

Key Instruments of Innovation in Child Emergency and Traumatology Care

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Authors of the article are R&D personnel of the HRDOP (Human Resource Development Operational Programme) 2.2.1-16 project: "Development of Accident and Emergency Medicine for Child Care", which seeks the possibility of integrating different care models. In the framework of staff exchange programme of the InterReg HELIUM project implemented by the National Health Service Centre (ÁEEK) Dr. Bognár and Dr. Kassai paid a visit to the Alder Hey Children's Hospital in Liverpool, and studied the R+D+I solutions of the hospital with the aim to introduce and adopt some of the best practices in Hungary.

Injuries received in accidents and clinical diseases treated in the framework of acute child emergency and traumatology care are among the leading death causes in Hungary. At the moment there is no independent network for the treatment of the above mentioned injuries and casualties. The lack of the above mentioned services initiated the HRDOP 2.2.1-16 project backed by a governmental programme, which has defined setting up an independent, standardised and progressive nationwide network for child emergency and traumatology care.

The Charter of the European Association for Children in Hospital specifically determines the following issues below:

- children should be separated from adult patients
- hospitals should have a continuous relationship with parents and family members,
- children should receive comprehensive information in accordance with their age;
- child-friendly atmosphere should be provided during the entire length of care.
- age specific care should be provided

<https://www.each-for-sick-children.org/each-charter>

The currently existing practice and care environment in Hungary are insufficient to implement the requirements of the EACH Charter detailed above. We are looking for possibilities of development and innovation in order to achieve the above goals. The Alder Hey Hospital which opened its gates in 2016, is one of the top European state-of-the-art institutions, where integration of R+D+I processes had been applied in all aspects of patients' care, and were actually formulated among the strategic goals even at the planning phase of the hospital. As a consequence, an innovation hub¹ was established within the hospital, which ensures and results a favourable environment for all kinds of R+D activities.

<https://vimeo.com/194418957>

¹ NHS Alder Hey Children Hospital closely cooperates with The Innovation Agency (AHSN), Liverpool John Moores University (<https://www.ljmu.ac.uk>) and ACORN investor group (<http://www.acorn-partners.co.uk/>) and its co-partner Deepbridge Capital (<http://www.deepbridgecapital.com/>)

<https://www.healthstatejournal.com/story/20304/alder-hey-innovation-hubs-pioneering-work>

Alder Hey's original innovation hub, with a mock-up patient bedroom, nurses station and simulated operating theatre, has been used to demonstrate and develop new technology for the new hospital such as telehealth and patient entertainment and therapy systems. It has been used to facilitate 3D printing pilots and for telemedicine pilots.

A new £2m hub was developed in the new hospital with the aim of providing a one stop shop for healthcare technology that would generate revenue for Alder Hey and its partners. The Hub provides a unique area for industry to work alongside clinicians to create, develop and test new products so that they can be taken to market. The hub is available for Trust staff, strategic partners, researchers, university teams and industry to use and will space for: co-collaboration, product development and testing, display and demonstration facilities, simulation exercises and tutorials.

With all of the above, raised issues and problem solving are closely tied both in time and location. Problems of the medical profession arise during doctors' everyday work, challenges of providing a children-friendly environment are emerging in children's presence, the continuous need of patient-education and patient-information are articulated in the process of care. Solutions to these problems are not sought in different separated institutions, but are elaborated in multidisciplinary (medical, IT, economic, psychological, bio engineering, architectural) working teams within the hospital.

Following the articulated need in 2009, a consortium was formed consisting of NHS Northwest Trust, Liverpool City Council, and a private investor group. This threefold partnership provided the initial economic conditions and background of the completion of the new hospital building procured under Private Finance Initiative contract, and including the donation of the 22 acre land (Park in Alder Hey) for Europe's first children's hospital built in a park.

<http://www.bdp.com/en/projects/a-e/Alder-Hey-Childrens-Health-Park/>

We would like to underline that the 4 years' long planning phase of the project (2009-2013) exceeded the length of the construction works of erecting the hospital (2013-2016). One of Europe's biggest and busiest state of the art paediatric hospitals, having 270 beds, out of which 48 are children's intensive care beds, was inaugurated by her majesty Elisabeth II, in 2016.

