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Research Letter

A new model to prioritize waiting lists for elective surgery under the COVID-19 pandemic pressure

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Dear Editor

The reduced capacity for routine surgery during the COVID-19 outbreak triggers severe consequences on waiting lists, determining their impressive expansion with management costs[1]. The problem immediately burdens patients with urgent issues and cancer, whose number of avoidable deaths indirectly due to COVID-19 is estimated close to that of SARS-Cov-2[2]. Planning and scheduling of surgery becomes complex on clinical, ethical and technical grounds. Although several authors and professional associations have proposed clinical prioritization through urgency classifications[3], pathways and data system models, specific tools are necessary actually to run priority-based scheduling sustainably, in a usable and scalable fashion[4]. The Surgical Waiting List InfoSystem (SWALIS) has been proposed previously[5] with such aims. Here we report on the pilot adoption of a new (SWALIS-2020) model to prioritize elective surgery during the COVID-19 pandemic (https://www.isrctn.com/ISRCTN11384058).

This was a 6-week (March to May 2020) feasibility pilot cohort study testing a bespoke software-aided, interhospital, centralized, multidisciplinary pathway serving all major elective urgent surgery from specialties in the Metropolitan area of Genoa with 840 000 inhabitants. The pathway is based on centralized and multidisciplinary team triage of referrals, prioritized further by the SWALIS-2020 model (*Fig. 1*):

- Urgency categorization over maximum waiting time, defined by implicit clinical criteria: A1, 15 days (certain rapid disease progression); A2, 21 days (probable progression); A3, 30 days (potential progression); B, 60 days (no progression but severe symptoms); C, 180 days (moderate symptoms); D, 360 days (mild symptoms)
- Waiting list prioritization, real-time ordered by the SWALIS-2020 score (percentage of waited-against-maximum time) computed by a proportional, time-based, linear cumulative method (PAT-2020) (*Figs 1 and 2*)
- Theatre capacity planning, based on prioritized demand
- Flexible, service-based, priority-based scheduling

We monitored the safety and efficacy of the pathway by adverse events, drop-offs and completions, auditing its performance weekly by the SWALIS cross-sectional and retrospective waiting list indexes (dimensions and centrality), and by the SWALIS-2020 score at admission. Applicability was tested over pathway deviation events, number of postponements (before admission) and cancellations (on the day). Data were managed by live-running interface, code-developed on MS VBA™ (Microsoft, Redmond, WA, USA). Statistical analysis included use of Spearman's rank test for correlation, the Mann–Whitney *U* test or one-way ANOVA with the Kruskal–Wallis rank sum test, Dwass–Steel–Critchlow–Fligner or Loess tests, performed with R software version 3.6.3 (The R Foundation for Statistical Computing, Vienna, Austria).

After a 2-week feasibility phase (55 patients), 240 referrals were prioritized over 4 weeks with no major pathway-related critical events (M : F ratio 73 : 167; mean(s.d.) age 68.7(14.0) years). Waiting lists were monitored, and theatres fully allocated based on prioritized demand for the services. The mean(s.d.) SWALIS-2020 score at admission was 88.7(45.2) in week 1, then persistently over 100 per cent (efficiency), over a controlled variation (equity), with a difference between A3 compared with A1 (153.29(103.52) *versus* 97.24(107.93) respectively; $P < 0.001$), and A3 *versus* A2 (153.29(103.52) *versus* 88.05(77.51); $P < 0.001$). A total of 222 patients eventually had surgery, with no pathway-related complications or delayed/failed discharges.

