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**Asthma UK Centre
for Applied Research**

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@AUKCAR

IoT – Medical Applications

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Usher Institute – Centre for Medical
Informatics



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education for health



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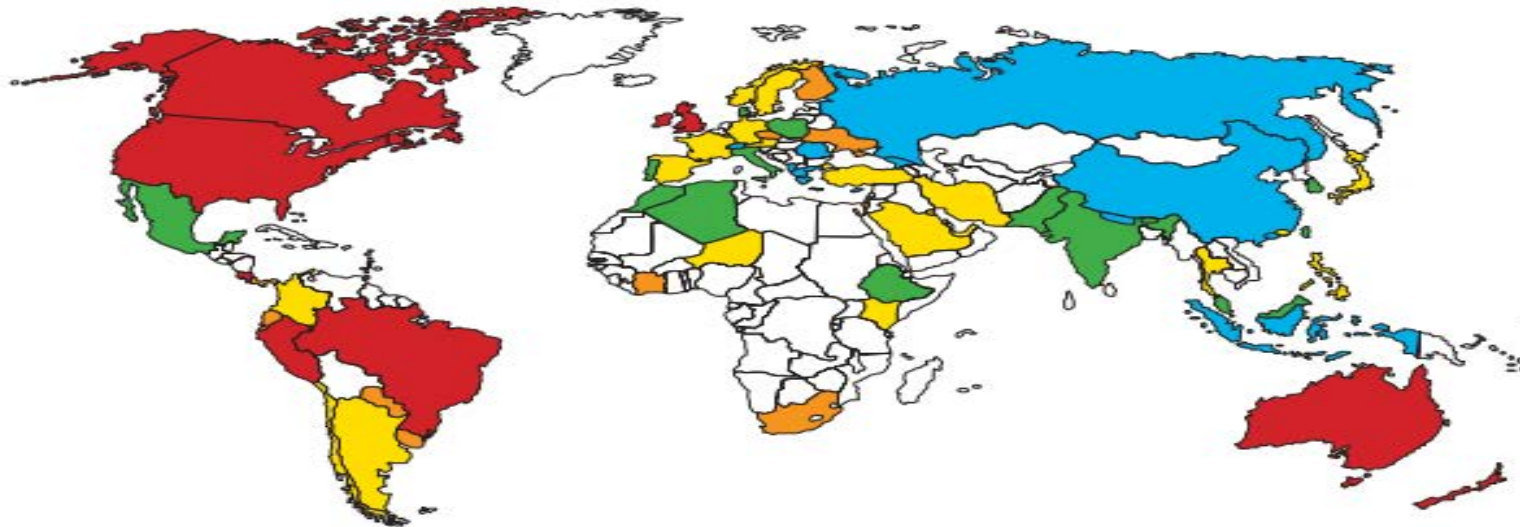
The University
Of Sheffield.



University of East Anglia

Health Services Challenges – Asthma

World Map of the Prevalence of Clinical Asthma



Proportion of population (%)*



No standardised data available

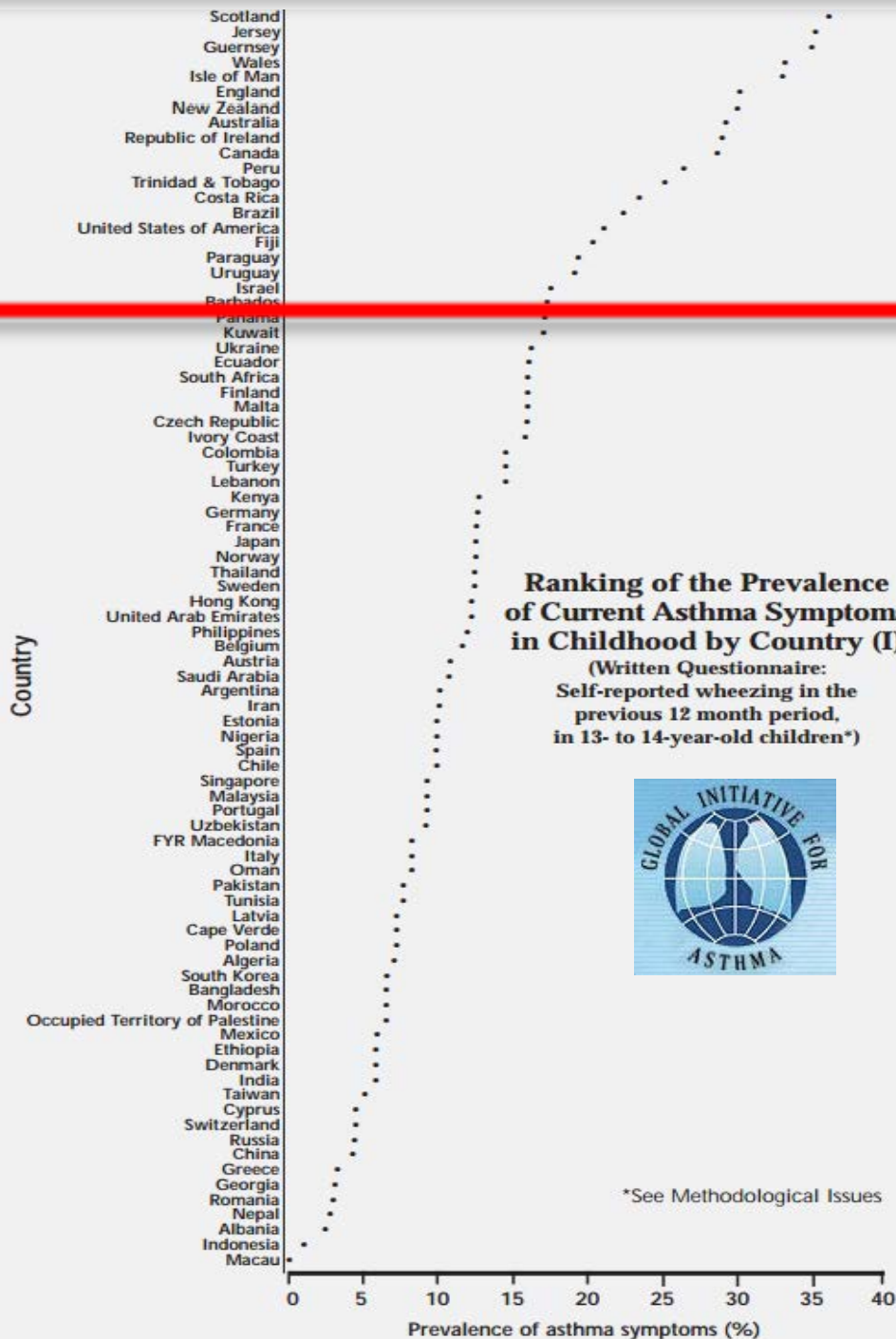
Scotland	18.4	Ivory Coast	7.8	Oman	4.5
Jersey	17.6	Colombia	7.4	Pakistan	4.3
Guernsey	17.5	Turkey	7.4	Tunisia	4.3
Wales	16.8	Lebanon	7.2	Cape Verde	4.2
Isle of Man	16.7	Kenya	7.0	Latvia	4.2
England	15.3	Germany	6.9	Poland	4.1
New Zealand	15.1	France	6.8	Algeria	3.9
Australia	14.7	Norway	6.8	South Korea	3.9
Republic of Ireland	14.6	Japan	6.7	Bangladesh	3.8
Canada	14.1	Sweden	6.5	Morocco	3.8
Peru	13.0	Thailand	6.5	Occupied Territory of Palestine	3.6
Trinidad & Tobago	12.6	Hong Kong	6.2	Mexico	3.3
Costa Rica	11.9	Philippines	6.2	Ethiopia	3.1
Brazil	11.4	United Arab Emirates	6.2	Denmark	3.0
United States of America	10.9	Belgium	6.0	India	3.0
Fiji	10.5	Austria	5.8		

