Waiting for coronary revascularization in Toronto: 2 years' experience with a regional referral office

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Objectives: To determine the frequency of major adverse events among patients awaiting coronary revascularization; to assess the match between referring physicians' estimates of urgency, a computer-generated multifactorial urgency rating score and actual waiting times; to determine the changes in waiting times as capacity for bypass surgery increased; and to evaluate the influence of choice of procedure or operator on waiting times.
Design: Consecutive case series.
Setting: Greater Toronto region.
Subjects: All 571 patients referred to an organized referral office by cardiologists at hospitals without on-site revascularization facilities between Jan. 3, 1989, and June 30, 1991.
Main outcome measures: Preoperative fatal or nonfatal myocardial infarction; proportions of patients waiting longer than the maximum period recommended for their urgency rating; mean waiting times for various subgroups; and correlations among referring physicians' urgency ratings, computer-generated multifactorial urgency scores and waiting times.
Results: Of the 496 patients accepted for a procedure 5 had fatal cardiac events and 3 nonfatal myocardial infarction. Events occurred three times more often in patients with left main-stem disease than in those in other anatomic categories (relative risk [RR] 3.05, 95% confidence interval [CI] 1.48 to 6.27, $p = 0.03$). Both the computer-generated scores and the referring physicians' scores were correlated with the actual waiting time ($r = 0.46$ and 0.57 respectively). Waiting times and the proportion of patients with excessive waiting times fell during the study period ($p < 0.0001$). However, urgent cases were much less likely to be done "on time" than those with a recommended waiting time of more than 2 weeks (RR 0.16, 95% CI 0.11 to 0.25, $p < 0.0001$). The mean wait for coronary artery bypass grafting (CABG) was 22.73 days if the referral office was allowed to find a surgeon or interventional cardiologist and 35.31 days if one was requested ($p = 0.002$ after adjustment for urgency scores).
Conclusions: Death of a patient on the waiting list is uncommon in an organized referral system. Patients with left main-stem disease are at higher risk of death than those in other anatomic categories. There were significant correlations between referring physicians' ratings of urgency, multifactorial urgency scores and actual waiting times. Expansion of capacity for CABG led to shorter waiting times, but patients with unstable symptoms continued to wait longer than recommended. Requests for a specific surgeon caused significantly longer delays.

Objectifs : Déterminer la fréquence des principales complications chez les patients qui attendent une revascularisation coronaire; évaluer la concordance entre les estimations de l'urgence par les médecins traitants, une échelle de classement de l'urgence multifactorielle établie par ordinateur et les périodes d'attente réelles; déterminer les variations des périodes

