TRANSFORMING EVIDENCE TO PRACTICE; - KNOWING THE CONSEQUENCES BEFORE IMPLEMENTATION.

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OBJECTIVES

Barbados, like the rest of the Caribbean, has seen a rising burden of end-stage renal failure (ESRF). The Health Care System in Barbados is socialized and treatment is provided free for all citizens. Hence the burden of renal replacement therapy (RRT) on society is significant.

The aim of this study was to estimate the required hemodialysis (HD) capacity if new evidence based guidelines for initiating HD (KDOQI) were to be implemented (= the intervention).

BACKGROUND

Discrete Event Simulation (DES) simulates each individual patient in a healthcare system. Even though the progression of chronic renal failure to end-stage renal failure (ESRF) is continuous the patients' contacts with the healthcare system take place as discrete events (visit to specialist, admission to hospital etc.). The treatment can be modeled as being non-continuous. Especially renal replacement therapy (RRT) in itself, where each dialysis session is a discrete event that repeats itself normally 3 times a week.

Discrete event simulating (DES) has previously been used as a tool to estimate the future need of resources for patients with end stage renal disease (=ESRD)[1;2]. We have previously shown that DES can be a useful tool in helping accessing the optimal amount of resources needed when 'testing' (=simulating) the effect of planned interventions[3;4].

The core of our simulation model is the universal RRT model as originally presented by Davies & Roderick(1). It basically deals with the flow of patients within what we could call the 'chronic RRT-core'. It admits patients with ESRD onto RRT based on known gross incidences of patients in need of RRT. The model then simulates interaction between the three available modalities (PD, HD, TX).

For socio-economical reasons only HD is of relevance for Barbados.

There is by nature only one-way out of the model, namely death. Hence mortality within each of the modalities determines a patient's exit.

References and info

1) Davies H, Davies R. A simulation model for planning services for renal patients in Europe. J Oper Res Soc 1987; 38(8):693-700.

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3) Lassen Nielsen A, Hilwig H, Kissoon N, Teelucksingh S. Discrete event simulation as a tool in optimization of a professional complex adaptive system. Stud Health Technol Inform 2008; 136:247-252.

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5) Slinin Y, Guo H, Gilbertson DT, Mau LW, Ensrud K, Rector T et al. Meeting KDOQI guideline goals at hemodialysis initiation and survival during the first year. Clin J Am Soc Nephrol 2010; 5 (9):1574-1581.

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THE INTERVENTION

Meeting a greater number of KDOQI guideline goals at dialysis initiation is independently associated with survival during the first year of dialysis treatment. These goals are related to vascular access, anemia management, and nutritional status. Slinin et al.[5] in their study used three primary predictor variables as indicators for these goals:

1) *The use of arteriovenous fistula or graft at initiation as mode of dialysis access;*
2) *Hemoglobin level > or = 11 g/dl; and*
3) *Good nutritional status assessed as s-albumin.*

They found mortality hazard ratios (95% confidence intervals) were 0.81 (0.80 to 0.83) for patients who met one of the above criteria, 0.53 (0.51 to 0.56) for patients who met two, and 0.34 (0.30 to 0.39) for patients who met three guideline goals, compared with patients who met none.

Model group	No of criteria met [from Slinin et al's[5]]	Mortality hazard ratios (95% confidence intervals)	Percent of new patient ($N_{yearly} = 70$) Pre-intervention	Post-intervention
Timely referrals	3	0.34 (0.30 to 0.39)	5 %	60 %
Known not ready	2	0.53 (0.51 to 0.56)	10 %	25 %
Late referrals	1	0.81 (0.80 to 0.83)	25 %	10 %
Very late referrals	0	1	60 %	5 %

Table: Attributes assigned to the 4 patient groups entering the DES model.