Ranking of the Prevalence of Current Asthma Symptoms in Childhood by Country (I)

(Written Questionnaire: Self-reported wheezing in the previous 12 month period, in 13- to 14-year-old children*)



*See Methodological Issues



Ranking of the Prevalence of Current Asthma Symptoms in Adults by Country

(Written Questionnaire: Self-reported wheezing in the previous

12 month period, in 20- to 44-year-old adults*)



*See Methodological Issues



Asthma UK Centre
for Applied Research



Asthma in Scotland

in 2011-12



1.3m

people experienced
symptoms indicative
of asthma over a lifetime*



734k

people were diagnosed
by a physician
over a lifetime*

0.4m

people diagnosed with
symptomatic asthma
by a physician
(reported by patients)*

0.5m

people diagnosed & treated
by a physician
(reported by patients)*

0.3m

people diagnosed & treated
by a physician
(reported by GPs)

505k

GP and Nurse Consultations

5k

Out of Hours Calls

8k

ambulance conveyances
(7k to hospital)

9k

A&E
attendance

8k

episodes of
hospital care

180

episodes of
intensive care



94 people lost their lives to asthma



At least **£93m** was spent treating asthma

Data from national health surveys, primary & secondary care databases
and administrative databases;
For year 2010-11*.



Source

The epidemiology, healthcare and societal burden and costs of asthma in the UK and its member nations: analyses of
standalone and linked national databases; Mukherjee, M., et al; BMC Medicine, 14 (113), Aug 2016.
DOI: 10.1186/s12916-016-0657-8.