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d'attente à mesure qu'augmente la capacité chirurgicale en pontages; et évaluer l'influence du choix de l'intervention ou du chirurgien sur les périodes d'attente.
Conception : Série de cas consécutifs.
Contexte : Région métropolitaine de Toronto.
Sujets : La totalité des 571 patients dirigés vers un bureau professionnel d'aiguillage par des cardiologues d'hôpitaux sans installation de revascularisation sur place, entre le 3 janvier 1989 et le 30 juin 1991.
Principales mesures des résultats : Infarctus du myocarde préopératoire mortel ou non mortel; proportions des patients qui attendent plus longtemps que la période maximale recommandée en fonction de leur classe d'urgence; périodes d'attente moyennes pour les divers sous-groupes; et corrélations entre les classes d'urgence estimées par les médecins traitants, les cotes d'urgence multifactorielles établies par ordinateur et les périodes d'attente.
Résultats : Des 496 patients acceptés pour une intervention, 5 ont subi un infarctus du myocarde mortel et 3, un infarctus non mortel. Des complications sont survenues trois fois plus souvent chez les patients ayant une atteinte de la souche principale gauche que chez ceux qui font partie d'autres catégories anatomiques (risque relatif [RR] de 3,05, intervalle de confiance [IC] à 95 % de 1,48 à 6,27, $p = 0,03$). Les cotes établies par ordinateur et les cotes estimées par les médecins traitants étaient en corrélation avec la période d'attente réelle ($r =$ 0,46 et 0,57 respectivement). Les périodes d'attente et la proportion des patients dont les périodes d'attente étaient excessives ont diminué pendant la période étudiée ($p < 0,0001$). Cependant, les cas urgents avaient beaucoup moins de chances d'être traités «à temps» que ceux où la période d'attente recommandée était de plus de 2 semaines (RR 0,16, IC à 95 % de 0,11 à 0,25, $p < 0,0001$). L'attente moyenne pour le pontage aortocoronarien (PAC) était de 22,73 jours lorsqu'on a permis au bureau d'aiguillage de trouver un chirurgien ou un cardiologue d'intervention et de 35,31 jours lorsqu'on en a demandé un en particulier ($p = 0,002$ après l'ajustement selon les cotes d'urgence).
Conclusions : Le décès d'un patient inscrit à une liste d'attente est rare dans un réseau professionnel d'aiguillage. Le risque de décès est plus élevé chez les patients ayant une atteinte de la souche principale gauche que chez les patients qui font partie d'autres catégories anatomiques. Il y a des corrélations significatives entre les classes d'urgence estimées par les médecins traitants, les cotes d'urgence multifactorielles et les périodes d'attente réelles. L'accroissement de la capacité en PAC a entraîné des périodes d'attente abrégées, mais les patients dont les symptômes sont instables ont continué d'attendre plus longtemps qu'on l'a recommandé. Lorsqu'on a demandé un chirurgien en particulier, l'attente a été beaucoup plus longue.

In January 1990, 4495 patients were booked for open heart surgery in Canada, the average expected delay being 22.6 weeks for elective cases.[1] In the United States these waiting times, particularly for coronary revascularization, have been used to argue against state-funded and state-administered health care systems,[2-4] sparking commentary by then President George Bush.[5]

In Ontario waiting lists for coronary artery bypass grafting (CABG) were longest between 1987 and 1989, but the situation has since improved because of increased surgical capacity.[1] The crisis was thought to be especially acute in Metropolitan Toronto because of highly publicized deaths of patients on surgical waiting lists and a cabinet-appointed inquiry into waiting-list management practices at St. Michael's Hospital.[1,6] The inquiry led to the recommendation that queue management principles be adopted based on a demonstration project — the Metropolitan Toronto Cardiovascular Triage and Registry Program — established in 1988. Patient referrals for coronary revascularization were accepted into the program from Jan. 3, 1989. In April 1991 the introduction of a provincial network for managing cardiac surgical referrals supplanted the program's function for coronary surgery, but referrals for percutaneous transluminal coronary angioplasty (PTCA) continued.

The program's main objective was to simplify the mechanics of referring patients for revascularization. The service was provided as an alternative to traditional direct referral patterns, and its use was entirely at the discretion of referring cardiologists. A number of research objectives were also built into this demonstration project, in part to determine the program's feasibility.

In analysing the program we had four main goals: (a) to determine the frequency of major adverse events among patients awaiting either CABG or PTCA, (b) to assess the match between referring physicians' informal estimates of urgency and a formal multifactorial urgency rating system, (c) to assess the relation of patients' waiting times to their corresponding informal and formal urgency ratings, with particular reference to changes over time, and (d) to evaluate the influence of choice of procedure or operator on waiting times.

Methods

Urgency rating

The urgency rating score (URS) was developed by

a panel of cardiologists and cardiac surgeons.[7,8] In brief, the panel agreed on clinical factors affecting risk of delay, which were then combined into 438 hypothetical cases. Each panellist rated the cases on a scale with seven time-frames representing the maximum acceptable delay before revascularization (Table 1).

