Inability to reach 85% of the predicted maximal heart rate for age during exercise stress testing (chronotropic incompetence) has been considered indicative of an uninterpretable or inadequate test. A new study from the Cleveland Clinic suggests that a submaximal heart rate response to exercise may be a significant independent risk factor for all-cause and cardiovascular death in individuals with known or suspected coronary artery disease (CAD).

A "low-risk" group of 2953 consecutive patients with known or suspected CAD (36% women; mean age, 58 years) underwent symptom-limited treadmill thallium testing using a standard Bruce protocol. Participants were excluded if they had a prior history of coronary angiograms or invasive procedures, congestive heart failure, valvular disease, congenital heart disease, pre-excitation syndrome, or β-blocker use.

Chronotropic incompetence was assessed if individuals failed to reach at least 85% of their age-predicted maximal heart rate or had a chronotropic index <0.8. The chronotropic index uses directly measured variables to correct for age, physical fitness, and resting heart rate, all of which can affect maximal heart rate response. It is unaffected by exercise protocol or exercise time. Chronotropic index at peak exercise was determined with the use of the following formula, where HR represents heart rate:

$$HR_{\text{peak}} - \frac{HR_{\text{rest}}}{220} - \text{age in years} - \frac{HR_{\text{rest}}}{220}$$

Eleven percent failed to reach at least 85% of their age-adjusted maximum heart rate, and 26% had a low chronotropic index.
Chronotropic incompetence was more common at older ages, in smokers, and in those with a history of diabetes mellitus, hypertension, chronic obstructive pulmonary disease, known CAD, and with use of calcium channel blockers, digoxin, or nitrates.

End points were all-cause and cardiac mortality; the follow-up period was 2 years. There were 91 deaths, of which 22 were determined to be cardiac. The adjusted relative risks (RR) of death associated with failure to reach 85% maximal heart rate and with low chronotropic index were 1.84 and 2.19, respectively. Thallium perfusion defects were also independently predictive of death (adjusted RR, 2.10). A low chronotropic index was predictive of cardiac death (adjusted RR, 3.14). Calcium channel blocker use did not affect the association between chronotropic incompetence and risk of death. Chronotropic incompetence alone carried approximately the same mortality risk as thallium perfusion defects alone, and the presence of both was associated with a substantially higher risk of death.

This study was limited by the short follow-up period and the relatively small number of deaths. However, there are distinct implications for insurance medical directors and underwriters. Interpretation of thallium stress tests that reflect submaximal heart rate responses should be viewed cautiously and not dismissed outright as invalid. The study population was similar to that of many insurance applicants in this age group, with histories of known or suspected coronary disease but without additional information, such as cardiac catheterization results.

An additional and potentially valuable tool in this study is the chronotropic index. Its use in correcting for the effects of age, resting heart rate, and functional capacity when assessing the heart rate response to exercise, may be useful especially in certain groups such as older applicants.
LITERATURE REVIEW

Symptoms in Peripheral Artery Disease

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Recognizing peripheral artery disease (PAD) is significant when one considers the implications for cardiovascular morbidity and mortality. Previous studies have shown that in general medicine practices, patients older than 55 years may have a prevalence of PAD as high as 25%. This study attempts to identify the difference in (1) those in whom PAD was diagnosed in the past year, (2) those in whom PAD was not previously identified, and (3) a control group.

The study design was a prospective evaluation of patients older than 55 years, randomly selected among those who had appointments in a general internal medicine clinic. Patients were surveyed and offered an evaluation that included an ankle-brachial index (ABI). The following patients were excluded: those who scored <18 of 30 on the Mini-Mental State Examination, those who had lower extremity amputations or were confined to a wheelchair, and those who were nursing home residents. Additionally, the investigators did not accept non–English-speaking patients because translators were not available. Those with a diagnosis that limited life expectancy to <6 months were also excluded.