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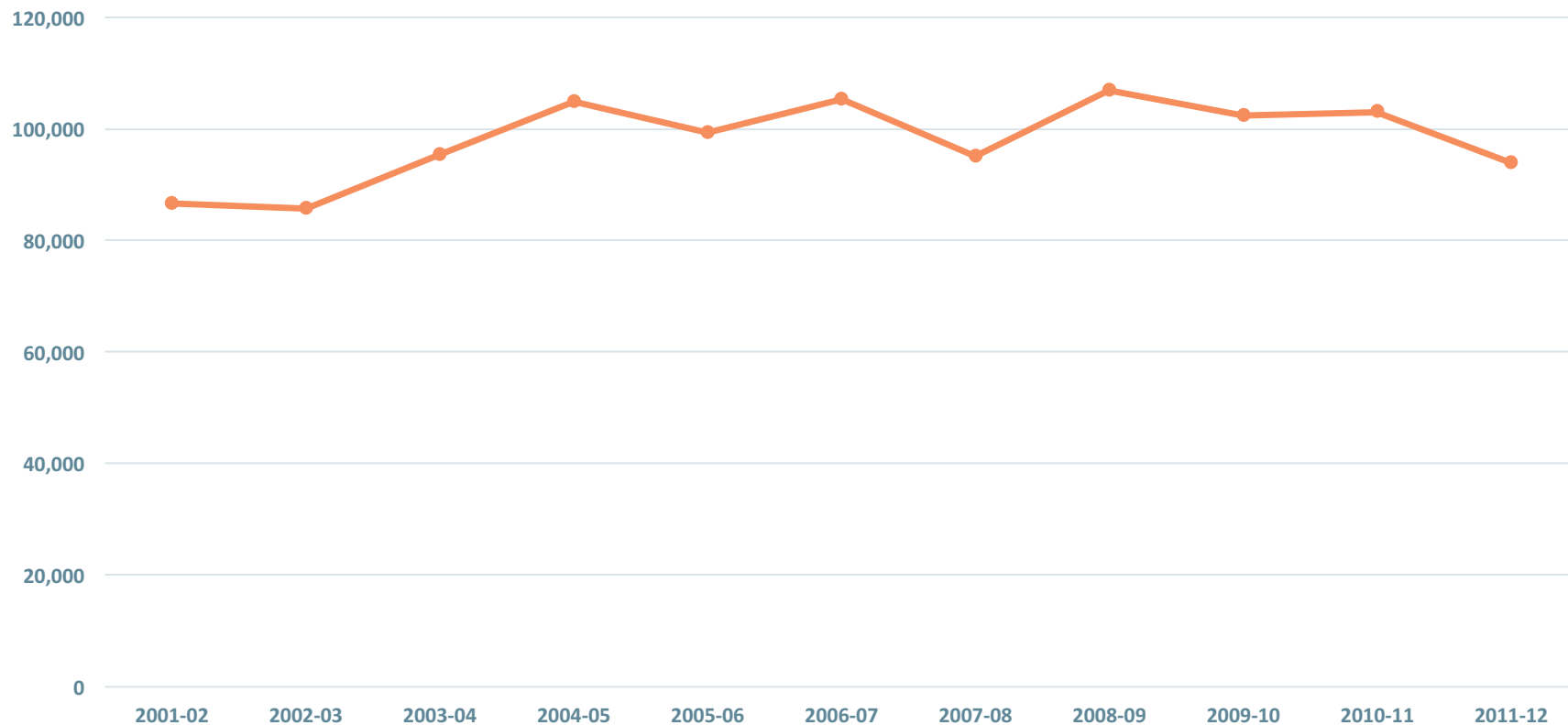
**Asthma UK Centre
for Applied Research**

Table 1: Incidence and lifetime prevalence rates of asthma 2001-2005

Year	Total patients	Patients with Asthma	Age-sex standardised rate per 1000 patient-years (95% CI)	Relative % change in standardised rate (from 2001)
Lifetime prevalence				
2001	2,864,938	285,941	100.5 (100.1-100.9)*	0
2002	2,89,0190	301,048	104.8 (104.4-105.2)*	4.3
2003	2,921,178	315,559	108.5 (108.2-108.9)*	8.0
2004	2,922,024	325,857	111.9 (111.5-112.2)*	11.3
2005	2,958,366	333,294	113.0 (112.6-113.4)*	12.4
* Age-sex standardised rate per 1000 patients (95% CI)				

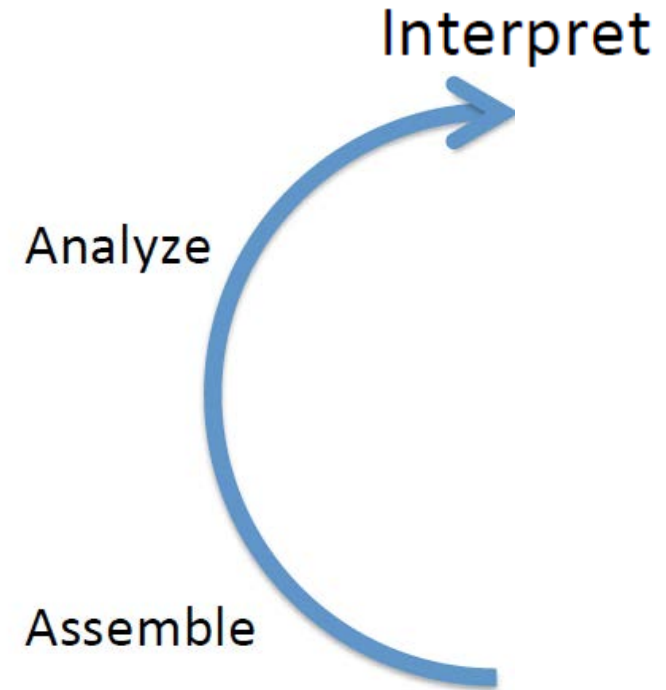


Number of UK inpatient episodes with asthma as the primary diagnosis



Current situation

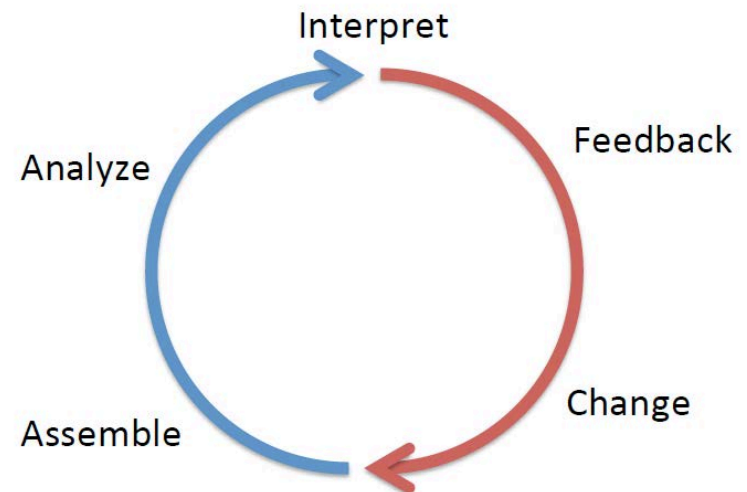
- Blue Afferent path:
 - Gathering and analysing data (big/large data)
- But.....
- High quality analytics – leading to national stats, high impact papers and emerging algorithms
- Difficult to judge direct impact on clinical practice