THE DISCRETE EVENT SIMULATION MODEL

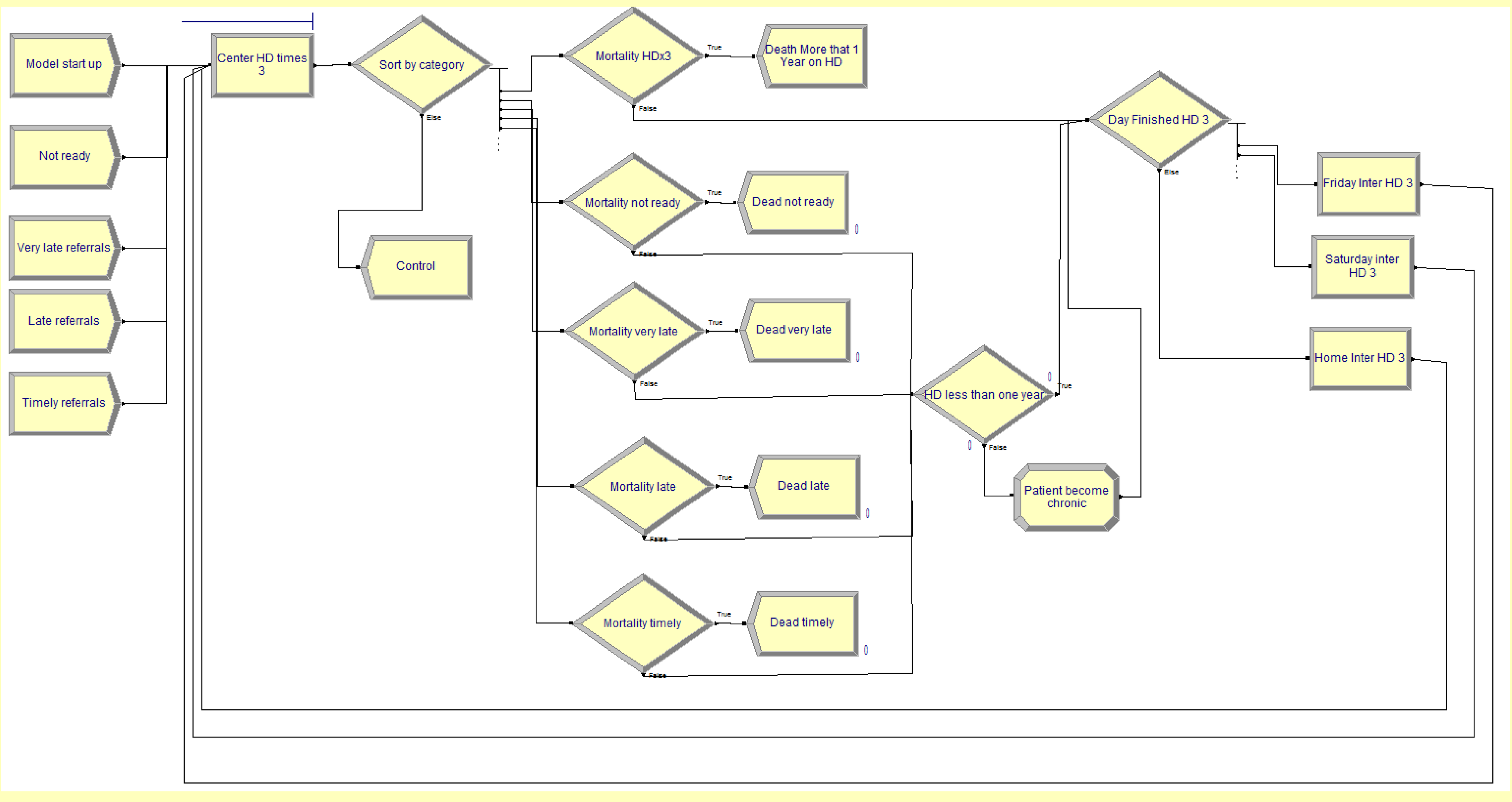

Fig 1: The hemodialysis flowchart (ARENA® simulation software (V 13.00 Rockwell Automation Inc USA)