The study classified patients into 3 groups. Group 1 included patients who were identified as having PAD by the vascular laboratory during the 1996 calendar year. Group 2 included patients randomly selected from those with pending appointments in the general internal medicine clinic. Patients with previous diagnoses such as PAD, peripheral revascularization, and clinically recognized claudication were excluded. Group 3 included patients with general internal medicine appointments who had no evidence of PAD after a screening evaluation (ABI >0.90) (Table).

Unfortunately, a weakness of the study is the large number of patients excluded. Only 26 patients remained in group 2. The statistical significance of these numbers is somewhat doubtful since only 1 of 26 subjects was noted to have claudication. Some patients who may have a high incidence of vascular...
disease, such as those with low scores on the Mini-Mental State Examination (<18/30), were excluded. Exclusion of this group, as well as the non-English-speaking persons, may have further underestimated the prevalence of this condition.

There are many implications of this rather small study. Clinical manifestations of PAD, particularly mild PAD, are quite diverse. In multiple logistic regression analysis, with only age and ABI as categorical variables, female sex ($P < .01$) and diabetes ($P < .05$) were 2 of the strongest predictors of lack of symptoms in patients with PAD.

The sensitivity of intermittent claudication is poor among patients identified through ABI screening in a general medicine clinic. The authors conclude that intermittent claudication sensitivity is higher in those identified by the vascular laboratory during the previous year. This is somewhat of a circular argument since patients are referred for vascular testing if they have symptoms. Of the 131 randomly selected general medicine appointment patients screened by ABI, 20% had an ABI <0.90.

These data confirm that PAD is prevalent in the general medicine clinic. Patients who are older, diabetic, and male are associated with lack of symptoms. This is certainly multifactorial because patients may decrease activity as they age, thus limiting potentially ischemic/symptomatic activities.

Previous investigations have shown the limitations of physical examinations in the diagnosis of PAD. This study also reveals that PAD is prevalent and that intermittent claudication is neither sensitive nor specific for PAD. The high number of asymptomatic patients continues to be underappreciated in the general medicine clinic population.
T he use of exercise electrocardiography is one of the mainstays of risk selection testing for high-amount life insurance policies. Despite its widespread use, cardiac stress testing has come under criticism for the fact that by itself, without thallium or echocardiography supplementation, the sensitivity of the test is only 66% for detection of all forms of coronary disease. In addition, the rate of false-positivity has accounted for countless numbers of tests being repeated with thallium or echocardiography at significant expense and patient risk.

What can be done to increase the sensitivity and specificity of stress testing? Certainly the addition of thallium-201 imaging or echocardiography to the exercise electrocardiogram significantly improves these parameters. Unfortunately, these are cost prohibitive in the case of risk identification for life insurance. What is needed is a way to significantly improve sensitivity at a reasonable cost. To that end, this article from the University of Athens Medical School (Greece) may have found a solution to this problem that is elegant in its simplicity.

In this article, 245 patients were studied by exercise electrocardiography with standard 12 leads, by exercise electrocardiography with standard leads plus right-sided V3R through V5R leads, by exercise electrocardiography with thallium-201 scintigraphy, and finally by cardiac catheterization. The results, which are summarized in the Figure, show that the simple addition of 3 right-sided precordial leads dramatically increased the sensitivity of the testing. While the effects were most pronounced in single- and double-vessel coronary artery disease, the addition of right-sided precordial leads resulted in sen-
Sensitivity (%) of Stress Modalities in Coronary Artery Disease

<table>
<thead>
<tr>
<th></th>
<th>Single-Vessel Disease</th>
<th>Two-Vessel Disease</th>
<th>Three-Vessel Disease</th>
<th>Any Coronary Artery Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress with standard 12 leads</td>
<td>52</td>
<td>71</td>
<td>83</td>
<td>66</td>
</tr>
<tr>
<td>Stress with standard 12 leads &amp; V3-V5 R</td>
<td>89</td>
<td>94</td>
<td>95</td>
<td>92</td>
</tr>
<tr>
<td>Thallium 201 Scintigraphy</td>
<td>87</td>
<td>96</td>
<td>98</td>
<td>93</td>
</tr>
</tbody>
</table>

Percentage of sensitivity of stress modalities in coronary artery disease.

