

# Hospital alerting via electronic noticeboard (HAVEN)

<b>Submission date</b> 20/05/2016	<b>Recruitment status</b> No longer recruiting	<input type="checkbox"/> Prospectively registered <input checked="" type="checkbox"/> Protocol
<b>Registration date</b> 27/07/2016	<b>Overall study status</b> Completed	<input type="checkbox"/> Statistical analysis plan <input checked="" type="checkbox"/> Results
<b>Last Edited</b> 25/03/2021	<b>Condition category</b> Signs and Symptoms	<input type="checkbox"/> Individual participant data

## Plain English summary of protocol

### Background and study aims

Late recognition of deteriorating patients (i.e their condition getting worse) in hospitals causes delays in treatment for these patients, which then results in an increase in mortality (ill health) and morbidity (death) despite the widespread introduction of vital sign-based “early warning scores”.

Therefore, developing systems that recognise earlier when a patient is at risk of a severe but reversible deterioration in health is a key goal for the NHS. The HAVEN Project aims to produce a hospital-wide IT system that enables a continuous risk assessment in all hospital patients, and predicts those at risk of deterioration.

### Who can participate?

Data are collated from the records of all adult patients over the age of 18 who are admitted to all participating hospitals. Data without identifying information are sent to the central office in Oxford. Staff members from Oxford and Portsmouth trusts are also recruited to help design the user interface.

### What does the study involve?

An IT system is developed that routinely stores electronic data (including demographics, laboratory results and vital signs recordings) to create a continuous risk assessment. Data is gathered from different local databases; at present they are not integrated or displayed in a way that supports decision making or calculation of patient risk. Risk prediction algorithms are then developed (programs that look at the information and decide whether a patient is likely to be at risk of deteriorating) and tested. These use the records of patients who are admitted to hospital and then admitted to an intensive care unit (ICU) after two or more days in hospital. The information about these patients illustrates the pathway from the first signs of deterioration on the ward to ICU admission. There is no direct involvement for patients who are included in the project. Information from their hospital stay is collected by the NHS IT groups in a way that will allow the university-based research team to review the information without knowing who the people are. During the project, the automatic system is checked to see whether it has correctly recognised if patients needed intensive care treatment during their hospital stay. Doctors and nurses who are part of the research team need access to individual patient information to check this. The algorithms are used to create an interface allowing clinical staff to identify, rank,

review and treat patients who, without acute medical intervention (treatment), will deteriorate and require ICU admission. Members of staff are asked questions about the information they would look for to recognise that a patient was becoming unwell. They are then observed as they carry out their usual daily tasks.

What are the possible benefits and risks of participating?

There are no risks to patients whose data is used in the project and the potential benefit is the development of a hospital-wide IT system that is capable of recognising patients at risk of deterioration. Clinical participants (healthcare staff) will need to find time to meet with the research team to discuss the project plans in some detail as well as participate in the cognitive task analysis and user interface testing.

Where is the study run from?

The project is run from the University of Oxford. It takes place at the University of Portsmouth, Portsmouth Hospitals NHS Trust, and Oxford University Hospitals NHS Foundation Trust. Other hospitals taking part provide data only.

When is the study starting and how long is it expected to run for?

August 2015 to March 2023

Who is funding the study?

Department of Health and the Wellcome Trust through the Health Innovation Challenge Fund provided the initial project funding. The ongoing work is funded by the NIHR Oxford Biomedical Research Centre.

Who is the main contact?

Rachel Henning  
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## Contact information

### Type(s)

Public

### Contact name

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## Additional identifiers

**Protocol serial number**

160405-HAVEN-v1

## Study information

**Scientific Title**

Hospital Alerting Via Electronic Noticeboard (HAVEN)

**Acronym**

HAVEN

**Study objectives**

Production of a hospital-wide IT system that enables a continuous risk assessment in all hospital patients, optimised for end-user functionality.

**Ethics approval required**

Old ethics approval format

**Ethics approval(s)**

1. South Central Oxford C Research Ethics Committee, 20/06/2016, ref: 16/SC/0264
2. Confidentiality Advisory Group, 04/07/2016, ref: 16/CAG/0066

**Study design**

Observational mixed quantitative/qualitative study

**Primary study design**

Observational

**Study type(s)**

Other

**Health condition(s) or problem(s) studied**

Patients at risk of deterioration (and requiring intensive care unit admission) in hospital

**Interventions**

Patients will be identified by the system as likely (or not) to require intensive care unit admission. The system generated results will be compared against reality and discrepancies reviewed.

Creation of the risk prediction score will be a multi-stage process involving:

#### 1. Candidate Variable Selection

Candidate variables will be selected by a systematic review of variables associated with in-hospital deterioration; analysis of data of 5000 admissions to ICUs at the Royal Berkshire Hospital, the Churchill Hospital, Oxford and the John Radcliffe Hospital, Oxford to identify common factors to patients admitted from general wards; analysis of 127,000 patient episodes in Portsmouth Hospital to obtain information on patients who did not require ICU admission, and compare the frequency of candidate variables between those who deteriorated and those who remained stable; and a modified two-round

Delphi Process to review possible candidate variables identified in the above processes and to obtain further suggestions for variables of interest.

