Paperless Transformation and Workflow Optimization: Digital Lab Results, Electronic Medical Orders, and Electronic Signatures

Site: Warszawski Uniwersytet Medyczny (WUM), Warsaw, Poland.

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Life Cycle Assessment Support

Life Cycle Assessments were conducted by Dr James Larkin, Postdoctoral Researcher and Sustainability Officer at Trinity College Dublin.

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Why did you start?

Problem Description

The haemodialysis department relied heavily on paper-based lab result printing and medical orders, leading to excessive paper waste, increased costs, and inefficiencies in doctor-patient interactions. The project aimed to eliminate paper usage for lab results and medical orders and replace it with digital access via tablets.

Specific Aims

Following the **SMART Goals** framework, the project aimed to:

1. **Specific** - Transition from paper-based to electronic systems for lab results and medical orders in the haemodialysis department, ensuring full adoption across all staff members.
2. **Measurable** - Reduce paper printing by at least 90% within 5 months, measured through tracking of paper and toner consumption.
3. **Achievable** - Utilize existing Wi-Fi infrastructure and tablets, ensuring the necessary training is provided to all medical staff.
4. **Relevant** - Improve operational efficiency, reduce environmental impact, and enhance security in medical documentation by integrating digital signatures in Phase Two.
5. **Time-bound** - Complete the transition to electronic lab results and medical orders within 5 months, followed by the implementation of electronic signatures within one year.

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What did you do?

Context

The centre provides dialysis treatment to approximately 90 patients and employs a team of 5 doctors and 12 nurses. Before the intervention, each patient generated an average of 100 printed pages per year.

Additionally, the project extends to the Nephrology Department, which operates with an estimated 1,000 patient-days per month. Each of these patient-days requires multiple medical orders, making a streamlined, paperless process essential for improving efficiency and reducing administrative workload.

Intervention

To guide implementation, a structured action plan was developed, outlining the key steps followed during the project:

Step 1: Preparation and Infrastructure Setup

- Conduct initial assessment of paper usage and workflow inefficiencies.
- Ensure Wi-Fi installation across the nephrology and haemodialysis departments.
- Obtain leadership support and compliance approvals for paperless transition.

Step 2: Implementation of Paperless Lab Results and Medical Orders

- Training sessions for doctors, nurses, and administrative staff on tablet usage.
- Digital transition of lab results and medical orders, eliminating printed documents.
- Real-time support team to assist staff with troubleshooting and technical difficulties.
- Baseline data collection to compare efficiency before and after implementation.

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Step 3: Monitoring and Continuous Improvement

- Establish regular feedback loops through patient and staff surveys.
- Track key performance indicators such as paper reduction rates, staff time saved, and workflow efficiency.
- Adjust implementation strategy based on collected data and feedback.

Phase Two: Introduction of Electronic Signatures

- Evaluate system readiness for integrating electronic signatures.
- Collaborate with IT security teams to ensure compliance with data protection laws.
- Pilot program for electronic signatures with a subset of doctors and nurses.
- Full rollout and monitoring of digital documentation efficiency.

Measures

Patient outcomes:

Patient outcomes were monitored to ensure the intervention did not negatively impact clinical care. This included observation for any delays, errors, or disruptions in access to laboratory results and medical orders, as well as any unintended effects on diagnostic or treatment processes.

Environmental sustainability:

Paper and toner use was measured through purchasing records tracked by the Head of Nurses. Life cycle assessment took into account the carbon emissions associated with the production and use of tablets to compare the impact of the previous paper based system to the new digitalised workflows.

Economic sustainability:

The financial impact of the intervention was assessed by estimating the cost of paper and toner use before and after implementation of the change.

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Costs associated with digital infrastructure (e.g. tablets and Wi-Fi) were not included in this analysis, as these were already in place prior to the intervention.

The cost of staff time spent printing laboratory results was considered, however, this was not quantitatively included in the financial analysis at this time.

