From a patient’s heart monitor to electronic health records, eHealth has integrated itself into all aspects of healthcare. Grid computing is playing a key role in this growing area, providing storage and computing power for initiatives in several biomedical disciplines. These tools enable researchers to investigate diseases and rare conditions, as well as providing doctors with new ways to diagnose and treat patients. And by integrating the vast amount of medical data available, they could herald the beginning of personalised treatments for patients.

Together, eHealth and grids are shaping the future of healthcare. This briefing examines some of the key eHealth projects in Europe, looks at the challenges involved and presents opinions from experts in the field.

Safeguarding Europe’s health

Information and Communication Technologies (ICTs) are becoming more integrated into our lives, and healthcare has proved no exception. For clinicians, researchers and patients, eHealth is making healthcare more efficient, accessible and personalised.

Since the early 1990s, the EU has invested more than €500 million in the development of eHealth tools and systems. Consortiums such as the Assembly of European Regions e-He@lth Network work together with policy makers, medical personnel and IT experts to further eHealth. And, due to a heavy emphasis on ICT research and improving public services, the EU’s i2010 strategy (see box) has ensured that the subject has been firmly on Europe’s agenda.

Grids for healthcare

Grid computing allows users to share computer power and data storage capacity over the internet. Today grids facilitate work done in many areas of healthcare, with initiatives such as HealthGrid working with both clinicians and researchers to promote awareness of the advantages linked to deploying grid technologies.

Grid technologies are being used in many areas:

- Researchers can use grid computing’s processing power to hunt for new viruses, search for new drugs, model disease outbreaks, image the body’s organs and determine treatments for patients
- Doctors can gain access to relevant health data regardless of where it is stored
- Patients can receive a more individualised form of healthcare
- Healthcare workers are better able to collaborate and share large amounts of information

The Future of Healthcare: eHealth and Grid Computing

Credit GridTalk

The i2010 vision

The i2010 strategy is the EU policy framework for information society and media. Running from 2005 to 2010, it aims to:

1. establish a single European information space
2. reinforce innovation and investment in ICT research
3. promote inclusion, public services and quality of life

Samuel Keuchkerian, HealthGrid - “Enhancing the capacity of the bioinformatic and medical communities with the power of grids and clouds provides the opportunity for new fields of operations where diagnosis, drug discovery, exchange and monitoring of health related data will become increasingly fast, accurate and easy to handle. Healthgrids are the right innovation for health professionals to use applications saving time, money and allowing an increase in scope and results that could not be provided through traditional IT services. Grids and clouds are therefore the future for medical and biomedical applications”
Putting health on the grid

Grid computing is perfect for research that requires large homogeneous datasets and to study the heart’s response to defibrillation. Grids are also well placed to enable image processing. Producing images is a computer-intensive but essential task that helps clinicians visualise organs in the body for disease, damage or irregularities. Grid computing is the workhorse behind imaging tools such as the GLOBE Genome 3D Browser (see box) and HemeLB, which allows doctors to view a 3D representation of a patient’s brain, giving them detailed information when it comes to planning neurosurgery.

Grid-enabled treatment: RadiotherapyGrid

Every year 3.2 million Europeans are diagnosed with cancer. One of the most common and effective techniques for treating the disease is with external radiotherapy, but calculating the process for delivering treatments for cancer patients and to study the heart’s response to defibrillation. Grids and eHealth initiatives involve the storage of large amounts of patient data that must be kept in an accessible but secure manner, and must adhere to data protection laws. eHealth initiatives must be designed with this in mind, and services provided to anonymise data. However with care, healthgrids can overcome these issues. RadiotherapyGrid (see box), used in the treatment of cancer patients, ensures the data is fully secure by using security tools built into EGEE that only authenticated users have access to.

Finding a way to represent this genomic information in a visual form, and to reveal its scientific meaning, is a major challenge. The GLOBE 3D Genome Platform answers the question - how do we view this data in order to analyse it further? This browser acts as a virtual desktop behind which the grid enables researchers to both visualise and analyse DNA sequences.

“A clearer view: Using the grid to image DNA?”

When analysing DNA, problems abound due to the large amounts of data involved. Researchers might have to work with up to 10 million markers on a DNA strand, which is very time consuming without a supercomputer or grid.

A more secure patient data platform

For pharmaceutical companies, grid technologies can move drug discovery from the lab to the computer, saving money when developing potential new drugs. The WISDOM initiative, which relies on the Enabling Grids for E-Science (EGEE) infrastructure, has taken this approach, using the grid to find strong drug candidates for malaria.

As a disease that offers pharmaceutical companies little chance of profit, malaria is often neglected, but the grid can provide an ideal and cheap platform on which to base further research.

Heathcare spanning borders

Grid computing can break down barriers between healthcare systems in different countries by providing a homogeneous way to efficiently store, exchange and access medical data in a secure manner. This could potentially lead to EU citizens having access to both their medical data and treatment no matter where they are on the continent.