Although different geographical areas are facing the COVID-19 outbreak asynchronously, the waiting list backlog will continue for months, burdening hundreds of thousands of patients, and prioritization will long remain a major issue. The SWALIS-2020 model is designed for the broadest hospital acute care environment. It has smoothly selected and prioritized the very few patients with the greatest need, scheduling their access even with approximately 30 per cent capacity modifications weekly, managing active and backlog waiting lists in the same process. The heterogeneity of established practices in different services

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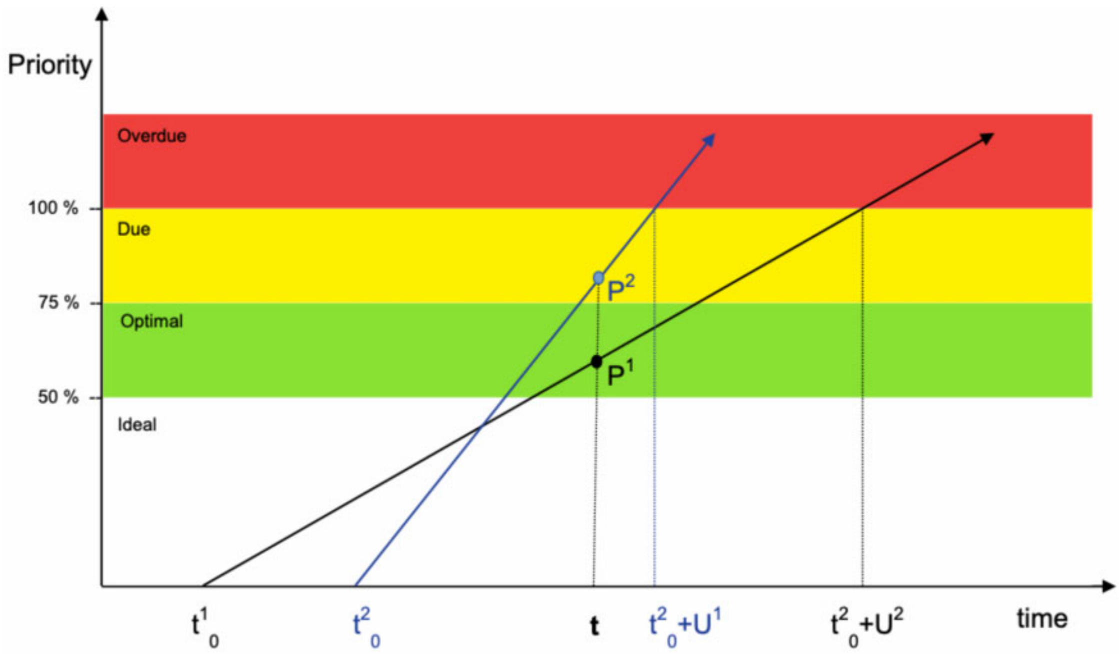

Fig. 1 The linear method of prioritization method (Patent (PAT)-2007, SWALIS-2009)

The referring surgeon declares patient's clock start date (t_0) and clinical urgency category (U) based on the likelihood of quick deterioration to the point where it may become an emergency, or on the level of symptoms, dysfunction or disability. Clinical urgency (U) is then associated with maximum waiting time from t_0. In the SWALIS-2020 model, U can assume six different values in days: $U = \{A1=15, A2=21, A3=30, B=60, C=180, D=360\}$. Given U and t_0, and defining $P(t_0 + U) = 1$, the priority (P) at the time of prioritization $P(t)$ is defined as follows:

$$\mathbf{P}(\mathbf{t}) = \frac{1}{U}(\mathbf{t} - \mathbf{t}_0)$$

$t^1{}_0$ = patient 1 clock start date; U_1 = patient 1 urgency category maximum allowed waiting time; $t^2{}_0$ = patient 2 clock start date; U_2 = patient 2 urgency category maximum allowed waiting time; P^1 = patient 1 priority at time of prioritization (t); P^2 = patient 2 priority at time of prioritization (t). See *Fig. 2* legend for explanation of colour coding.