Where we want to get to:

- The Learning Health System completes the big data generation and analytics cycle
- Efferent (Red) side
 - Feeding back into the system what has been learned e.g. via decision support
 - Implementing change
 - Develop a continuously operating cycle of health improvement e.g. for people with asthma

Figure 1. The learning cycle, as described in "Toward Complete & Sustainable Learning Systems" by Professor Charles Friedman, available at http://medicine.umich.edu/sites/default/files/2014_12_08-Friedman-IOM%20LHS.pdf (accessed 24/02/2015)

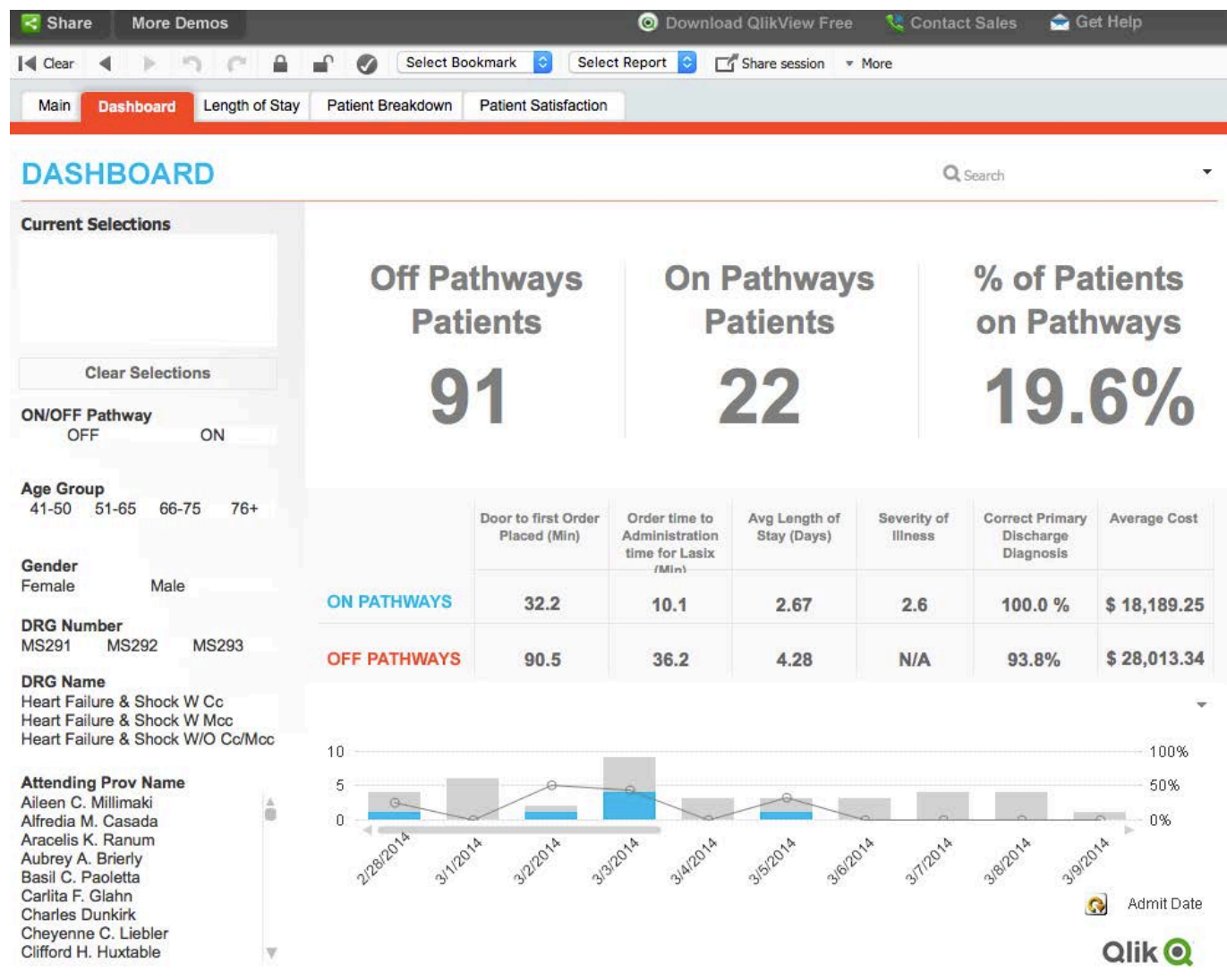


Our overall aims

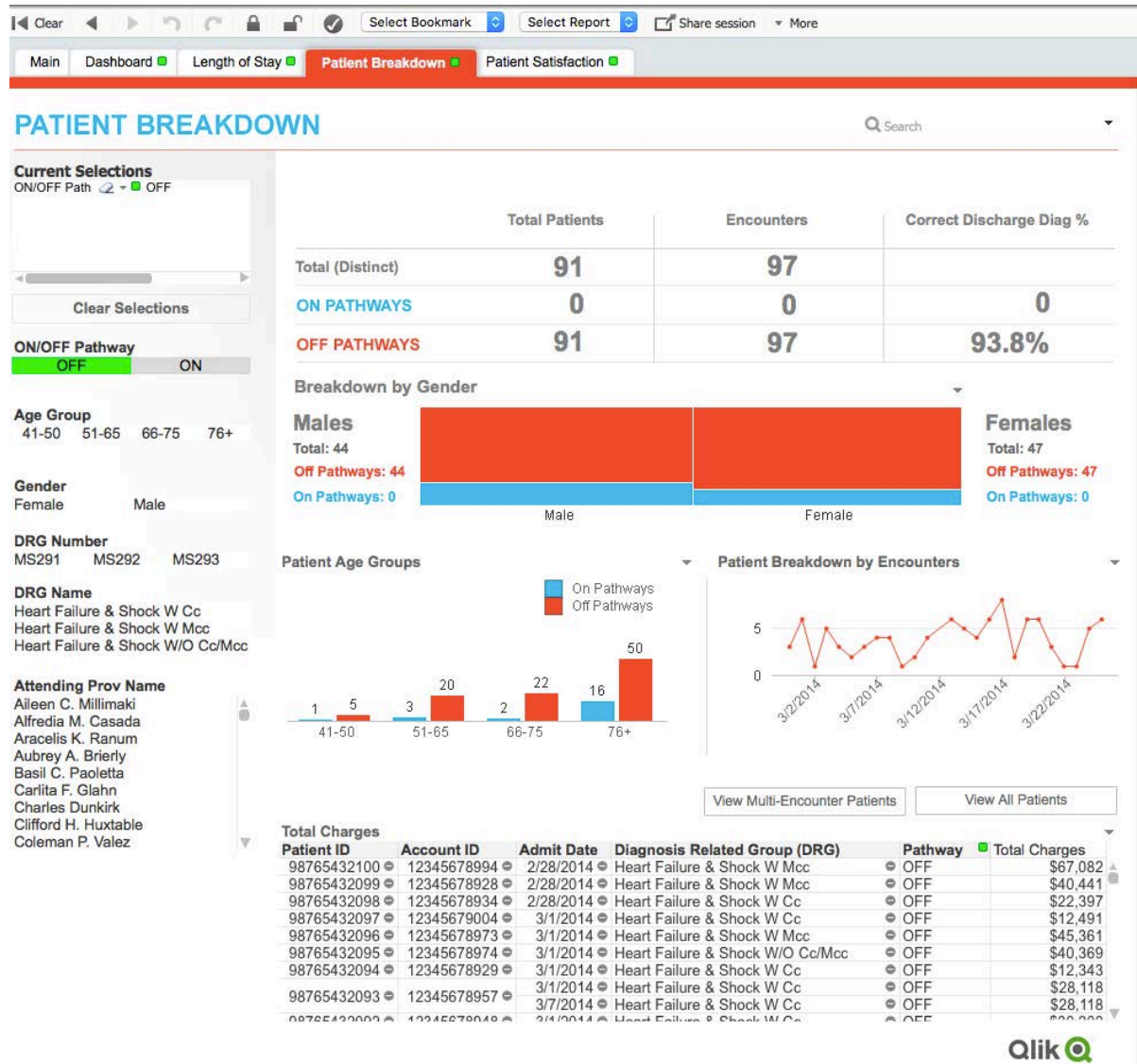