#### 2. Score Creation

To create the risk prediction score, the project will utilise standard statistical approaches (including linear and non-linear regression), machine learning techniques and techniques such as Gaussian processes for trend analysis using trajectories in multi-dimensional input space.

Algorithms will be developed in which correlations between the various time-series are learned automatically, allowing early detection of physiological deterioration by identifying unexpected changes in correlation or other changes in dynamics. The algorithms will include probabilistic, Bayesian methods that can cope with missing or artefactual data from one or more input time-series in a principled, robust

manner, as is required for a realistic real-time risk estimation system.

#### 3. Score Validation

The risk prediction score will be validated by comparing observed ICU admissions with predicted ICU admissions. The goodness-of-fit of observed to expected ICU admissions will be described using the Hosmer-Lemeshow (HL) test.

#### 4. Clinical Expert Review

The first risk prediction model will be run on new inpatient episodes. A list of false negatives (patients in whom the algorithm reported a low risk, but the patient was admitted to ICU) and false positives (patients in whom the algorithm reported a high risk, but the patient was not admitted to ICU) will be generated. Clinicians from the project team to examine these patients' standard clinical records (EPR, paper notes, etc) to determine new factors (or combinations of factors) used by the clinical team to determine the patients' need for ICU.

#### 5. Score Re-validation

The score will be re-validated following the modifications made to the risk algorithm after step iv.

### **Intervention Type**

Other

### **Primary outcome(s)**

1. Validated risk prediction score identifying at least 50% of deteriorating patients admitted to the ICU at least 12 hrs ahead of their admission, with a false positive rate of under 60%. This will be validated by comparing observed ICU admissions with predicted ICU admissions. The goodness-of-fit of observed to expected ICU admissions will be described using the Hosmer-Lemeshow (HL) test. This outcome will be measured during the second half of 2017

2. Data aggregation software in place capable of supplying all data fields to the algorithm

3. Working interface complete with functional underlying software and prototype graphics. A minimum success criterion would be usability scale results above average (>68%). This will be designed using Human Factors methods. This will involve process mapping and task analysis of existing workflows used to recognise deterioration of patients on the ward. Knowledge gained will be used to produce a design specification for the interface. This will then be tested formally assessing efficiency, effectiveness and user satisfaction as outlined in ISO 9421

The end of the study will be a key timepoint for overall evaluation of the outcomes from the project.

**Key secondary outcome(s)**

No secondary outcome measures

**Completion date**

31/03/2023

## **Eligibility**

**Key inclusion criteria**

1. Aged 16 years and over
1. Admitted to any hospital from Portsmouth Hospitals NHS Trust since 1st January 2010 or Oxford University Hospitals NHS Foundation Trust since 1st January 2014

**Participant type(s)**

Patient

**Healthy volunteers allowed**

No

**Age group**

Adult

**Lower age limit**

16 years

**Sex**

All

**Total final enrolment**

496710

**Key exclusion criteria**

1. Patients <16 years of age
2. Patients whose data are not entered into local electronic patient records

**Date of first enrolment**

01/08/2015

**Date of final enrolment**

31/07/2018

# Locations

## Countries of recruitment

United Kingdom

England

## Study participating centre

**Oxford University Hospitals NHS Foundation Trust**

Oxford

United Kingdom

OX3 9DU

## Study participating centre

**Portsmouth Hospitals NHS Trust**

Portsmouth

United Kingdom

PO6 3LY

## Study participating centre

**Royal Preston Hospital**

Sharoe Green Lane

Fulwood

Preston

United Kingdom

PR2 9HT

## Study participating centre

**Warwick Hospital**

Lakin Road

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United Kingdom

CV34 5BW

## Study participating centre

**Royal Berkshire NHS Foundation Trust**

London Road

Reading

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RG1 5AN

# Sponsor information

## Organisation

University of Oxford

## ROR

<https://ror.org/052gg0110>

# Funder(s)

## Funder type

Government

## Funder Name

Department of Health/Wellcome Trust Health Innovation Challenge Fund

## Funder Name

NIHR Oxford Biomedical Research Centre

# Results and Publications

## Individual participant data (IPD) sharing plan

The datasets generated during and/or analysed during the current study are/will be available upon request. Currently researchers need to apply to Peter Watkinson (HAVEN Chief Investigator) to access the de-identified data. Applicants will need to outline their hypothesis and analysis plan. Valid submissions will be reviewed by a 'Data Access Committee' who will grant access (or not). At the end of the HAVEN project the trialists will provide a full access statement.

## IPD sharing plan summary

Available on request

## Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
<a href="#">Results article</a>		01/07/2021	25/03/2021	Yes	No
<a href="#">Protocol article</a>	protocol	11/09/2019	31/07/2020	Yes	No
<a href="#">HRA research summary</a>			28/06/2023	No	No
<a href="#">Other publications</a>	development of mathematical model	16/07/2020	31/07/2020	Yes	No

[Study website](#)

Study website

11/11/2025 11/11/2025 No

Yes