Social sustainability:

Social impact was assessed using the KitNewCare modelling framework, including estimates of forced labour medium-risk hours. In addition, staff and patient feedback on ease of use and satisfaction with the new system was collected.

What did you find?

Results

Results are presented for the combined haemodialysis and nephrology activity, with per-patient values normalised to the haemodialysis population for consistency across case studies.

Patient outcomes:

No negative clinical or organisational effects were observed following the transition to electronic documentation. Patients continued to receive results and medical information without delays, and no disruptions in diagnostic or therapeutic processes were reported.

Environmental sustainability:

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Eliminating printed laboratory results (13,500 pages annually) and reducing the number of printed documents requiring signatures (approximately 1,000 pages) reduced total paper use from around 14,500 printed pages per year to approximately 1,450 pages annually. This corresponds to a reduction of approximately 13,000 pages per year. Based on the average yield of high-capacity toner cartridges used in the department's printers (approximately 7,000 pages per cartridge), this corresponds to a reduction of approximately two toner cartridges per year.

Modelled over a one year period, transitioning from a paper-based system to a predominantly digital workflow carbon emissions decreased from approximately 521.70 kg CO_2e to 326.51 kg CO_2e, representing a reduction of around 195.19 kg CO_2e, while water impact reduced by approximately 128.83 m^3.

At patient level, this corresponds to an estimated reduction of approximately 2.17 kg CO_2e and 1.43 m^3 water use impact per haemodialysis patient per year.

Whilst there was a carbon impact associated with the production and electricity use of the tablets, this was accounted for in the analysis and an overall environmental saving was still observed.

Economic sustainability:

The shift to electronic documentation generated direct savings in paper and toner use as well as substantial indirect savings in clinical labour.

The total direct savings from reduced paper and toner purchasing is estimated at 1,430 PLN per year (approximately €338). This includes 531.21 PLN from reduction of paper and 900 PLN saved from two toner cartridges no longer required. When standardized

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across the haemodialysis population (approximately 90 patients), this corresponds to an estimated saving of approximately €3.75 per patient per year.

For centres where digital infrastructure is not already in place, initial investment in tablets may be required. While acquisition costs were not assessed in this study, these represent a one-off expense and would be expected to be offset over time through reduced consumable use and improved staff efficiency, particularly when implemented at scale.

By removing the need to print laboratory results and paper-based orders, the department saved the equivalent of one full working day per month of a specialist or resident. This corresponds to12 working days per year. Even without assigning a specific monetary value, the regained clinical hours represent the most substantial economic impact of the intervention, exceeding material savings and improving the effective capacity of the medical team.

Social sustainability:

Estimated social impact, expressed as forced labour medium-risk hours, decreased from 86.48 hours to 20.81 hours, reflecting a reduction of approximately 65.67 hours. At patient level, this corresponds to an estimated reduction of approximately 0.73 hours of forced labour medium-risk per haemodialysis patient per year.

While the digital system introduces impacts related to electronic device production and energy use, the overall social burden remains substantially lower due to the reduced reliance on paper-based materials.

Informal feedback indicated improved workflow clarity and reduced frustration associated with printer downtime, missing printouts, or manual preparation of paper records. Staff reported that electronic access to lab results and the introduction of electronic signatures streamlined daily routines and reduced administrative burden.

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What does it mean?

Summary

The transition to digital lab results, electronic medical orders, and partial adoption of electronic signatures significantly reduced paper use, increased workflow efficiency, and aligned the department with sustainability goals. These outcomes directly addressed the project's aims of reducing waste, improving staff efficiency, and modernising documentation processes.

Key elements contributing to success included:

- strong leadership support and clear policy direction,
- adequate digital infrastructure (Wi-Fi, tablets, secure EHR access),
- staff willingness to adopt new workflows,
- integration of changes directly into everyday clinical routines.

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