Sensitivity in all cases that were comparable to the use of thallium-201 imaging.

Subsequent cardiac catheterization demonstrated that the greatest benefit from the use of the right-sided chest leads was in detecting coronary disease in the right coronary and left circumflex coronary arteries that was not detected by the standard 12-lead configuration. The standard 12-lead configuration was best at detecting disease in the left anterior descending artery.

Could the simple addition of 3 right-sided chest leads be the low-cost answer to improving the sensitivity of exercise electrocardiography? The simple elegance of this technique deserves more attention and study. This is the perfect type of study in which life insurers could participate. I urge life insurance medical directors to consider requesting V₃R through V₅R leads in their routine stress tests. This will begin the necessary step of generating additional data, which can then be analyzed to confirm or discount the results presented here. The chance to achieve thallium-like results for the low cost of 3 electrodes deserves further investigation.
Efficacy of Bilateral Prophylactic Mastectomy in Women With a Family History of Breast Cancer

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This article reported a retrospective study of 639 women with a family history of breast cancer who had bilateral prophylactic mastectomy during 1960–1993 at the Mayo Clinic. Bilateral prophylactic mastectomy was associated with a very significant (90%) reduction in the occurrence of breast cancer in women considered to be either at moderate or at high risk for breast cancer. There was insufficient information to determine whether total mastectomy was more protective than subcutaneous mastectomy.

The efficacy of prophylactic mastectomy has not been adequately determined in prior studies. An accurate estimate of the risk reduction is very useful. Currently, there are few risk-reducing modalities available to women at increased risk for breast cancer. To be able to properly counsel these women, accurate estimates of the efficacy of treatment are needed. Tamoxifen was reported as significantly reducing the risk of breast cancer in women at high risk (for breast cancer) in the Breast Cancer Prevention Trial (BCPT). That trial, as well as this retrospective study, did not address BRCA1 and BRCA2. Tissue samples of the high-risk cohort in this retrospective study are currently being studied. (Similar tissue studies are being done in the BCPT participants as well.) As noted in an editorial in the same issue as this article, 30% to 50% of women with the BRCA1 and BRCA2 mutations will have developed breast cancer by age 42, the median entry age of this study. This will likely limit the utility of this study, as well as the BCPT, for BRCA1 and BRCA2.

With the use of chart review, 639 women who underwent prophylactic mastectomy were identified. The median duration of follow-up was 14 years, and the average age at entry was 42 years. The entrants were divid-
ed into 2 cohorts: 214 at high risk and 425 at moderate risk. The high-risk cohort was intended to include those who were likely to have an autosomal dominant predisposition to breast cancer. I refer you to the article for the criteria. The moderate-risk cohort included all the rest, 425 women who had some family history of breast cancer.

Breast cancer occurred in 7 women after prophylactic mastectomy. Six were confined to the chest wall at diagnosis. One presented with bone metastases 12 years after mastectomy. The median time from mastectomy to the diagnosis of breast cancer was 6 years (range, 2 to 25 years). All 7 women had had subcutaneous mastectomy. Of 575 women who had had subcutaneous mastectomy, there were 7 breast cancers. There was no breast cancer in 64 women who had had total mastectomy. There was no statistically significant difference ($P = .38$) between the 2 groups.

The Gail model (developed with data from 243,221 white women screened annually for breast cancer for 5 years) was used to estimate the number of breast cancers expected in the moderate-risk cohort. With the use of the Gail model, 37.4 breast cancers would be expected. Since 4 breast cancers occurred, the risk reduction was 89.5% ($P < .001$).