To create a continuous gradient of urgency for waiting-list management a regression-based model was created wherein weights for each clinical factor could be combined to generate urgency scores.[7] The URS and times were then related within each time-frame: for example, a score of 4.5 corresponds to 4 weeks, half way between 4.0 (2 weeks) and 5.0 (6 weeks).

Three clinical factors constitute about 90% of a URS: symptom status, coronary anatomy and ischemic jeopardy as determined by prereferral noninvasive tests. Symptom status is graded according to an adaptation of the Canadian Cardiovascular Society (CCS) classification system.[9] The adaptation sets out two levels of stable angina (CCS classes I and II combined, and CCS class III) and three levels of unstable angina (class IV-A [unstable symptoms largely resolve with intensified medical therapy], class IV-B [symptoms only partly resolve but intravenous therapy is no longer needed] and class IV-C [patients must remain on parenteral therapy in a monitored unit]).[8,9]

Anatomy was classified according to native disease and, for reoperations, combinations of native and graft disease. Angiographic stenosis was defined visually as luminal occlusion of at least 50% for left main-stem disease and at least 70% for disease in other vessels. Five anatomic categories were defined based primarily on data from randomized trials:[10] left main-stem stenosis, with or without other disease; three-vessel disease without proximal left anterior descending arterial (PLAD) involvement; two- or three-vessel disease with PLAD stenosis or severe two-vessel disease (i.e., more than 90% stenosis in both the right coronary artery and the circumflex artery); one-vessel PLAD disease; and one- or two-vessel disease without PLAD or equivalent stenosis.

Table 1: Urgency rating scale used by referring cardiologists to assess patients' needs for revascularization*

Scale	Description	Waiting time
1	Emergency	None
2	Extremely urgent	< 24 h
3	Urgent	24–72 h
4	Semi-urgent	72 h–14 d†
5	Short-listed	2–6 wk
6	Delayed	6 wk–3 mo
7	Markedly delayed	3–6 mo

*Adapted from Naylor et al.[7] Each level represents the period within which revascularization is expected to be performed; the upper time limit for each level represents the maximum acceptable waiting period for patients assigned that urgency score.
†During same admission.

Ischemic jeopardy was defined with noninvasive tests such as exercise electrocardiography and thallium scintigraphy. Results were dichotomized to perceived high risk (e.g., unequivocal ST-segment changes before 3 minutes on a standard exercise test) and low risk.[7] The criteria were chosen to help identify patients at increased risk of ischemic events and to corroborate angiographic findings suggesting extensive myocardial jeopardy. For obvious reasons the results are not used in urgency ratings of very unstable patients (e.g., angina classes IV-B and IV-C).

Patient triage and data collection

The triage system was accessed through a single telephone number, the calls being answered during weekday working hours by nurse coordinators with previous experience in acute coronary care. The coordinator, using on-call schedules of cardiac surgeons and interventional cardiologists, identified and notified a suitable and willing surgeon or interventional cardiologist, who was then asked to communicate directly with the referring physician within 24 hours, or less for urgent cases. Subsequent patient management and its timing were negotiated by the referring physician and the accepting physician or surgeon. The referring physician was permitted to express a preference for a given institution, surgeon or interventional cardiologist.

At the time of referral the attending physician was asked to provide relevant demographic, clinical and angiographic data, and to estimate the relative urgency of the patient's condition according to the descriptors and time-frames set out in Table 1. Each patient therefore had two urgency ratings: (a) the referring doctors' impression, as a whole number between 1 and 7 (the subjective score) and (b) the URS, calculated automatically to two decimal places by the triage system computer. Clinical data and the two scores were relayed to the accepting surgeon or interventional cardiologist.

Follow-up information was collected for each patient until the proposed procedure was performed, a decision was reached to treat the patient medically, the patient was referred to another centre or the patient died. Waiting time, in days, was the time elapsed between initial referral to the triage system and performance of either CABG or PTCA. All data were entered into a custom-designed database with automated range and logic checks as well as regular manual checks of data completeness and quality.

