Lean Innovation Transforming Global Access to Cancer Care

Dr Ilana Fear | Senior Research Fellow
Radiation Physics Laboratory

Conflict of Interest Declaration
Founder of Nano-X Pty Ltd

NB: SAM hints may or may not be provided
With pop-up yellow boxes throughout this talk

Low and middle income countries need an additional 10,000 radiotherapy machines just to meet current (2020) demands.
Lean Innovation

Realization of an effective solution with limited resources.

Outperforms or at least as good as the best alternatives.

Scalable and sustainable.

Myths of lean innovation

Myth: Low cost = Obsolete Technology

Myth: It's only for LMICs

Lean innovation drives the creation of well-designed and high quality products that are scalable and sustainable with limited resources.
Lean Innovation in Radiotherapy?

- 100% increase costs in a decade of radiotherapy
  - Van de Werf, Verstraete, Lievens, 2011, Radiotherapy & Oncology

- Higher treatment not necessarily associated with better patient-related outcomes
  - Boero et al 2015, Radiotherapy & Oncology

Challenges to implementing high-impact technologies include resources in equipment budgets, personnel availability, infrastructure requirements and expedient decision making
Existing ‘Low-Cost’ Technologies

- Cobalt systems with 3D CRT
- Low-cost offerings of standard linacs
- Second hand units

Best in class systems are what is needed and wanted!

Patient positioning in the proton radiotherapy era

Salvatore Deviscendi, Lidia Striga, Marco D'Andrea, Marcellino Benassi, Vincenzo Cimicci and Maurizio Porzio

Abstract
The high relevance to the diffusion of proton therapy facilities is the high cost for gantry installations, and alternative techniques. A solution for fixed beam treatment rooms, where the patient is rotated and placed in space with a robotic arm solution to enable beam incidence in various angles. The technological efforts based on robotic applications made up to now for patient positioning in proton beam facilities are described here, highlighting their limitations and perspectives.

Product Genesis fixed proton, stereotactic brain therapy

Photo courtesy: Brendan Whelan
Do we need to rotate gantries if we can handle complexities in software AND if patients tolerate slow rotation?

• Fixed, vertical, inline linac
• Onboard kV imaging
• Dynamic MLC tracking

Nano-X: fixed beam real-time IGRT

• Compact frame and bunker (about 1/3 size)
• Rotating Couch

Eslick & Keall, 2014, Technol Cancer Res Treat, 2015, 15, 547-72
Feain et al., 2016, under review
Deformation due to rotation 2-3 times that due to respiration.

Counter et al. 2016, under review
CBCT Image Reconstruction Development

<table>
<thead>
<tr>
<th>Ground Truth</th>
<th>Without corrections</th>
<th>With Nano-K correction algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>rotating gantry: 180 projections</td>
<td>rotating rabbit: 300 projections</td>
<td>rotating rabbit: 300 projections</td>
</tr>
</tbody>
</table>

Adapting to the motion
Real time tumour imaging and dynamic MLC tracking

Tumor tracking components

kV imaging during Tx: Find the target
MLC motion during Tx: Hit the target

Courtesy Chun-Chien Shieh

 Courtesy Vincent Callet
Nano-X workflow

CT scan → film → Align Patient → Treat → Repeat daily

Upright Chair Development

Fixed beam linacs utilising patient rotation aim to deliver high-impact radiotherapy with lower overheads, smaller machines and smaller bunker sizes
DO PATIENT’S ACCEPT ROTATION?

Clinical trial:
15/15 cancer patients rotated on Omniax
Found no increase in motion sickness, anxiety or claustrophobia

Conclusion: we have an obligation to innovate
Needs multi-disciplinary approaches between academia, industry, investors, government, hospitals.
Can fixed beam treatments be delivered safely with automated planning, QA and adaptive tumour tracking techniques?

“There’s a way to do it better - find it!”

THOMAS EDISON 1847 - 1941