

Time telling devices used in Danish health care are not synchronized

Mikkel Brabrand¹, Susanne Hosbond², Dan Brun Petersen³, Alice Skovhede¹ & Lars Folkestad⁴

ABSTRACT

INTRODUCTION: Many patients begin their encounter with the health-care services in an ambulance. In some critical patients, it is pivotal that the timing of treatment and events is registered correctly. When patients are transferred from one health care provider to another, there is a risk that the time telling devices used are not synchronized. It has never been examined if this is a problem in Denmark. We performed the present study to examine if time telling devices used in the pre-hospital setting were synchronized with devices used in emergency departments.

MATERIAL AND METHODS: We used an on-line atomic clock as reference time. The reference time was compared to watches found in the resuscitation rooms at emergency departments at two hospitals in Denmark. Furthermore, we compared the reference time to the watches on the defibrillators in the ambulances at two ambulance stations.

RESULTS: The watches in the Emergency Department at Sydvestjysk Hospital Esbjerg had a median deviation of minus three minutes. In the Emergency Department at Hospital Lillebælt Kolding, we found a median deviation of minus 30 seconds. The watches in the defibrillators of 11 ambulances had a median deviation of minus 45 seconds. The maximum deviation between two devices was 19 minutes and 5 seconds, and the maximum deviation between a wall-mounted clock in an emergency department and a defibrillator in an ambulance was five minutes and 22 seconds.

CONCLUSION: Examining the time telling devices at two Danish emergency departments and 11 ambulances demonstrated that they are not synchronized.

FUNDING: not relevant.

TRIAL REGISTRATION: not relevant. The study was not registered, as it is an observational study.

Many patients begin their encounter with the health-care services in an ambulance. Most transfers are uneventful, but some are highly critical. Patients involved in major trauma, those suffering from cardiac arrest or who are critically ill for other reasons are rushed to the hospital and vital treatment is started in the pre-hospital setting. Both for medico-legal treatment and research

reasons, it is pivotal that the time recording of these actions is correct. However, when patients are transferred from one health care provider to another, there is a risk that the time telling devices used are not synchronized and information could be lost.

In the international consensus report on reporting outcome of cardiac arrests, known as the Utstein template, the authors stress that: "Clock inaccuracy and lack of synchronization continue to be a problem" [1]. Although this problem is well-described in the international literature [2-6], to our knowledge it has never been systematically examined if lack of synchronisation is a problem in Denmark.

We therefore performed the present study with the aim of examining if time telling devices used in the pre-hospital setting were synchronized with devices used in the emergency departments in Denmark.

MATERIAL AND METHODS

We used the on-line service from the National Institute of Standards and Technology [7] in the United States of America as time reference. By adding six hours to Eastern Standard Time (accuracy of ± 0.2 seconds), we converted the time into Danish time.

We compared the reference time to all time telling devices found in the resuscitation rooms at the emergency departments at Hospital Lillebælt in Kolding and Sydvestjysk Hospital in Esbjerg. We also compared the reference time to the watches on the defibrillators at all

ORIGINAL ARTICLE

- 1) Department of Medicine, Sydvestjysk Hospital Esbjerg
- 2) Department of Cardiology, Odense University Hospital
- 3) Quality and Development, The Region of Zealand
- 4) Department of Endocrinology, Sydvestjysk Hospital Esbjerg

Dan Med J
2012;59(10):A4512



Synchronization is important.

TABLE 1

Deviation from reference time at the emergency departments.

Location	Deviation from reference time, min.:sec.
<i>Esbjerg</i>	
Wall-mounted clock	-02:00
Wall-mounted clock	-03:00
Wall-mounted clock	-03:00
Wall-mounted clock	-02:00
Watch in defibrillator	-17:05
<i>Kolding</i>	
Wall-mounted clock	00:00
Wall-mounted clock	00:00
Clock in telephone	-01:00
Clock in telephone	+01:00
Watch in defibrillator	-08:00
Watch in defibrillator	-11:11

TABLE 2

Deviation from reference time in defibrillators in ambulances.

Location	Deviation from reference time, min.:sec.
<i>Esbjerg</i>	
Watch in defibrillator in ambulance	-05:09
Watch in defibrillator in ambulance	+00:01
Watch in defibrillator in ambulance	-03:15
Watch in defibrillator in ambulance	-05:22
<i>Kolding</i>	
Watch in defibrillator in ambulance	-02:40
Watch in defibrillator in ambulance	-00:01
Watch in defibrillator in ambulance	-01:42
Watch in defibrillator in ambulance	-00:45
Watch in defibrillator in ambulance	+02:00
Watch in defibrillator in ambulance	-01:26
Watch in defibrillator in ambulance	-00:01

ambulances arriving at Sydvestjysk Hospital Esbjerg over a 90-minute period and all ambulances at the Kolding Ambulance Station. Using a convenience sample consisting of the ambulance personnel and nursing staff on call at the Emergency Department (ED) at Sydvestjysk Hospital Esbjerg, we asked about their preferred method of time telling during emergencies.