Statistical analysis

Continuous variables are described as the mean (and standard deviation [SD]); 95% confidence intervals (CIs) are also reported in some instances. Comparison of means was by unpaired *t*-test or by analysis of variance and covariance. Categoric data were analysed by χ^2

analysis or, for cells with low counts, Fisher's exact test. Pearson's product-moment correlation coefficient was used to relate continuous variables and Spearman's rank correlation coefficient to relate continuous to ordinal variables.

Results

Patient characteristics

Between Jan. 3, 1989, and June 30, 1991, 571 patients with a mean age of 60.11 (SD 9.80) years were referred by 95 cardiologists for revascularization. The propensity to refer varied, 13 cardiologists generating 59.3% of all referrals. CABG was requested for 421 (73.7%) of the patients and PTCA for 150 (26.3%).

Of the 317 patients for whom noninvasive test data could potentially affect urgency scores (angina classes I through IV-A) 145 (45.7%) had highly positive or high-risk results, 62 (19.6%) had average or low-risk results, and 110 (34.7%) had no available test data, primarily because these tests had not been performed recently (e.g., 61 of the patients with missing data had recent unstable angina and were in class IV-A).

Multiple drug therapy was common: 91% of the patients were given at least two classes of drugs from among ß-blockers, calcium channel blockers and nitrates; 51% were given three classes of drugs. Additional baseline characteristics of the referred patient population are shown in Table 2.

Disposition of referrals

The surgeon or interventional cardiologist independently appraised the appropriateness of the route of revascularization suggested by the referring physician. Of the 421 patients referred for CABG 360 (85.5%) underwent the procedure, 40 (9.5%) were treated medically, 15 (3.6%) underwent PTCA, 4 (1.0%) died before CABG could be performed, and 2 (0.5%) were lost to follow-up. Of the 150 patients referred for PTCA 101 (67.3%) underwent PTCA, 35 (23.3%) were treated medically, 13 (8.7%) underwent CABG, and 1 (0.7%) died before the procedure.

Preoperative myocardial infarction

Of the 496 patients accepted for revascularization 8 (1.6%) had preoperative myocardial infarction, which led to death in 5 (1.0%). Events were significantly more frequent among those with left main-stem stenosis than among those in the other anatomic categories (4/84 v. 4/412; $2p = 0.031$, relative risk [RR] 3.05, 95% CI 1.48 to 6.27). None of the eight patients had either one-vessel or limited two-vessel disease; six had persistent symptoms of unstable angina despite intensified medical therapy before a fatal or nonfatal infarct (6/225 v. 2/271; $2p = 0.15$, RR 3.61, 95% CI 0.74 to 17.73).

Waiting times and urgency ratings

The mean URS for patients undergoing CABG (4.66 [SD 0.06]) was similar to that for patients undergoing PTCA (4.70 [SD 0.12]), but the mean waiting times differed significantly (24.99 [SD 1.34] days and 18.43 [SD 2.35] days respectively, $p = 0.02$). The URS and waiting times also differed significantly depending on the patients' location (intensive or cardiac care unit, hospital ward or home) at the time of referral ($p < 0.001$).

Proportionately more patients in the more urgent categories than in the less urgent categories had waiting times in excess of the maximum acceptable, as defined by the expert panel.[7,8] For example, 19 of the 157 patients with a rounded URS between 1 and 4 underwent the procedure "on time" or "early," as compared with 246 of the 332 patients with a rounded score between 5 and 7 (RR 0.16, 95% CI 0.11 to 0.25; $p < 0.0001$).

The URS was clearly correlated with the subjective score of the referring physician ($r = 0.60$). Also, there was an overall correlation between the waiting time and both the subjective ($r = 0.57$) and computer-generated ($r = 0.46$) assessments of urgency. However, substantial mismatching was evident (Fig. 1).