The architects made special emphasis to design the 24-module paediatric intensive care unit of Alder Hey, which provides a one stop shop access for acute patients. There are 16 operating theatres, 4 out of which (25 %) are only used for day-care treatment. The intensive care unit has 48 beds providing full spectrum of care: neonatal surgery, cardio-surgery, traumatology, orthopaedics- spine surgery, general paediatrics. There is a high-level special care unit for patients with serious burn injuries. By the establishment of the complex and integrated service units, territorial care and capacities had become optimised. Paediatric care institutions of the Liverpool and Manchester area can refer their patients of high progressive care demand here. The hospital provides a wide range of inpatient medical, surgical and specialist services,

(emergency care, medical care, surgery, critical care, outpatients and diagnostic services, neonatal services, end of life care and transitional services) as well as a 24-hour A&E. The hospital is also a designated national centre for head and face surgery, a centre of excellence for heart, cancer, spinal and brain disease, and a Major Trauma Centre. It is one of four national Children's Epilepsy Surgery Service centres.

The 3 wings of the building start from a central plaza like atrium space. A multi-storey car park with 1200 spaces is available for those who arrive by car. Returning out-patient clients can check in by using the auto-checkin consoles. There are volunteer helpers who assist patients to find their way around. Day-care, In-patient and Out-patient care facilities are geographically and physically well separated. The central mid-section market hall like space offers various facilities for shopping and eating, in order to satisfy family needs and reducing and easing potential tensions related to anxious suspense. The applied interior decorations and designs (colours, shapes, geometric shapes and spaces) reflect a unified child-friendly concept and atmosphere. There are maximum 2 bed rooms, and parents' presence is always assured. The semicircle design of the emergency unit enables smooth operation of the patient inspection. This idea is embodied by the care bay structure, each consisting of 8 beds. Each ward has a balcony area, and there is a covered play field at the end of the corridor of each age group, which can be used even when it rains outside.

We have experienced high level of medical care and have seen various start-up initiatives, which improve patients' safety. Advance planning of orthopaedic-traumatology surgeries and educating patients on planned interventions (instant patient information) are visually supported by 3D printed models at Alder Hey, based on the MRI scans.

3D printing can help improve clinical outcomes, including one to see how it can be used for improving hip dysplasia surgery which is one of the most common problems for children following hip disease. An advanced 3D model of a spine has recently been used in a complex operation to treat hyper kyphotic scoliosis because of a congenital spinal anomaly. The model of the spine was used for pre-surgical assessment and planning, and then sterilised and brought into the operating theatre to provide further guidance during the course of the operation.

In general surgical teams use CT and MRI scans to plan surgeries, but now, 3D lifeprints enable the surgeons to hold an accurate model of the part of the body they are operating on before going into surgery. This gives surgeons a better idea of what they will encounter during an operation and so can reduce the length of time a patient is under anaesthetic. They have also been used for the training of medical staff and to help explain procedures to parents and give them a better understanding of what surgery can achieve for their children. Future clinical trials are also being planned for learning about ankle fractures and how 3D printed models of the skull and soft tissues overlays can allow cranio-facial operations to be practiced beforehand.

Further advantage is provided by the usage of 3D simulation models of internal organs (heart, stomach etc.) in graduate and post graduate education. By the help of virtual reality and

wearing 3D glasses one has the ability to go inside the organ which is the actual set target of the pathological examination.

https://www.youtube.com/watch?v=4Nld9d2LD_M

<https://alderhey.nhs.uk/parents-and-patients/having-surgery/innovation-and-technology>

Alder Hey is using a new approach to enabling patient-centred hospital care by developing specially designed applications both for computers and smartphones to assist families with: a) find one's way/orientation inside the hospital building; b) providing ongoing contact between parents and children; c) dressing monitor to illustrate various ways of clothing matching a changed body image and different physical conditions, d) screening examinations to do hearing and vision tests at home, e) remedy and preventing medication errors, f) picture path/picture cards to assist every day communication of children with Autism g) mechanical monitoring of fluid intake and output in surgical patients by *aquarate*.

<https://alderhey.nhs.uk/>

A basic requirement of the state-of-the-art health care is to give a thorough and all-round provision of information to patients. This is a real challenge in paediatric care as not only the parents but also the involved child patients must be informed, and should receive all the necessary information in an age-appropriate manner. The fulfilment of this obligation is assisted by computer and smart phone applications, and besides models, and games special training is provided for the medical staff. This communication includes not only providing information on acute patient care and surgical operation, but in case of chronic diseases it should be extended to giving guidance/raise awareness on how a disease-conscious way of living can be built for the given child.

Taking into account the above experiences we sum up the contextual advantages of the innovation hub operating within the hospital:

1. sensitivity to problems
2. quick response
3. local test environment with the potential to provide instant feedback

In order to achieve the above, the full and simultaneous satisfaction of the below framework conditions are essential:

1. R+D+I capacity
2. locally accessible multidisciplinary knowledge-base
3. independent economic background

Superhospitals, planned by the government, would provide good potentials to establish local innovation hubs in Hungary.

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