Development of Automation in Semen Analysis

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Andrology Laboratory – what does it do?

Comprehensive service

- Diagnostic semen analysis (fertility care pathway)
- Post vasectomy testing (effectiveness of surgery)
- Fertility preservation (sperm banking)
  - Patients - chemotherapy, surgery
  - High risk occupation – armed forces, security
  - Donors
- Assisted Conception
  - Artificial insemination (partner, donor)
The problem behind the solution

Semen Analysis - Poorly reproducible/time consuming

NEQAS – National External Quality Assurance Scheme

Sperm Concentration

- Mean 53 million/ml
- Range <20 -> 80 million/ml
- 50% away from target
- Achieve different diagnoses/treatment options???
The problem behind the solution

Sperm Motility

Progression
- Grade a: >25µ/sec
- Grade b: >5µ/sec <25µ/sec
The potential solution

- Recognition of a problem (low risk)
- Consistent training across sectors
  - Pathology and IVF
- Accreditation??
  - Cost effective/proportionate to risk
  - Applicable to IVF industry AND pathology
- Automation
  - Reduction of the ‘human factor’
Automated semen analysis in Nottingham - The Early days

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Multi-parameter Tracking Algorithms

NUH Fertility Unit Reporting database

Applied these algorithms to EQA video
“Sperminator” The Early days
Automation – Sperm Counts

Objective 1. Apply multi-target tracking algorithms to a larger population of sperm from the microscope

- Digital recognition of sperm from video
- Fixed depth chamber 20µm
- Fixed area/volume
- Provides answer in millions/ml

Objective 2.

- Assess sperm swimming speeds from 1 second video D/T

• Length x breadth x depth = vol
Problem 1. Seminal fluid doesn’t always just contain sperm

Eliminate

• Leucocytes
• Germinal cells
• Cell debris
• Epithelia

Use an Editing step
Automation – Count and Motility

- Simultaneous assessment - count, motility, average velocity
- Colour coded sperm tracks - according to motility grade
- Manpower saving – 15 mins per sample (average)
Automation – Quality Assurance

Semen Analysis - More than just numbers

Original – video

Tracked – video
Automation – The benefits

For the patient and the clinic

- **Similar results**
  - Across staff in same centre
  - Between centres (regions, countries)

- **Efficiency, Manpower**
  - Average service 1500 tests pa (10 weeks technician time)

- **Hard copy (images, video)**

- **Clinical value**
  - Natural conception
  - Assisted conception (AI, IVF)
  - Frozen/thawed sperm assessment
Automation – The benefits

For the Trust

- Financial
  - Royalties
  - IP
  - use of staff
  - cost effective and quality semen analysis

- Reputation as an ‘innovator’

- Opens doors for research
  - Testing culture media
  - sperm toxicology
  - cryopreservation
Frustration/Stumbling Blocks

1. IP disputes
   - Lack of clarity in the NHS Trust IP policy (where was the incentive?)
   - Clarity where there is NHS Trust and University overlap
   - Delayed progress and investment
   - SOLVED by personal investment in an IP lawyer

2. Business expertise within the organisation
   - Appropriate expertise and direction (innovation hub)
   - Flexibility with business model
     - VC investment/business angel/sales force
     - Bootstrapping (‘friends, family, fools’) frowned upon
   - R&D provided limited resources (6 months) then pulled out
3. Research Ethics

- Understanding of risk in research
- Brief risk assessment/rapid decision making

4. Time Management

- Running a business alongside day job (NHS, University)
  - Tax, VAT, book-keeping, marketing, selling
  - Development work, R&D investment
Summary

Semen analysis ‘in general’
- Poorly reproducible/time consuming
- Reduced clinical value/variable service quality to users

Automation
- Reduce error between staff/centres/regions/countries
- Reduces uncertainty/Improve clinical value/help research

Development Frustration
- IP policy
- Resources within the organisation for developing an idea
- Appropriate business advice
END