

Feasibility of Large-scale Cholesterol Screening: Experience with a Portable Capillary-Blood Testing Device

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Abstract: We conducted a voluntary cholesterol screening in a medical/occupational setting using the Eastman Kodak Ektachem (desk top) blood analyzer. In 10 hours, five technicians performed a finger-stick puncture on 1,081 screenees, 17.7 per cent of whom were classified as moderate-to-high risk. The cost per screenee was under \$3; cost per moderate-to-high risk case was under \$16. Turn-around time from check-in to report of result was under one hour. This project suggests the feasibility and acceptability of large-scale cholesterol blood screening. (*Am J Public Health* 1987; 77:73-75.)

Introduction

In 1984, a Consensus Development Conference conducted by the National Institutes of Health (NIH) concluded that elevated blood cholesterol should be considered a causal risk factor for coronary artery disease and that lowering blood cholesterol levels is a desirable public health goal.¹ All Americans were advised to obtain a blood cholesterol measurement, but the panel stopped short of recommending mass cholesterol screening until the feasibility of various screening methods in adults could undergo evaluation.

The availability of new laboratory technologies which are portable and require only a small amount of capillary blood for study could herald a new era in preventive cardiology. Such laboratory equipment is now said to be available² and purported to be simple and inexpensive to operate, minimally uncomfortable to screenees, and capable of rapid cholesterol analyses. The purpose of this report is to document and describe our experience with a cholesterol screening performed in a medical/occupational setting utilizing one of the newly-available portable blood testing devices.

Methods

Screening took place at Strong Memorial Hospital, the primary teaching site of the University of Rochester School of Medicine and Dentistry. The Hospital and Medical Center have approximately 2,500 full-time employees who work during the shift-hours of the screenings with a female:male ratio of 2.6 to 1.

A number of strategies that have been used successfully in other recruitment efforts³ were employed to inform people

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in advance about the screenings. These included: articles in the hospital's internal newspaper, announcements in payroll checks, displays and posters in the Medical Center, mailings through the hospital workers' union, and letters to attending physicians. During the week of the project, the screening was announced daily on the hospital public address system.

Screening Procedure

Screenings were held in the hospital's main lobby in an area 17 × 21 feet during lunch hours on five consecutive days. A staff of 11 performed the screenings, including one check-in person, five blood technicians, two blood analyzer operators, one centrifuge operator, one check-out person, and one coordinator. Four screening stations were set up as follows:

- **Preparatory Station**—At the check-in station, participants were logged in and given a booklet bearing an identifying number for each person.

- **Blood Sampling**—Participants moved from the waiting area to the blood stations as openings became available. Before blood sampling, an identification sticker was removed from the patient's booklet and attached to the blood tube. The participant then had a finger-prick blood sample drawn. For each participant, a 300 microliter (0.3 ml) Sarstedt Corporation lithium-heparinized blood collection tube, a lancet, alcohol swab, gauze swab, and band-aid were needed.

- **Chemistry Analysis**—Centrifugation and blood analysis were conducted in a third area. Blood samples were transferred from the sampling station to a Beckman desk-top centrifuge for three minutes of centrifugation. Analysis was done on two Eastman Kodak Ektachem DT60 analyzers using Kodak's new slide technology.⁴ One slide is required for each sample analyzed as well as a number of extras for initial calibration and periodic calibration checks during the screening. Only 10 microliter (0.01 ml) of serum is required for the analysis. The DT60 is currently capable of processing 65 total cholesterol samples per hour. Since only total cholesterol was measured, fasting samples were not required.⁵

- **Debriefing**—Informational materials on cholesterol suitable for all levels of education were available. A health educator was on hand to instruct screenees about cholesterol and advise appropriate follow-up.