Changes in waiting times

Cases referred within each quarter of the study period were analysed according to waiting times. (The last quarter was set aside as anomalous, given the reduction in CABG referrals.) After controlling for urgency scores,

Table 2: Clinical characteristics of patients at the time of referral for revascularization

Characteristic	No. (and %) of patients (n = 571)
Female	131 (22.9)
Myocardial infarction in the preceding month	165 (28.9)
Inpatient	330 (57.8)
Previous coronary artery bypass grafting (CABG)	25 (4.4)
Previous percutaneous transluminal coronary angioplasty	13 (2.3)
Unstable angina*	
Class IV-A	138 (24.2)
Class IV-B	190 (33.3)
Class IV-C	64 (11.2)
Reported anatomic category	
Left main-stem disease	90 (15.8)
Three-vessel or severe two-vessel disease	301 (52.7)
One-vessel or limited two-vessel disease	180 (31.5)

*Classification adapted from Canadian Cardiovascular Society system.[9]

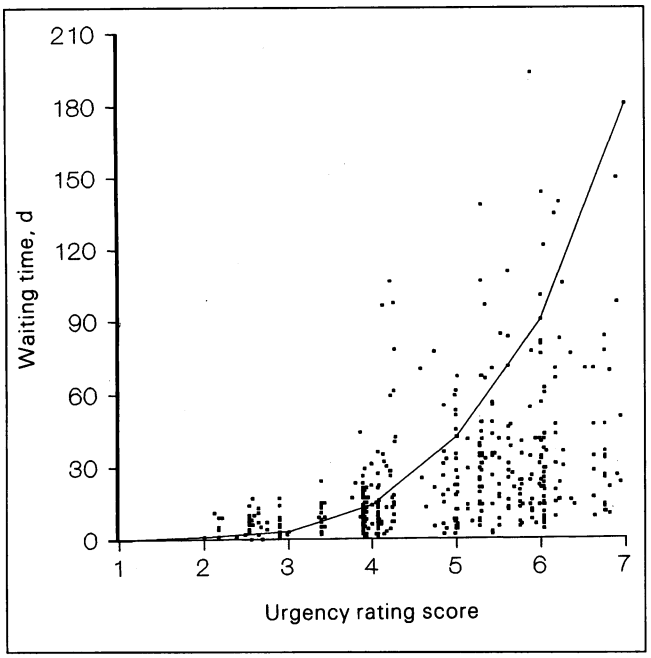

Fig. 1: Waiting time to revascularization according to urgency rating score (URS) for 496 patients undergoing either coronary artery bypass grafting (CABG) or percutaneous transluminal coronary angioplasty (PTCA). The curve represents the maximum waiting time corresponding to the URS; therefore, all points above the curve represent "excess" delays, according to criteria of an expert panel.[7,8] The line has different slopes for the interpolated maximum waiting time in days between urgency score integers. For example, a score of 3 corresponds to a maximum waiting time of 3 days, whereas a score of 4 signifies a maximum wait of 14 days.

we found a significant decrease in the average waiting times for CABG and PTCA ($p < 0.0001$). Quarterly matches between the URS-related maximum waiting time and actual waiting times are shown in Table 3. The decrease in mean waiting times led to a drop in the ratio of cases exceeding the maximum waiting time to those completed with an acceptable delay. However, as reflected in the r values, there was no evidence of an improved numeric correlation between actual delay and maximum recommended delay on an individual basis.

More specifically, the capability of offering sufficiently rapid revascularization to the most urgent cases did improve somewhat as capacity expanded. The proportions of patients who underwent a procedure on time in the first 6 months of the project were 18.4% of those with a URS of 4 or less and 53.5% of those with a score of more than 4, for a ratio of 2.9:1. In the last 6 months the respective figures were 37.9% and 81.9%, for a ratio of 2.2:1. An analysis by quarter showed that the ratio did fall significantly ($p = 0.0006$); however, throughout the entire study period the proportion of patients who had excessive delays remained significantly higher among those with a low URS than among those with a high URS (Fig. 2).