- Build a data feed that enables intelligent analytics to identify patients at-risk of asthma attack – decision support
- Create visualisation and management support tools
 - iteratively improved with input from general practices and their staff
- Promote positive action in the management of people with asthma via feedback at various levels
- Education (patient & clinician, behaviour etc.)



Visualisation Examples (diabetes)



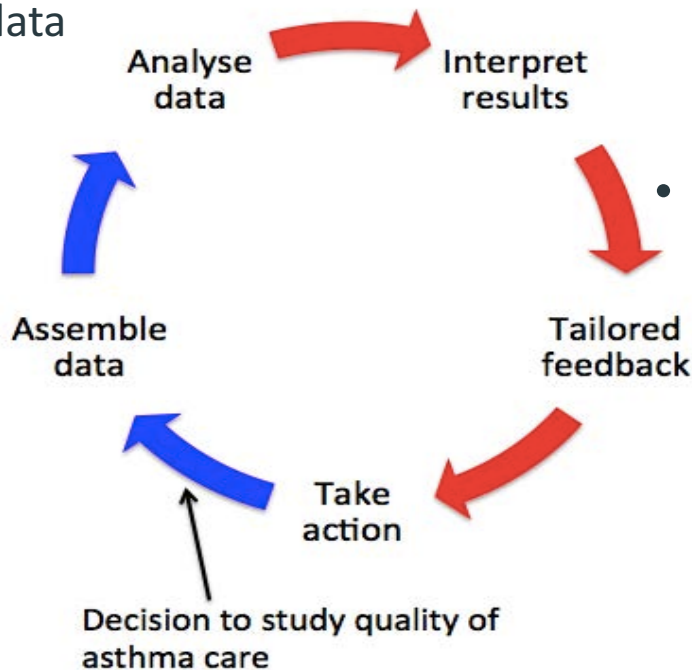
Visualisation Examples (diabetes)



A Learning Health System approach

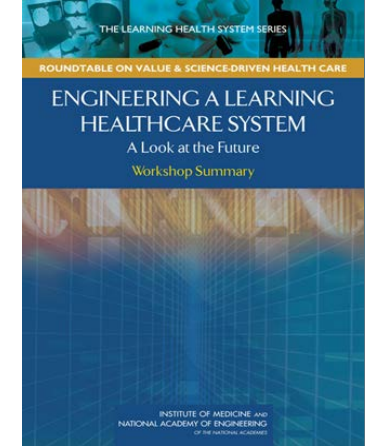
- Blue Afferent path:

- Gathering and analysing data (big/large data)

