ICT is new weapon in the war on drug-resistant diseases

Every year hundreds of thousands of people die because of infections that have become resistant to treatment. A new data-mining, clinical monitoring and decision-support system, developed by EU-funded researchers, offers a powerful new weapon in the war on resistance to antibiotics.

According to the World Health Organisation, around 440,000 new cases of multidrug-resistant tuberculosis emerge annually, causing at least 150,000 deaths, while hospital-acquired infections by highly resistant bacteria such as ‘Methicillin-resistant staphylococcus aureus’ (MRSA) have become increasingly widespread. Many other infectious diseases have also stopped responding to treatment, putting patients' lives at risk, reducing the efficacy of care and increasing the threat of epidemics.

'Clinically, antimicrobial resistance is a huge challenge. Pharmaceutical companies simply can't come up with new antibiotics fast enough to counter the resistance of bacteria to existing antibiotics and medications,' explains Dr Dirk Colaert, Chief Medical Officer at Agfa HealthCare in Belgium. 'By definition, it's a war that can't be won by antibiotics alone.'

When bacteria are first exposed to a new antibiotic they are usually quickly killed off. But over time the bacteria will evolve and adapt to resist the treatment, a problem made worse by factors such as
the incorrect prescription of antibiotics, their misuse or the failure of a patient to fully complete a course of medication. Continually developing new antibiotics can therefore only go so far toward treating diseases effectively.

Using antibiotics more smartly

'On top of new antibiotics, we need new tools to apply antibiotics more smartly,' Dr Colaert says.

That is the reasoning behind the Debugit project, coordinated by Dr Colaert and supported by EUR 6.4 million in research funding from the European Commission.

The idea is simple: monitor antimicrobial resistance using data from different hospitals, identify trends showing which types of bacteria are becoming resistant to certain types of antibiotics and then use that knowledge to implement courses of treatment with more effective drugs.

'If you monitor bacterial resistance and can see which bacteria is becoming more resistant you can switch drugs. When bacteria starts to show resistance to the new drug, say after a couple of years, you can switch again, even going back to the antibiotic that was used before, as the bacteria's resistance to it will have been reduced,' Dr Colaert explains.

Though the concept sounds simple, implementing it is a big challenge. Some hospitals have infectious disease specialists who monitor patient data and conduct antibiograms for antimicrobial resistance. Antibiograms are lab tests in which isolated bacteria samples are exposed to different antibiotics to determine resistance levels. But often the data is incomplete or stored in formats, systems and structures that make sharing, mining and analysing it difficult.

'The main challenge is the poor quality of clinical data. In an ideal world you have nicely coded and structured data, but in reality you have to deal with free text and incomplete data,' the Debugit coordinator says.

A semantic interoperability solution

Dr Colaert and his team overcame that challenge by using ICT technology and a semantic interoperability framework to extract heterogenous clinical and antibiogram data from hospital information systems (HIS) and use it to determine trends in antimicrobial resistance.

The Debugit system maps HIS data to a common domain ontology concerning microbes and infection control, aggregates this information from different sites and harmonises it with a common ontology to create a global but virtual clinical data repository. The data is then analysed by applying statistical and data-mining techniques and can be output via HIS systems or even through a standalone web application.

'The system could be used to aggregate and analyse data from many hospitals to determine antimicrobial resistance in a region, country or worldwide. However, in practice hospitals are reluctant to make their data available in this way. It's not a privacy issue, but rather the fact that hospitals do not want to disclose information that can show how good or bad they are performing,' Dr Colaert explains. 'Nonetheless, in Debugit we showed that this can be done, and we believe it should be done given the huge benefits to patients, society and healthcare systems in being able to use antibiotics more smartly.'

Besides saving patient lives and improving care through a more effective and efficient use of
antibiotics, the system, if implemented widely, could dramatically reduce hospital and healthcare system costs as less money would be wasted on ineffective treatments and patient recovery would be accelerated.

Several hospitals involved in the project are carrying out validation trials, including the University Hospital of Geneva which plans to permanently incorporate the Debugit platform into its hospital information system.

With the click of a button, doctors will be able to search for information about a bacterial infection, see its resistance levels to different antibiotics and receive decision-support about the best drugs to prescribe for any individual patient.

'Other factors can also be incorporated into the decision support mechanism, such as contraindications and side effects. In fact, our proof of concept demonstrator shows step by step that the more clinical data you provide, the more accurate and effective the system becomes,' Dr Colaert says.

Agfa HealthCare is considering incorporating the platform into its proprietary HIS, called ORBIS, to provide an antimicrobial resistance monitoring solution and as the basis for other potential applications.

'The underlying technology and semantic interoperability framework is capable of doing much more than monitoring bacterial resistance. For example, we are also looking at the potential of using it to help pharmaceutical companies find patients for clinical trials,' Dr Colaert explains.

Debugit received research funding under the European Union's Seventh Framework Programme.

(1) 'Detecting and eliminating bacteria using information technologies'.

Useful links:

- ['Detecting and eliminating bacteria using information technologies' website](http://www.debugit.eu/) [2]
- [Debugit project factsheet on CORDIS](http://cordis.europa.eu/projects/rcn/85484_en.html) [3]

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**Links**