Effect of specifying an operator

Preference was expressed for a specific surgeon or interventional cardiologist in 19.3% of all referrals. The mean waiting time for CABG was 22.73 (SD 1.32) days when no preference was expressed and 35.31 (SD 4.21)

Table 3: Quarterly changes in timing of revascularization procedures in relation to recommended maximum waiting times according to individual urgency scores

Quarter	No. of procedures: Total	Over waiting time recommended	Under waiting time recommended	Ratio	*r* value
All procedures					
1	27	21	6	3.50	0.37
2	37	26	11	2.36	0.64
3	47	23	24	0.96	0.50
4	48	28	20	1.40	0.46
5	54	27	27	1.00	0.46
6	40	18	22	0.82	0.60
7	67	23	44	0.52	0.50
8	65	20	45	0.44	0.46
9	76	30	46	0.65	0.61
CABG alone					
1	21	16	5	3.20	0.32
2	30	24	6	4.00	0.67
3	37	20	17	1.18	0.46
4	39	26	13	2.00	0.71
5	39	25	14	1.79	0.54
6	31	17	14	1.21	0.66
7	56	21	36	0.58	0.47
8	55	19	36	0.53	0.39
9	57	24	33	0.73	0.56

days when it was ($p = 0.0003$). When adjusted by analysis of covariance for urgency, as reflected in either the referring physician's subjective score or the computer-generated URS, this difference remained significant ($p = 0.002$). Similar differences in waiting times for PTCA were not observed when preference for a specific operator was expressed ($p = 0.63$ unadjusted and 0.40 after adjustment for differences in urgency scores).

Discussion

Our study design is limited in five ways. First, the patients had already undergone coronary angiography and were thus well along in the cardiac tertiary care system. Morbidity and mortality among patients waiting for coronary angiography cannot be assessed with these data but should be studied given that patients also may wait weeks or months for investigation.[5]

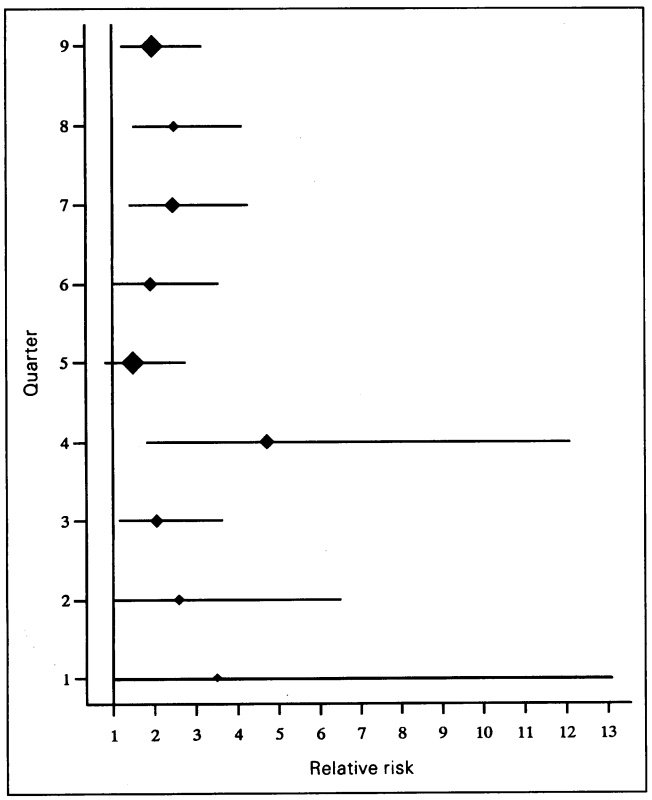

Fig. 2: Relative probability of procedure being done on time, by quarter during study period. Analogous to relative risk, the relative probability is derived by taking the probability of being done on time among patients with a rounded URS of more than 4 and dividing it by the same probability among those with a score of 4 or less. A high relative probability means that there is greater comparative mismatch among urgent versus elective patients in that quarter. The size of the diamond for each quarter is inversely related to the variance of the rate or probability ratio, and the lines represent the 95% confidence intervals for that quarter's ratio. A ratio significantly greater than 1.0 is found in almost all quarters, indicative of the delays experienced disproportionately more often by patients with a low URS.