RESULTS

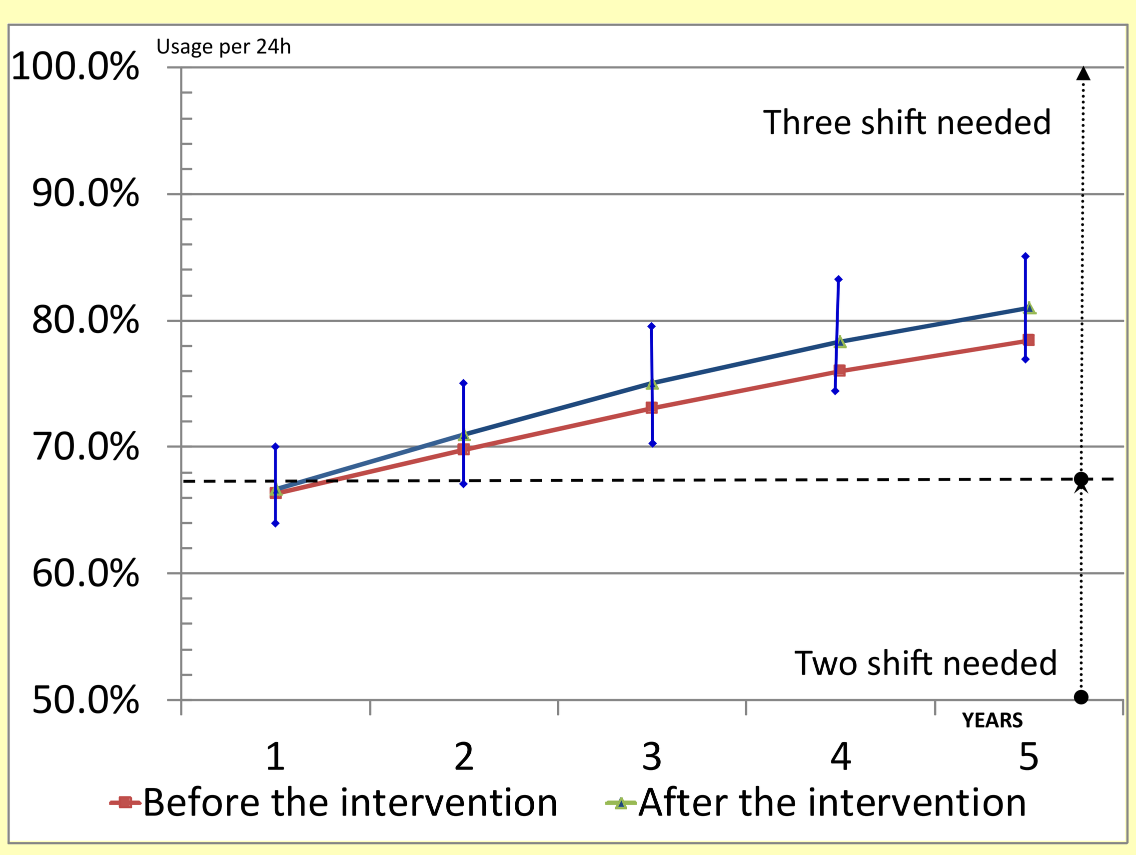

Fig 2: Average resource usage (% of 24h) with and without implementation of new guidelines

The simulation ran 500 iterations. The utility of the HD machines is at present 64%. In year one the system needs to work at its present maximum allocative efficiency (Usage 66.5% = two full shifts). It is very unlikely that the present capacity is sufficient after year one. (The minimum average usage is 66.8%, average is 71.0% and maximum usage is 75.2%). After the intervention 10 additional patients will yearly survive the first year. That is 5% increase of the present RRT population of 200 patients. But it is 19% (= 10/ 52) yearly increase in patient who survives the first year. Five year after the intervention on average 38 more patients will have survived the first year. With an average life expectancy of 10 years the intervention therefore is predicted to gain 380 patients' years.

Conclusion

We argue that DES is one of the tools that can be applied to investigate/assess the organizational consequence of evidence based recommended changes in treatment.