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Integrating the healthcare systems of many countries is a major task, requiring new sets of standards, and solutions to issues related to communicating medical data across borders. Initiatives such as ACTION-Grid hope to create a common health information infrastructure in Europe, and extend it to other regions by working with research centres, universities, hospitals, SMEs and public entities. Dr. Jochen Jocham, German Cancer Research Center, says, “While the grid indeed has the potential to improve health care, it is still in its infancy.”

Although SHARE has now ended, these issues have not been forgotten, with permanent policy bodies such as the e-Infrastructure Reflection Group setting up to work on the future of the grid. For example, the May e-IRG workshop held in Prague this year, medicinal chemistry and drug-related issues were high on the agenda.

The personal touch

A major European initiative, the Virtual Physiological Human (VPH) is working to assemble a model that will allow investigation of the human body as a single complex system. From the cellular level, to organs, and finally the whole individual, the initiative will integrate biomedical research across disciplines. The aim is to create a computer model which can be used to simulate conditions and treatments of individual patients, providing a way to personalise healthcare.

VPH is a huge undertaking that could give us vast prediction abilities about human functionality. However applying such a complex model requires a large amount of computing power and also places a huge demand on data storage and management. Because grids allow researchers to easily share and store data with each other, they are already playing a crucial role in VPH projects such as Health-e-Child and eNeuroST.

VPH projects range from those developing computational models of the heart and predictive models for dementia, osteoporosis and drug safety, through to projects furthering a common health information infrastructure to facilitate easier access to European supercomputing power. They require a wide variety of resources - from the supercomputing network DEISA to EGEE clusters.

“VPH proposes a new dimension in the integration of fields towards improvement of human health - it uses computing power to refocus disciplinary boundaries and translate knowledge into societal benefit,” says Miriam Mendes, VPH Project Coordinator.
A collaborative approach

For healthgrids to be truly effective, grid researchers and physicians need to work closely together to understand each other’s needs. As the SHARE roadmap states: ‘It is important that technical research and development be conducted in close collaboration with user communities.’

With new technologies also comes the need for training. Grid applications for eHealth must be designed for ease of use and in some cases developers may even want to ‘hide the grid’ to provide accessible interfaces. Initiatives such as Health-e-Child are leading the way, providing doctors with services that have real benefits but are also easy to use.

Joël Bacquet, European Commission

“Most biomedical researchers, involved in the Virtual Physiological Human initiative (see box), will need an access to a computational grid of some sort. Biomedical datasets need to be processed on high-performance computing facilities due to the size of the generated data. Researchers will also need to access and/or transfer large sets of data around grid infrastructures. However the barrier to entry seems still to be high as few researchers are using resources other than their local ones mainly due to accessibility and usability issues.”

The fight against influenza: A global task

Countries across the globe have been fighting the recent swine flu pandemic with quarantining, antivirals and calls for good hygiene. However, researchers hope to add a new weapon to their arsenal if another pandemic strikes: the grid.

Grid technology can monitor the spread of a disease, providing decision-makers with vital information for a public health response. Using the computing, storage and automatic updating services offered by grids, researchers can dynamically analyse the molecular biological data available on public databases. In this way, they can track mutations on the virus genome that could impact the way the virus is transmitted, causes disease and is affected by drugs.

“Everyone is aware and, in some way, is scared of what is occurring worldwide with the flu pandemics,” says Ana Lucia Da Costa, of HealthGrid. “Global health initiatives are needed to monitor such a threat. Grid permits us to federate all molecular data related to the disease and to process them automatically. Grid offers real-time in silico results which are very useful for experts’ decisions concerning detection, evolution and treatment of such a viral infection.”

Grids for kids: Improving paediatrics

Coughs and colds are common childhood illnesses, but rarer disorders are much harder for doctors to diagnose and treat. Health-e-Child is remedying this problem by providing new tools for paediatricians to treat their young patients.

The project uses a grid-based platform to enable clinicians and researchers to store, retrieve and manipulate medical records. Using this infrastructure, the Case Reasoner application, for example, allows doctors to search for similar conditions from anonymous patient records, giving them reassurance and help when treating rare diseases.

“Regardless of their location and thanks to a simple USB stick, physicians are able to seamlessly connect and navigate through the European population of children enrolled in their studies” says David Manset from the project. “Three years of intensive work were required to deploy this large grid network and to develop innovative new models addressing physicians’ hypotheses.”

A total of 15 institutions across Europe, including four hospitals, are participating in the Health-e-Child project. Its other applications include modelling and advanced imaging in cardiology, rheumatology and neuro-oncology, giving doctors a greater knowledge of how to treat children with heart conditions, juvenile arthritis and brain tumours.

For more information:

Europe’s Information Society Thematic Portal: ICT for Health
http://ec.europa.eu/information_society/ictforhealth
HealthGrid: www.healthgrid.org
Share roadmap: http://roadmap.healthgrid.org
Virtual Physiological Human NoE: www.vph-noe.eu
Health-e-Child: www.health-e-child.org
neuGRID: www.neugrid.eu
RadiotherapyGrid: www.beingrid.eu/radiotherapygrid.html
@neurIST: www.aneurist.org
iSGTW: www.isgtw.org
EGEE (Enabling Grids for E-sciencE): www.eu-egee.org
GridTalk : www.gridtalk-project.eu

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