Second, we relied on the reports of the referring physicians for the patients' characteristics. This was primarily a source of imprecision rather than bias: systematic errors would be limited both by the professionalism of the referring physicians and by their awareness that any and all referred patients would be reappraised by the surgeon or interventional cardiologist.

Third, noninvasive test results were not available for about one third of the patients, especially those with class IV-A symptoms. Highly positive test results would increase the rated urgency of cases in our scoring system but are less important as factors than symptom status and anatomy. The findings should not be invalidated by these missing data.

Fourth, this was a limited and selected group of patients, drawn from the over 6000 patients who underwent either CABG or PTCA in Toronto centres during the study period. Our series does not represent a random sample. There is clear selection bias: a self-selected population of cardiologists used the service and, in turn, referred only some of their patients. Many cardiologists who made limited referrals through the service continued to refer most of their patients directly to cardiac surgeons and interventional cardiologists. The study cohort differs from registry reports[11,12] in its very high proportion of people with unstable angina. Selection bias threatens the external validity or generalizability of our findings but should have no major consequences for the internal validity of the results. Generalizability might also be challenged given the unique nature of the Toronto revascularization "marketplace"; Toronto has three main hospitals offering coronary revascularization. However, the principle of urgency-driven cross-referrals, be they between surgeons or centres or both, is applicable in any context.

Fifth, the outcome measures for the burden of waiting are limited to fatal and nonfatal myocardial infarction. Other potential outcomes merit attention when assessing the burden of queueing for revascularization.

Despite these limitations we believe that the analysis sheds new light on various issues in health policy and management. Published data on queue management systems are minimal.[1] This prospective and consecutive case series shows that even with a population selected to include a high proportion of patients with unstable disease, cases of preoperative fatal and nonfatal myocardial infarction are uncommon if there is careful ranking according to clinical risk. The point estimate of a death rate of 1% is probably an overestimate, given the high incidence of unstable angina in this population.

This finding does not justify long queues for CABG or PTCA. Efficient use of operating rooms and catheterization laboratories demands advanced booking and some element of queuing.[1] However, apart from the obvious morbidity imposed by unrelieved symptoms of coronary disease, unduly delayed revascularization imposes psychosocial and economic burdens on patients.[1,13–16] Rates

of return to work may be reduced by long waiting times,[15,16] with a resultant societal burden. Furthermore, destabilization of patients in the queue may lead to hospital admission (with its own costs to patients and society), expedited revascularization (bumping other patients off the queue) and increased operative risks in the context of unstable angina with subocclusive thrombus.

Although preoperative death rates are low over 25 000 people are accepted annually to undergo CABG or PTCA in Canada, and even a rate of 0.05% would lead to about 125 deaths a year. Could these deaths be prevented? Based on our findings, and on a formal review of the clinical trials,[10] we hypothesize that two policies might reduce the number of preoperative nonfatal and fatal infarcts. One is to ensure expeditious revascularization for people with documented left main-stem disease, particularly those with severe symptoms. Another is to maintain enough "open slots" to avoid delays for patients who either present with unstable angina or whose condition becomes unstable while they await revascularization.

