Process Flow for Erythropoiesis Stimulating Agents (ESA) Delivery to Haemodialysis (HD) Patients at Toronto General Hospital
Process Optimization & Impact Analysis of Alternative Dosing Frequencies

Esther Y. Fung[1], Emily Musing[1], Gary Wong[1], Ann Tanghe[2], Katelijne Butaye[2]
[1] Toronto General Hospital, University Health Network, Toronto, Canada [2] hict, Bruges, Belgium

200 Elizabeth Street
Toronto, ON, Canada, M5G 2C4
Tel (416) 340-4800 ext.8442
Fax (416) 340-3685

Background

- Erythropoesis stimulating agents (ESAs) are effective agents for increasing haemoglobin levels in patients with end stage renal disease on haemodialysis (HD).
- Darbepoetin Alfa, a longer-acting ESA, allows Alternative Dosing Frequencies (ADF) in the dialysis population (weekly [QW] or every other week [Q2W] dosing, in stead of three-times-a week [3QW]).
- Delivering ESA therapy to HD patients is complex and requires a significant amount of operational resources.
- There has not been any systematic investigation of ESA delivery in hospitals in Canada, nor an impact assessment for ADF on ESA delivery.

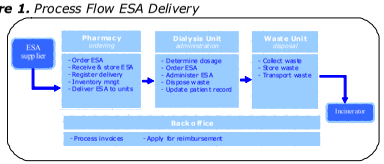
Objectives

- To describe and assess the entire process of ESA delivery to HD patients at Toronto General Hospital (TGH).
- To define process improvements for all departments involved in the process of ESA delivery (only process improvements in pharmacy and back-office are reported in the results).
- To identify the benefits (cost savings and qualitative benefits) of Alternative Dosing Frequencies for ESAs.

Methods

- A conceptual model was developed to characterize base processes related to delivering ESAs in pharmacy, 2 HD units (55 stations), waste unit and back-office (Figure 1).

Figure 1. *Process Flow ESA Delivery*



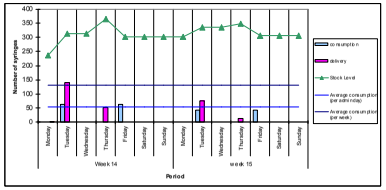
- Observation of the ESA-syringe throughout TGH and structured interviews with staff were used to develop a hospital specific description of ESA delivery at TGH.
- Amount of labour and materials (e.g. tissues) associated with each process was measured and costs were derived from accounting records.
- For the impact assessment a calculation model was setup to determine cost savings of ADF (e.g. switch from 3QW to QW ESA dosing).
- To define process improvements stock levels at pharmacy & HD units, dispensing & purchasing methods, work flows, etc. were analyzed.

Results

Process Improvements in Pharmacy

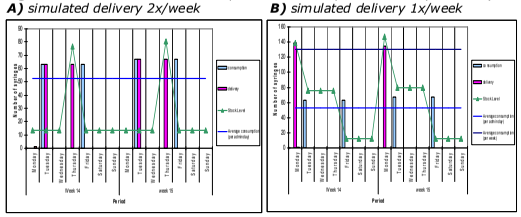
1. Current **frequency** of **checking** fridge & ward stock on HD units (majority of drugs stored in Automated Dispensing Cabinets [ADC]) is twice a week (2x/week).
   - Analyzing ESA dispensing data shows that only 59% of all checks induced an actual delivery.
   - Optimal frequency is 1x/week, which would generate time savings of 80 minutes per week.
2. Current **method** of **dispensing** to units is based on stocking up to defined maximum levels.
   - Suboptimal working method for ESA dispensing due to the predictable nature of ESA consumption (monthly prescription).
   - Results in high stock levels (av. stock level 312 syringes) and inventory carrying costs (Figure 2).

Figure 2. *ESA stock level, consumption and delivery for 2 weeks (1 HD unit)*



   - Optimal method of dispensing ESA is based on prescriptions, with a buffer stock of 10% of average ESA consumption. Reduces average stock level to 22 syringes in case of deliveries 2x/week, respectively 59 syringes in case of weekly deliveries (Figure 3).

