテにカルテ入力時間の短縮は、期待していない (Poissant *et al*)。しかし救急医はカルテ入力時間の短縮を望んでいる。(Perry *et al*)

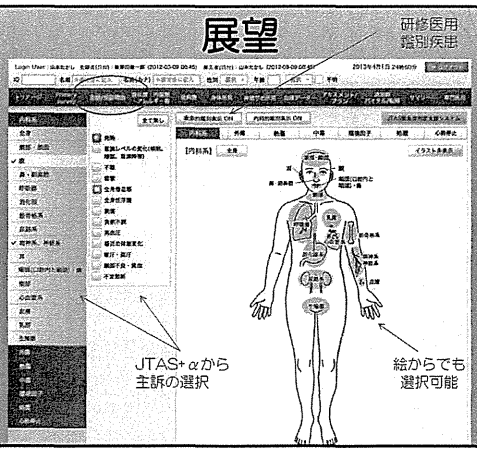
➡カルテ入力に重点をおいた電子カルテの開発が必要

考察

研修医に診療ガイドラインを見せる機能を望んでいる病院が多かった。

➡ 診療ガイドラインを表示する電子カルテの開発が必要

展望



展望

主訴から鑑別疾患を提示する

例：頭痛

臓器	CRITICAL DIAGNOSES	EMERGENT DIAGNOSES	NONEMERGENT DIAGNOSES
神経、血管	くも膜下出血	シャント不全 牽引性頭痛 腫瘍 硬膜下出血	偏頭痛 三叉神経痛 外傷後 腰椎穿刺後
中毒 / 内分泌	一酸化炭素中毒	高山病	
環境			
膠原病	側頭動脈炎		
眼科 / 耳鼻科		緑内障 / 副鼻腔炎	歯科疾患 / 顎関節疾患
筋骨格系			緊張性頭痛 頸椎症性
アレルギー			群発頭痛
感染	細菌性髄膜炎 / 脳炎	脳膿瘍	発熱による頭痛 / 頭蓋内以外の感染による頭痛
呼吸器系		酸素欠乏性頭痛 貧血	
心血管系		高血圧緊急症	高血圧（まれ）
詳細不明			労作時 / 性交時頭痛

66個の主訴をカバー
これを緊急度順に並びかえる。
RosenやTintinelliでこれをやっているのは6症候しかない