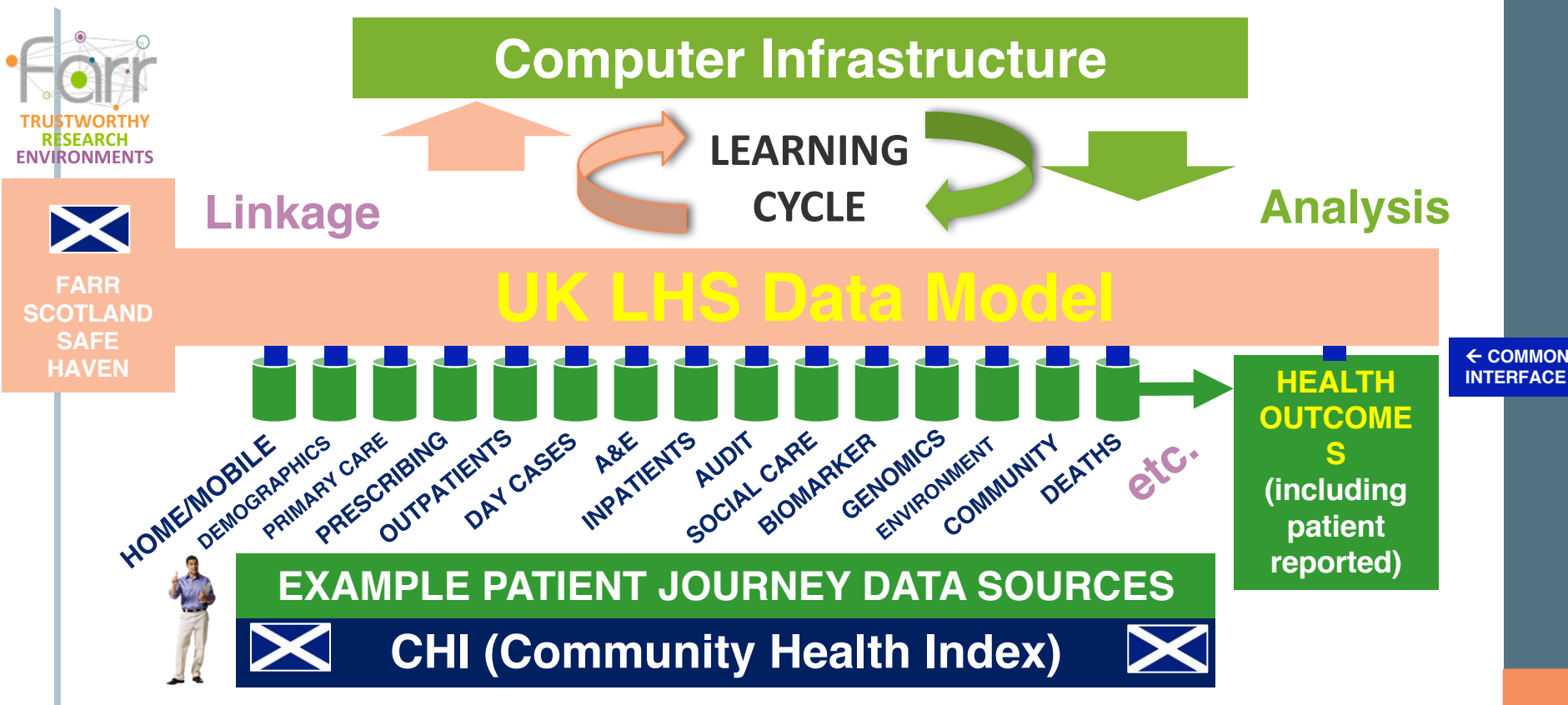


- Efferent (Red) side

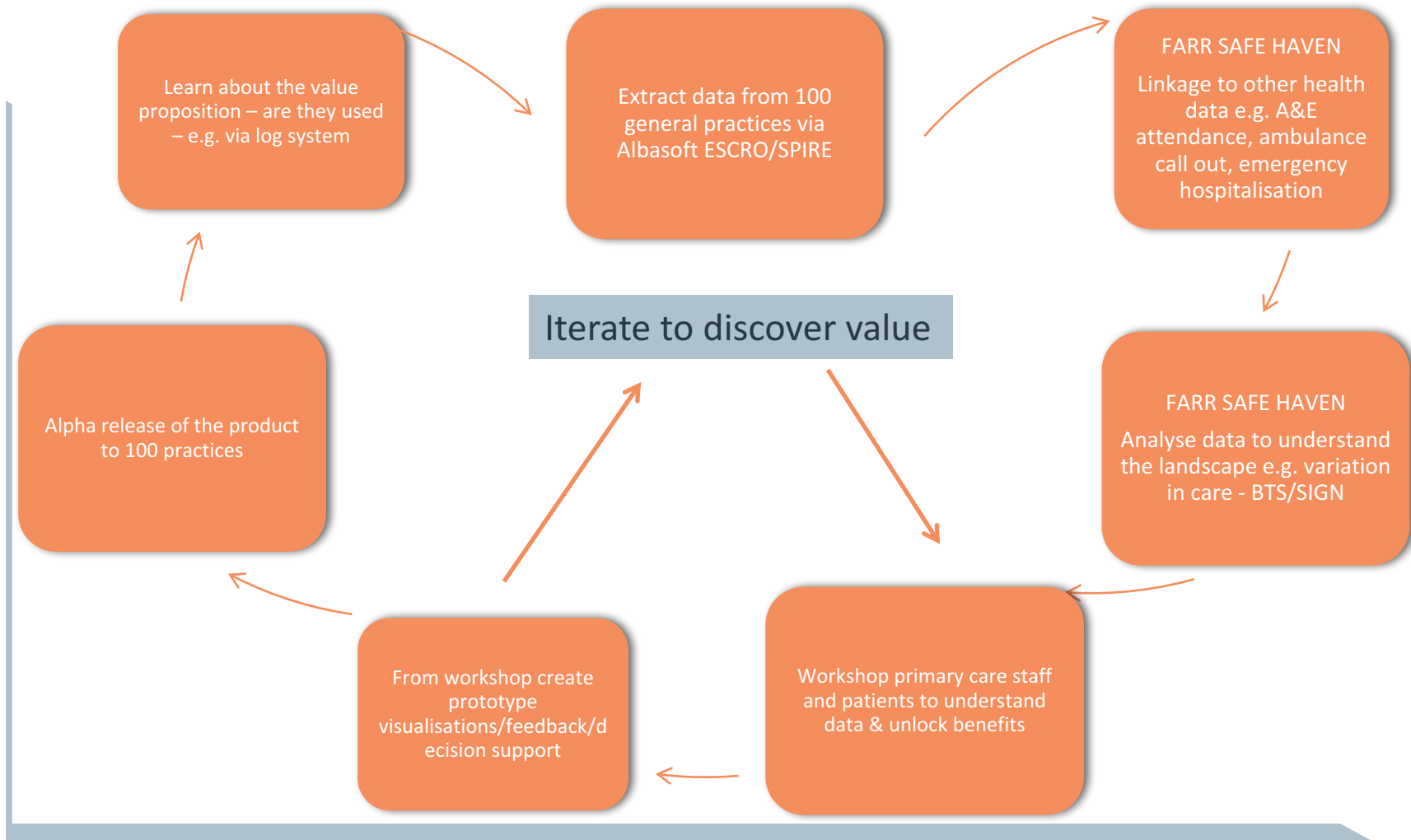
- Feeding back into the system what has been learned e.g. via decision support
- Implementing change
- Develop a continuously operating cycle of health improvement e.g. for people with asthma