Only 3 breast cancers occurred in the high-risk cohort. For that cohort, the Gail model could not be used to calculate the expected number of breast cancers, since it was not developed for women with strong family histories of breast cancer. The 403 sisters of the high-risk cohort were used as a comparison group.

Using the sisters of the high-risk cohort as a comparison group was problematic. The authors of the study considered multiple types of sampling errors. The rate in the comparison group was calculated several ways. First, all breast cancers in sisters were counted. A second method used Weinberg's method for correcting for families with high risk. A third method counted only those sisters who had had breast cancer after an entrant's mastectomy. This eliminated the oversampling that would occur when the entrant had a mastectomy after her sister's breast cancer. (To illustrate with an extreme example, if everyone in the study had only 1 sister and that sister had had breast cancer before the entrant's mastectomy, the comparison group of 403 sisters would have had 403 breast cancers).

Of the 403 sisters of the high-risk cohort of 214, breast cancer occurred in 156 at age 18 or older; 115 of these were diagnosed before the entrant's mastectomy and 38 afterward. With the use of the aforementioned 3 different methods, the expected number was calculated as 52.9, 30, and 37.4, respectively. The high-risk cohort had 3 occurrences of breast cancer. The rate of reduction, depending on the method of calculation, ranged from 94.3% (95% CI, 83.5–98.8) to 90.0% (95% CI, 70.8–97.9) to 92.0% (95% CI, 76.6–98.3). Obviously, by any of the methods, the reduction in risk is very significant.

The risk of death from breast cancer was predicted as 10.4 in the moderate-risk cohort with the use of the Gail model. No deaths occurred in the moderate-risk cohort. Risk reduction was 100% (95% CI, 70–100).

The risk of death from breast cancer in the high-risk cohort was predicted using their 403 sisters. Ninety of the 403 sisters died from breast cancer. Only 2 high-risk entrants died from breast cancer. With the use of similar methods for the determination of the risk of breast cancer, the expected number for the high-risk cohort (for death from breast cancer) ranged from 30.6 to 19.4 to 10.5. This results in risk reduction of 93.5% (95% CI, 76.4–99.2), 89.7% (95% CI, 62.8–98.8), and 80.9% (95% CI, 31.4–97.7), respectively. (It should be added that 2 women in the high-risk cohort died of ovarian cancer.)

There are obvious limitations to this retrospective study. It is from a single institution. It is based on family history that is inherently subject to certain determination errors. The authors point out that a prospective randomized clinical trial would be ideal but is unlikely given the choice of treatment, mastectomy versus nonsurgical. Caution must be used in applying the findings of this study to
BRCA1 and BRCA2 since, as noted earlier, the median age of entry was 42 years and many BRCA breast cancers likely present before age 42. Nonetheless, this retrospective study had such significant results that it clearly demonstrated the strong (90%) risk reduction in prophylactic mastectomy in women at moderate and high risk for breast cancer.
LITERATURE REVIEW

Long-Term Admissions to Home Health Agencies: A Life Table Analysis

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There are currently >120 insurance companies selling long-term care insurance. Most products sold today include a provision for a home health care benefit. The earlier discharge of patients today from hospitals helped form the environment in which the number of home health agencies tripled from 3000 in 1980 to 9800 in 1994. Home health care expenditures have increased 5-fold from $5.6 billion in 1985 to $28.6 billion in 1996.

Interest in understanding utilization patterns of home health agencies has grown in recent years. Both government and insurers need to understand the impact of the future demographic increase of the elderly as a percentage of our population. Evidence suggests that growth in the home health industry has been accompanied by a shift in clientele from short-term to long-term users.

This study is based on the 1992 National Home and Hospice Care Survey (NHHCS) conducted by the National Center for Health Statistics. This survey of hospices, home health agencies, and their respective patients examined 3 questions: (1) What proportion of older home health agency admissions are long-term users? (2) Among home health agency admissions, what characteristics predict long-term use? (3) What are the characteristics of long-term admissions?