Our second goal of the analysis was to assess the match between the referring physicians' informal estimates of urgency and the URS. The high correlation of these subjective and objective urgency rankings could be attributable to various factors: general awareness and acceptance of the URS,[17] a self-selected sample of referring physicians who supported the principles of the program and the concept of assigning priorities, and the fact that the URS was based in large measure on a statistical synthesis of clinical judgements by a group of cardiovascular specialists.[7] Nonetheless, the referring physicians' ability to offer defensible urgency rankings can, in part, reflect positively the role practitioners play in queue-based allocation of scarce resources. By accurately assessing the relative urgency with which patients need services in our universal health insurance system, Canadian clinicians daily help avoid the pitfalls of the approach in the United States, where denial based on income or insurance coverage coexists with excess capacity for those who are insured or able to pay.[1,18–21]

We found a strong relation between the waiting times and the corresponding informal and formal urgency ratings. These correlations presumably reflect, among other things, the explicit communication of priority scores by the program coordinators and the shared urgency rating paradigm of all concerned. We suspect, but cannot prove, that the program and its coordinators materially assisted in the rational triage process. These findings again support the pivotal role of referring and accepting practitioners in the management of limited resources[1,22] — a clinical function that is crucial to the safe and efficient operation of the Canadian health care system. Nonetheless, excessive waiting times were most often experienced by the patients judged to have the most urgent need. Somewhat paradoxically, the patients with less urgent needs and more stable disease tended to undergo revascularization within an appropriate time-frame. Perhaps the time-frames for the cases ranked highly urgent were unrealistically short and such rapid responses could never be achieved by surgeons and cardiologists. However, we doubt this because true emergency cases routinely crowd out scheduled procedures. Instead, we favour two other, related hypotheses. First, such rapid responses, although achievable, may simply not be seen as necessary in actual practice. Second, an insufficient number of openings for unstable cases may be left in the operating room schedule. Scheduled cases represent the known livelihood and personal practice of each surgeon. Unstable cases can be accommodated expeditiously only if the surgical service creates a pool of openings for that purpose or if a scheduled case is cancelled.

Waiting times over the study period were of interest because of the major infusion of resources into the cardiovascular sector. In 1990 the Sunnybrook Health Science Centre brought its new cardiac surgery program to full capacity (an additional 500 cases, of which over 70% were CABGs), and other centres outside of Metropolitan Toronto expanded their caseloads. These extra resources clearly shortened the overall waiting time, allowing more cases to be done within a reasonable time. We believe that this factor — not the referral service — had the largest impact on waiting times. Yet, the shorter mean waiting time was not reflected in improved correlation with the URS-related waiting times because of the rise in procedures done early. As long as most patients are not experiencing waiting periods that put them at risk of cardiac events, it is relatively unimportant to maintain a correlation between the urgency score and waiting times. However, for reasons of possible risk already noted, there should be concern about the tendency to reduce delays for elective patients without first redressing the commoner, although smaller but potentially more crucial, delays for patients with unstable symptoms.

Lastly, prespecification of operator by the referring physician increased the delay for CABG by 50% on average. This substantial increment could reflect two factors: first, requested surgeons or interventional cardiologists had consistently longer waiting times than those not requested; and second, the coordinator's search for operators with unexpected openings or shorter waiting lists reduced delays. The key implication here is not that traditional referral patterns be set aside or that surgeons with special skills no longer be sent particularly challenging cases. Instead, we see the need for better information in the marketplace. Referring physicians and their patients should have access to information about provider- or institution-specific waiting times for consultations and procedures. Specifically, if outcomes vary markedly for routine revascularization procedures, there is a fundamental problem with surgical quality control that must be addressed. If they vary only slightly, practitioner-specific waiting times clearly become a factor in

decision-making. Thus, dissemination of waiting-time data should facilitate decisions about the choice of specialist and mitigate the phenomenon of needlessly disparate waiting times for patients with similar symptoms. This concept is integral to the Provincial Adult Cardiovascular Care Network, an Ontario-wide initiative that represents the outgrowth from our demonstration project. Future analyses are planned by the network's organizers and should provide additional insights into the phenomena explored here. These analyses will involve all patients from all centres, thereby avoiding our study's limitations with respect to external validity.

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