Results

Demographics

A total of 1,081 people were screened with 1,033 returning informational questionnaires. Of the 1,033, 69.9 per cent were female, 93.3 per cent were White, and 75 per cent indicated they had no knowledge of having ever been tested for a cholesterol elevation. The mean age for men and women was 38 and 40 years, respectively. Most (75.8 per cent) were

TABLE 1—Distribution of Cholesterol Screenees by Age and Risk Categorization*

Age	Total Screened	Low Risk (%)	Moderate Risk (%)	High Risk (%)
20–29	321	268 (83)	29 (9)	24 (7)
30–39	317	276 (87)	24 (8)	17 (5)
>40	443	346 (78)	40 (9)	57 (13)
Totals	1,081 (100%)	890 (82)	93 (9)	98 (9)

*Cholesterol-related risk categories are defined according to NIH Consensus Conference¹ by cholesterol blood concentration:

Age	Low Risk	Moderate Risk	High Risk
20–29	< 200 mg/dl	200–220 mg/dl	> 220 mg/dl
30–39	< 220 mg/dl	220–240 mg/dl	> 240 mg/dl
> 40	< 240 mg/dl	240–260 mg/dl	> 260 mg/dl

employees and staff, while the remainder were visitors to the hospital on the day of screening. Over 63 per cent of screenees had completed college or postgraduate study. Based on shift assignment estimates, approximately 33 per cent of available workers were screened. The screened group was similar to the eligible population in age, sex, and education level.

Cholesterol Levels

Cholesterol levels of the 1,081 tested were categorized according to NIH Consensus Conference criteria and are shown in Table 1. The mean cholesterol level for females was 193 mg/dl and 191 mg/dl for males. In this screening, 18 per cent were in the moderate- or high-risk categories.

Repeated venous blood samples were subsequently obtained on 86 of the 191 screenees who were at moderate or high risk. The mean capillary value was 244 mg/dl compared to 251 mg/dl for venous samples. Capillary and venous samples were correlated ($r = 0.48$, 95% confidence intervals 0.29, 0.62).

Screening Process

The time required for screening was primarily determined by an average wait of 20 minutes (range = 5–40 minutes) to check in. The time from actual check-in to check-out (including interim waiting) averaged 15 minutes, yielding a rate of 100 persons tested per hour. Results were available within 25 minutes after check-out when the majority of screenees returned to pick up their result. Others were notified by postcard.

The direct cost of screening was \$2.78 per person. Included in this cost estimation is the expense of advertising, laboratory supplies, and wages. For the 191 moderate- or high-risk cases, cost per case was \$15.70.

Screening Impact

The 36 screenees with the highest cholesterol levels (> 95th percentile) were advised to consult their physician as soon as possible for follow-up, and written reminders were sent within two weeks of screening. Thirty-five of the 36 were contacted by phone approximately four months after screening. Thirty-one recalled being told their cholesterol was high, one recalled it being "high-middle," and three could not remember at all. Twenty-two of these participants had no prior knowledge of their cholesterol elevation; but 13 had been previously told their levels were high. Thirty-one recalled and four did not recall being advised to contact their physician. Two of these four also did not recall being told of their cholesterol elevation. In response to screening, 26 (74 per cent) contacted a physician for follow-up and reportedly

received some advice. Seven of the 26 screenees were simply reassured "not to worry" without further reassessment; nine were offered a secondary screening. Of the remaining 155 moderate- or high-risk screenees, 103 enrolled in an intervention research project for individuals with moderate or high cholesterol levels.

Discussion

This report demonstrates the feasibility of a relatively large-scale cholesterol screening as one response to the cholesterol problem for preventing atherosclerosis. The effectiveness of screening is judged by well-established criteria.⁶ A "good screening test" may now be available for cholesterol testing that is accurate, safe, inexpensive, and rapid. Voluntary testing in this occupational/health setting suggests that cholesterol screening can identify a moderate number of at-risk persons (18 per cent in this report). While this 18 per cent figure represents a large fraction of referred individuals, it is below the 25 per cent predicted by the cut-off values defined by the NIH Consensus Conference,¹ suggesting that a random, voluntary screening may not be as efficient as a "targeted" screening program. However, the large per cent of referred persons who sought follow-up advice (68 per cent) is strikingly high despite the lack of extensive follow-up reminders.⁷ Thus, these data suggest that those screened in a setting such as ours may be highly motivated.

Our follow-up confirmed at least one disturbing finding suggested by other studies.² We found that many physicians responded inappropriately when high-risk screenees sought further medical advice; over one-fourth of the highest risk patients were advised "not to worry" about their cholesterol result, suggesting a need to place added emphasis on preparation of the medical community to assess and treat high-risk screenees in future efforts of this nature.

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