Learning Health System - bi-directional flow



Prototype Learning Health System for Asthma



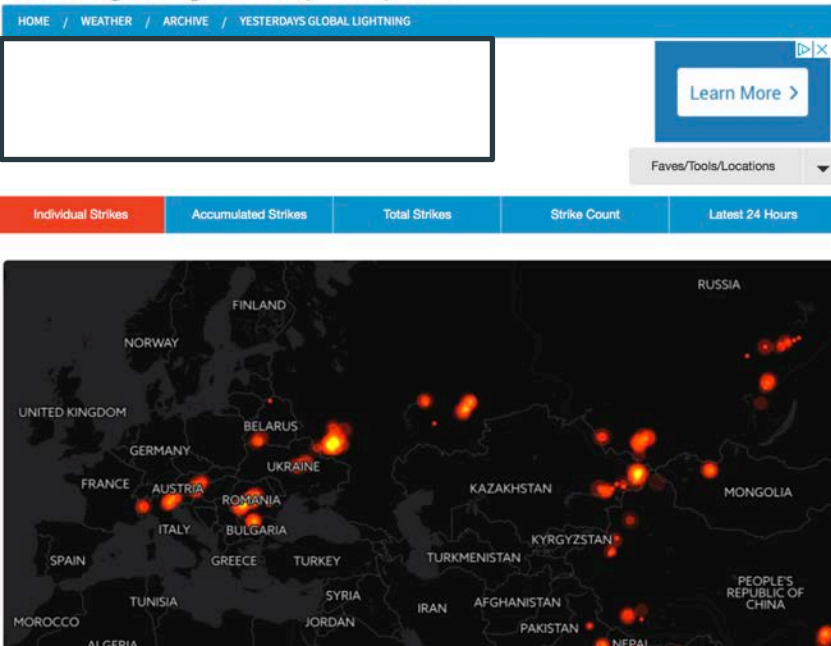
Farr Institute LHS for asthma prototype

- Agree on data to be extracted and data integration approaches
- Secure governance permissions (September 2016)
- Recruit 100 practices – (October 2016) and establish data extraction procedures
- Create appropriate feedback using visualisation tools and establishing channels to feedback key -
- Create algorithms for identifying asthma attacks for decision support tool (and how this fits with workflow)
- Iterate via workshops



NERC Learning Health System project

Global Lightning Saturday 1 July 2017



Atmospheric Pollutant Portal

Explore atmospheric pollutants over the UK as modelled by EMEP4UK

EMEP4UK is an atmospheric-chemistry transport model that simulates the composition of pollutants in the UK's atmosphere through time. It uses the Weather Research Forecast (WRF) model as its main driver. It is used to underpin research and develop European policy through the UNECE Convention on Long-range Transboundary Air Pollution.

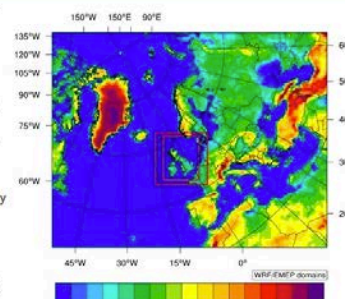
Here we present daily data from this model spanning 2001 to 2014 for 12 pollutants for you to explore. Select one of these pollutants below to begin.

Ozone	Nitric oxide	Nitrogen dioxide	Ammonia	Nitric acid
Sulphur dioxide	Ammonium particles $\leq 2.5\mu\text{m}$	Sulphate particles $\leq 2.5\mu\text{m}$	Nitrate particles $\leq 10\mu\text{m}$	Particles $\leq 2.5\mu\text{m}$
Particles $\leq 10\mu\text{m}$	Particulate organic matter $\leq 2.5\mu\text{m}$			

What is EMEP4UK?