There were, at that time, no definite rules prescribing how the synchronization of the time telling devices should be controlled at either hospital facility, but the wall-mounted clocks were all radio controlled. It is unknown how often and by whom all other time telling devices were checked and adjusted. There were no written instructions as to which specific device should be used for time registration purposes.

According to Danish law, approval of the present study by the regional ethics committee was not required.

Data are presented descriptively as minutes:sec-

onds and as median (interquartile range (IQR)).

Deviation from the reference time was calculated as reference time minus the time on the device. STATA 11.1 (Stata Corp, College Station, Texas, USA) was used for analyses.

Trial registration: not relevant.

RESULTS

We identified four wall-mounted clocks and one watch in a defibrillator in the ED at Sydvestjysk Hospital Esbjerg with a median deviation of -03:00 (IQR: -03:00 to -02:00) from the reference time. At Hospital Lillebælt Kolding, two wall-mounted clocks, two watches in telephones and two watches in defibrillators in the ED had a median deviation of -00:30 (IQR: -08:00 to 00:00) from the reference time, see **Table 1**. We identified a total of 19 time telling devices; all were included in our study.

We also studied the watches in the defibrillators in four ambulances at Sydvestjysk Hospital Esbjerg and seven at the Kolding Ambulance Station with a median deviation of -00:45 (IQR: -02:40 to -00:01) from the reference time, see **Table 2**.

Of the four members (three female, median age 42 years) of the nursing staff at the ED at Sydvestjysk Hospital Esbjerg, all used a wall-mounted clock during emergencies. We also interviewed five ambulance staff at Sydvestjysk Hospital Esbjerg (all male, median age 36 years); three used the watch in the defibrillator and two used their own watches during emergencies (which were both on time, data not shown).

The maximum deviation between two time telling devices was 19 minutes and five seconds and the maximum deviation between an ambulance based defibrillator and a wall-mounted clock in an emergency department was five minutes and 22 seconds, see **Figure 1**.

DISCUSSION

We have demonstrated that time telling devices used pre-hospital and in the emergency departments at two Danish hospitals were not synchronized. The maximum deviation found between two devices was 19 minutes and five seconds. Four members of nursing staff at the ED at Sydvestjysk Hospital Esbjerg reported that they used the wall-mounted clocks when the need occurred to time-stamp an event during an emergency. Three of five ambulance staff used the watch in the defibrillator. The maximum deviation we found using this combination was five minutes and 22 seconds.

Both during treatment and for research purposes, we need to be able to trust the information given on the treatment of our patients. However, we found that most time telling devices used in emergency care at two Danish hospitals deviated from our reference time. In

fact, only two of 11 (18.2%) time telling devices at the emergency departments were running correctly. In the ambulances, the watches deviated less than one minute in only four of 11 defibrillators (36.4%). Such a small deviation will probably have little impact on the treatment of our patients or on research.

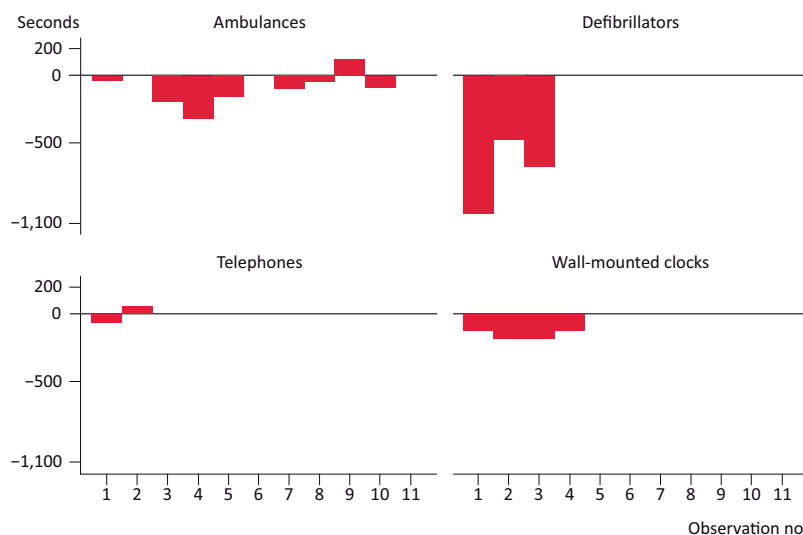
It is unclear when the lack of synchronization between time telling devices becomes clinically relevant. In clinical practice, there is little doubt that a deviation of a few minutes has no impact on care. Any physician treating a patient after e.g. cardiac arrest would continue care regardless of any time-lapse as long as there was hope of improvement. But when prognosticating patients after cardiac arrest, time does have some importance. Survival decreases with 7-10% per minute [8] and an error of several minutes in this context could potentially be disastrous. However, the use of unsynchronized time telling devices in research introduces a systematic error and could lead to skewed results and introduce bias, e.g. when using the Utstein template [1]. Indeed, a recent Danish article on the creation of a database on in-hospital cardiac arrest has indicated that this could be a problem. The authors found negative time data in their database indicating a lack of synchronization between devices used for registration [9], a problem also documented by Kaye et al [6]. Some defibrillators, e.g. Lifepak, offer the ability to download data from resuscitation attempts. When data are downloaded, time is automatically synchronized, which limits the problem. However, if data are extracted manually from written or printed notes, the problem persists, which is clearly documented in a recent article by Krarup et al [9].