METHODS

The study consisted of home health patients aged ≥65 years at the time of admission into the study between January 1, 1992, and December 31, 1992. There were 5883 patients representing the 1992 admission cohort drawn from a national population of 2.3 mil-
lion home health patients with 932,000 discharges in 1992.

The information in the NHHCS was used to calculate the length of use for home health care per episode of care. This was given as the number of days from admission (the beginning of service) to discharge (the end of service).

The study uses life table methods to calculate the complete length-of-stay distribution for the cohort. The life table is estimated from discharge rates calculated for intervals of time since admission, or "length-of-use" intervals.

The calculation of an average length of use for the admission cohort requires the assumption that all episodes of care end after 48 months. Length of use was also stratified for various subgroups on the basis of characteristics that are stable over time: sex, marital status, age at admission, race, admission diagnoses, region of care (South, Northeast, Midwest, West), and source of payment (Medicare, Medicaid, private insurance, out of pocket/other).

RESULTS

The profile of the cohort was as follows: 67% were female, 90% were white, and mean age at admission was 78 years. Only 44% were married. The most prevalent diagnoses at admission were heart disease (34%), hypertension (24%), and diabetes (18%). Medicare was the payer in 87% of the cases.

The study showed that 64% of patients admitted used the home health care services for <3 months, 22% for ≥6 months, 15% for 12 months, and 8% for ≥2 years. On average, women, unmarried persons, and those aged ≥85 years were the most likely to need home health long-term care, defined as ≥3 months of care. The overall mean length of use was 7.4 months.

Although long-term users were a minority of admissions, they accounted for the majority of patient-care months. The 36% of patients receiving ≥3 months of care received 76% of patient-care months. More than 50% of all care was received by the 15% of patients in home health care for ≥1 year.

Long-term care was defined as ≥3 months of home health care. The admission diagnosis of arthritis was the most frequent (40.9%) diagnosis found in those receiving long-term care, followed by hypertension (39.6%) and diabetes (35.6%). Diagnoses were not mutually exclusive.

The average length of use for admissions with a diagnosis of arthritis was 14 months, with a diagnosis of diabetes 11 months, and with a diagnosis of hypertension 8 months.

Medicaid was the primary payer in only 4.5% of patients. Medicare was primary in 87%. When long-term care was defined as ≥2 years, only 7% of Medicare and privately insured admissions were long term compared with 19% of Medicaid.

DISCUSSION

This survey provides an important profile of patients receiving home health care. It is limited to home health care agency services and does not include those receiving non-agency care, including informal care from family. Nevertheless, it is an important reference for government planning and the insurance industry.

This survey may underestimate length-of-use intervals because it treats a change in agency as 2 different episodes instead of as 1 continuous episode. The authors argue that this bias is minimal, with only 0.4% of discharges recorded as admitted into another home health agency.

A life table was generated with the use of the observed discharge rates in the 1992 admissions cohort. These rates were applied to the 2.6 million elderly people receiving home health care agency services to estimate the total number of patients using care at length-of-care intervals. In the first month, 2.6 million received care. Only 87,000 were still receiving care at 48 months. Discharges include recovery and death.

These numbers have significance for policy makers contemplating the impact of restric-
tions on length of use for government insurance. The authors use their data to caution that restrictions of long-term home health services will disproportionately affect those at highest risk for nursing home placement.

Providing an alternative for institutional care is one of the goals of today's long-term care insurance policies, which include home health care benefits. With the mobility of society, families are spread apart. Family caregivers are themselves aging as the elderly population lives longer. There is concern that informal care systems will be strained in the future. The availability of formal home health care may prevent or delay the need for institutional care, which is generally more expensive. The findings of this annual survey will be of great interest to observe how the profile of home health care evolves in the future.