The EMEP4UK model framework consists of an atmospheric chemistry transport model (ACTM) which simulates hourly to annual average atmospheric composition and deposition of various pollutants and the weather research and forecast model (WRF). Pollutants simulated include PM_{10} , $\text{PM}_{2.5}$, secondary organic aerosols (SOA), elemental carbon (EC), secondary inorganic aerosols (SIA), SO_2 , NH_3 , NO_x , and O_3 . Dry and wet deposition of pollutants are also calculated by the model. WRF is used to calculate the required meteorological input data for the ACTM.

EMEP4UK operates at horizontal resolutions ranging from 50 to 1km by 1km covering the





Location of usual residence and place of work by method of travel to work

Table population All usual residents aged 16 and over in employment the week before the census

Interactive Visualisation

Chart showing the in-flows and out-flows for an area.

Choose an area

> choose area <

View

Explore in detail

Get data from this table for a range of areas and variables.

Query data

This dataset provides 2011 Census estimates of the usual residents of the UK aged 16 and over in employment the week before the census. The data classifies people currently resident in each local authority or higher area of the UK by method of travel to work and shows the movement between their local authority of residence and workplace. The estimates are as at census day, 27 March 2011.

Statistical Disclosure Control


In order to protect against disclosure of personal information from the 2011 Census, there has been swapping of records in the Census database between different geographic areas, and so some counts will be affected. In the main, the greatest effects will be at the lowest geographies, since the record swapping is targeted towards those households with unusual characteristics in small areas.

More details on the ONS Census disclosure control strategy may be found on the [Statistical Disclosure Control](#) page on the ONS web site.

Revisions and Corrections

2014-11-25 09:30

Table ID	WU03UK
Source	Census 2011
Units	Persons
Keywords	Commuting patterns, Workplace flows, Method of travel to work
Coverage	United Kingdom
Area Types	Local Authorities and above i
Latest Data	2011
Last Updated	2014-11-25 09:30
Variables	place of work i , Method of travel to work i
Contact	Census
Email	census.customerservices@ons.gov.uk
Phone	01329 444 972
Website	http://www.ons.gov.uk/census i



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 - ProXed
 - Secure File Exchange

Scottish Exchange of Data (ScotXed)



Scottish Exchange
OF DATA

The ScotXed Unit is part of Education Analytical Services Division within the Learning and Justice Directorate of the Scottish Government.

The unit, headed by Albert King, is located at Victoria Quay, Edinburgh. We support and develop a significant number of secure, efficient and effective electronic data exchanges between partners in the Scottish Government and wider service communities. ScotXed initially collected data solely for the Learning and Justice Directorate but is now being used more widely within the Scottish Government and its agencies. Data collections include the pupil and staff censuses, Looked After Children, Mental Health Benchmarking and Drug Treatment and Testing Orders to name a few. To view our extensive range of surveys, please see the links within the Data Collection Topics section below or the topics menu on the left hand side of this page.





Future project 1. Incorporating wearable sensor data into a Learning Health System for Asthma – e.g. measuring night symptoms

Future project 2. Evaluating micro-weather measurement and air pollution sensors for use in a Learning Health System for Asthma

libelium

Products Resources Case Studies Development Company Ecosystem Libelium World Contact

Technical Overview Introduction Overview Sensor Cloud Encapsulated Line Documentation Buy

Know more about ...

- Hardware
- Sensor Boards
- Wireless Interfaces
- Industrial Protocols
- Over the Air Programming
- Encryption Libraries

Buy Waspote

Contact us and get the IoT Platform used by more of 5000 active developers

Buy Waspote

Sections:

Hardware

Waspote hardware architecture has been specially designed to work with extremely low consumption. Digital switches allow to turn on and off any of the sensor interfaces as well as the radio modules. Three different sleep modes make Waspote the lowest consumption IoT platform in the market (7 μ A).

Sensor Boards

There are more than 110 sensors available to connect to Waspote: CO, CO₂, soil moisture, wind, IR presence, humidity, temperature, pH, radiation, liquid, luminosity, etc. Our Sensor Boards allow developers to easily use sensors in Waspote.

Wireless Interfaces

There are 16 different wireless interfaces for Waspote including long range (4G / 3G / GPRS / GPRS+GPS / LoRaWAN / LoRa / Sigfox / 868 MHz / 900 MHz), medium range (ZigBee / 802.15.4 / DigiMesh / WiFi) and short range (RFID/NFC / Bluetooth 2.1 / Bluetooth Low Energy). They can be used solely or in combination of two by using the Expansion Radio Board.

Industrial Protocols

Connect any sensor in industrial environments. Compatible with: RS-232, RS-485, Modbus, CAN Bus, 4-20mA.





Further Details: Colin Simpson



@DrColinSimpson





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Collaborators

Asthma UK Centre for Applied Research

- Chuck Friedman – Professor and former CSO Office of the National Coordinator for Health IT (ONC) in the U.S. Department of Health and Human Services.
- Stefan Reis, Massimo Vieno CEH
- Hester Ward - Consultant in Public Health Medicine for ISD
- Sir Lewis Ritchie- University of Aberdeen
- Saturnino Luz Chancellor's Fellow- Machine Learning/Visualisation
- Dave Kelly, Albasoft Ltd
- Ed Conley - Chief Scientific Officer, The Farr Institute
- Kenny Fraser, Triscribe Ltd
- Mark Parsons, EPCC
- Steve Pavis, eDRIS
- Chris Dibbon, Tom Clemens, ADRC
- 14 AUKCAR Partners & Asthma UK



SIVE II

Evaluation, Trials and Studies Coordinating Centre

Other - Practices recruited

Project Month	Month	Actual	Initial Target
10	July-15	0	0
13	October-15	183	500
16	January-16	225	500