It can be difficult to estimate time when you are in a stressful situation. Our group [10] has previously documented that both physicians and nurses are unable to precisely estimate the duration of time in simulated cardiac arrest. However, the deviation was only minor, with a median deviation of 5.7%. Stigelund & Lippert have retrospectively examined charts from patients suffering cardiac arrest while admitted to hospital. They did not specifically look at the timing of events, but found room for improvement as they were only able to assess conformity with the guidelines in 56% of the patients [11]. If staff document events after completion of treatment, which can be necessary when human resources are limited, they cannot be trusted to use their recollection of durations as shown by us, but also to a larger extent by Wong et al [5]. This again leads to an increased risk of documentation error and introduction of systemic bias when data are subsequently used for research.

As previously mentioned, this is not a problem unique to Denmark. Cordell et al [3] evaluated time telling devices in the emergency medical systems of Indianapolis, Indiana, USA. They found a maximum deviation of 19 minutes and 41 seconds with an average difference from reference time of one minute and 45 seconds.

FIGURE 1

Deviation from reference time.



ation of 19 minutes and 41 seconds with an average difference from reference time of one minute and 45 seconds. Ferguson et al [4] examined the time telling devices in a large American urban paediatric tertiary care setting. They found a median minus four minutes of deviation for wall-mounted clocks and minus 2.5 minutes of deviation for monitors. Wong et al [5] determined the variation in time telling devices used in delivery and resuscitation rooms in a Scottish hospital. They found a maximum discrepancy between delivery room clocks and resuscitation room clocks of seven minutes and 52 seconds. Castrén et al found that almost half of 88 automated external defibrillators (AED) at Finnish ambulance services deviated from the reference time by more than 60 seconds and even in ambulance systems with written instructions for synchronisation of the AEDs, there was a mean deviation of 357 seconds [2].

Our study has some limitations. First of all, it is a study of limited size using only two emergency departments, nine persons and 11 ambulances. Also, some of the wall-mounted clocks did not have indicators for seconds. This limits the precision of inaccuracy somewhat. There is no guarantee that our findings are generalizable to the rest of Denmark, but they do raise an important question: Are time telling devices used in Danish health care synchronized?

It has not proven easy to solve the problem of ensuring complete synchronization. The study by Castrén et al has shown that, even where written instructions existed for synchronisation of devices, there was a mean deviation of 357 seconds [2]. This could imply that the instructions are not followed. So, the most obvious solu-

tion is to take the human factor out of the equation and use only electronic devices that automatically synchronize or automatically synchronize data when downloaded. This will not be practical in all situations, but there is room for improvement.

CONCLUSION

Examining the time telling devices at two Danish emergency departments and 11 ambulances, we found that they were not completely synchronized. This may pose a problem and needs to be examined further.

CORRESPONDENCE: Mikkel Brabrand, Medicinsk Afdeling, Sydvestjysk Hospital Esbjerg, 6700 Esbjerg, Denmark. E-mail: mikkel@brabrand.net

ACCEPTED: 13 July 2012

CONFLICTS OF INTEREST: none

ACKNOWLEDGEMENT: Lars Thykjær Pedersen, Falck Kolding, for access to ambulances.

LITERATURE

1. Jacobs I, Nadkarni V, Bahr J et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries. *Resuscitation* 2004;63:233-49.
2. Castrén M, Kurola J, Nurmi J et al. Time matters; what is the time in your defibrillator? An observational study in 30 emergency medical service systems. *Resuscitation* 2005;64:293-5.
3. Cordell WH, Olinger ML, Kozak PA et al. Does anybody really know what time it is? Does anybody really care? *Ann Emerg Med* 1994;23:1032-6.
4. Ferguson EA, Bayer CR, Fronzo S et al. Time out! Is timepiece variability a factor in critical care? *Am J Crit Care* 2005;14:113-20.
5. Wong CM, Stenson BJ, Laing IA. As time goes by. *Scott Med J* 2002;47:138-9.
6. Kaye W, Mancini ME, Truitt TL. When minutes count – the fallacy of accurate time documentation during in-hospital resuscitation. *Resuscitation* 2005;65:285-90.
7. Technology NIoSa. www.time.gov (26 Aug 2010).
8. Lloyd-Jones D, Adams RJ, Brown TM et al. Heart disease and stroke statistics – 2010 update: a report from the American Heart Association. *Circulation* 2010;121:e46-e215.
9. Krarup NH, Lofgren B, Hansen TK et al. Registries of in-hospital cardiac arrest are a challenge in daily clinical practice. *Ugeskr Læger* 2012;174:856-9.
10. Brabrand M, Folkestad L, Hosbond S. Perception of time by professional health care workers during simulated cardiac arrest. *Am J Emerg Med* 2011;29:124-6.
11. Stigelund S, Lippert FK. Documentation of in-hospital cardiac arrest. *Ugeskr Læger* 2008;170:348-51.