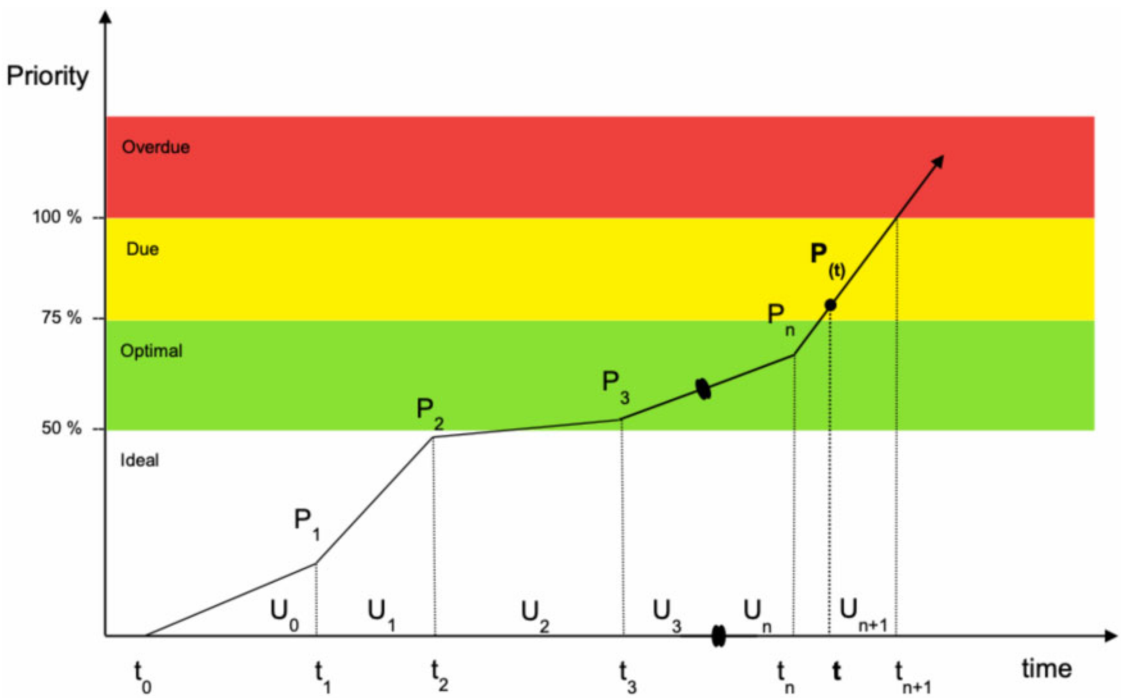

Fig. 2 The cumulative linear method of prioritization (PAT-2020, SWALIS-2020)

Clinical conditions can change during the waiting time (t_0, t_1, t_2, … t_n), affecting the patient's urgency (U_0, U_1, U_2, …U_n). Priority can be calculated as summation, based on urgency variations:

$$\mathbf{P}(\mathbf{t}) = \frac{1}{\mathbf{U}_0}(\mathbf{t}_1 - \mathbf{t}_0) + \frac{1}{\mathbf{U}_1}(\mathbf{t}_2 - \mathbf{t}_1) + \frac{1}{\mathbf{U}_2}(\mathbf{t}_2 - \mathbf{t}_1) + \ldots\ldots + \frac{1}{\mathbf{U}_n}(\mathbf{t} - \mathbf{t}_n)$$

$$\mathbf{P}(\mathbf{t}) = \frac{1}{\mathbf{U}_n}(\mathbf{t} - \mathbf{t}_n) + \sum_{1}^{n} \frac{1}{\mathbf{U}_{n-1}}(\mathbf{t}_n - \mathbf{t}_{n-1})$$

t_0 = start waiting time; U_0 = urgency for patient at starting time t_0; t_n = updated urgency time; U_n = updated urgency for patient; t = time of prioritization. The SWALIS-2020 prioritization method assumes four priority score stages: 'ideal' (0–50 per cent), colour code white; 'optimal' (51–75 per cent), colour code green; 'due' (76–100 per cent), colour code yellow; 'overdue' (more than 100 per cent), colour code red.

represents a challenge for waiting list pooling. However, the SWALIS-2020 model has passed the test, allowing effectiveness, efficiency and equity. These results encourage its wider adoption to prioritize surgery during the COVID-19 pandemic. We are looking for collaboration for further multicentre research.

Collaborators

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