Figure 3. *ESA stock level, consumption and delivery for 2 weeks (1 HD unit):*
A) *simulated delivery 2x/week* ***B)*** *simulated delivery 1x/week*

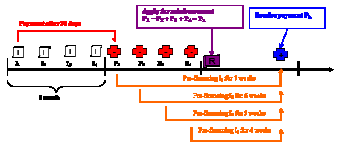


3. Current **purchasing method** to suppliers is based on manual stock checks 3x/week (comparing current with min/max stock levels).
   - Manual checks are time consuming (210 minutes/week).
   - 3 checks per week are redundant, since the objective is to place 1 order a week for most drugs.
   - Implementing Kanban principle generates time savings: no manual stock checks and integration of stock checks in daily dispensing (orders are identified during picking).
   - Implementing full automated order system could imply av. 12.5 minutes per week spent on ordering (currently >260min/week).
   - Both methods support JIT ordering and smaller stock levels .
4. The current **min/max levels** are static - resulting in high stock levels – and need to be revised periodically based on historic usage.

Process Improvements in Back-Office

1. Current **method** for applying for ESA reimbursement is time consuming (e.g. manually pulling invoices out archives) and suboptimal (e.g. invoices also stored in Pharmacy for no purpose).
   - Reorganizing this process (ESA invoices are sent from pharmacy to Acc. Receivable 1x/month, Acc. Payable sends overview of paid ESA invoices 1x/month) generates time savings of 77 minutes per month.
2. The **Ministry of Health** Ontario reimburses ESA based on invoices (purchased ESA), without a link with ESA consumption or patient.
   - In case MOH would implement the more cost-effective European practices – reimbursement based on administered ESA– better registration of ESA administration needs to be setup.
3. The **cost of pre-financing** ESA invoices is $\mathbf{a[(1+i)^n - 1]}$, with **a** = invoice amount and **n** = # days between payment and reimbursement.
   - In case of 4 invoices of $ 100.00 (daily interest rate **i** 0,01%): current cost of pre-financing is $ 1.54 (Figure 4).

Figure 4. *Current cost of pre-financing ESA*



   - Applying for reimbursement every 2 weeks: $ 1.26.
   - Change payment term to '30 days end of month': $ 1.12.
   - Paying invoices after reimbursement would generate a profit.

Impact assessment of ADF on ESA delivery

- In the current situation 92% patients were on a QW ESA dosing regime, 7% on a Q2W and 1% on a 3QW dosing regime (n= 219).
- The majority of costs associated with ESA delivery was concentrated in the dialysis unit, in particular labour costs (Table 1).

Table 1. *Annual costs associated with ESA delivery (current & TIW dosing regimes), incl. cost reduction EPO TIW to current dosing regime*

Department	Estimated Annual Costs				Estimated Annual Cost Reduction	
	EPO 3QW situation		Current situation		EPO 3QW → Current situation	
	Labor	Material	Labor	Material	Labor	Material
Pharmacy	$858.24	-	$2,649.07	-	-$1,790.83	-
Dialysis unit	$161,721.22	$36,524.24	$26,969.96	$2,142.58	$134,751.26	$34,381.67
Waste unit	$0.00	$163.98	$0.00	$56.22	$0.00	$107.76
Back-office	$275.52	-	$640.64	-	-$365.13	-
Total	$162,854.98	$36,688.22	$30,259.68	$2,198.80	$132,595.30	$34,489.43

- Switching from 3QW to current dosing regime resulted in a 83% labour and material cost reduction in TGH ($ 167,084.73 annual).
- Largest reductions were found in the dialysis units due to the time required to prepare and administer ESA injections to patients.
- Small cost increase was observed in Pharmacy due to extra time for stock checks in pharmacy and units (9 dosages >< 1 multidose).
- Qualitative benefits of ADF are risk reductions (infections, needle accidents, dosage errors), higher patient interaction and quality of care.

Conclusion

• The study demonstrated that using a systematic assessment can result in efficiencies in pharmacy work flow, inventory levels & control, back-office processes, etc.

• The efficiency and automation of TGH pharmacy practices is higher than the average hospital, due to their broad implementation of ADC's throughout the hospital, further automation of inventory system, storage solutions, vision on future pharmacy practices, etc.

• TGH Pharmacy continues to improve pharmacy practices, e.g. by implementing process optimizations defined in this study.

• The study also demonstrates the annual cost reductions that were achieved at TGH due to implementing Alternative Dosing Frequencies (in 2005 they switched from a three-times-a-week to their current dosing regime).

Disclosure: Authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation:

Esther Y. Fung, Emily Musing, Gary Wong: None

Ann Tanghe, Katelijne Butaye: The study was performed by hict and sponsored by Amgen Canada.