(automatically by the computer program) before a decision can be made. As the first step, a single decision tree or rule-set is constructed from the training data (like for example the one presented in our paper). This classifier will usually err in some cases in the data and the first decision tree possibly gives a wrong class for some. When the second classifier is constructed, more attention is paid to these cases. As a consequence, the second classifier will generally be different from the first. It will also make errors in some cases, and these will be focused upon when constructing the third classifier. This process continues for a predetermined number of iterations (usually \( \geq 10 \)). When a new case is to be classified, each classifier votes for its predicted class with a voting weight equal to its confidence value, and the votes are totted up. The class with the highest total vote is chosen as the final prediction (majority decision). The following Table shows the evaluation of 10 different classifiers in the INTERVENT project. All 454 cases are correctly classified.

A classifier is usually evaluated in terms of its error rate in new cases. However, misclassification errors of one kind are more serious than those of another. The consequences of misclassifying a patient with complications as one without complications is more serious and ‘costs’ more than the converse. Therefore, we calculate, indirectly, the desired risk functions, but use a cost function to calculate the decision trees for which the total cost of misclassification is minimized (Table 1: column ‘cost’). The results are cross-validated. Since our algorithm is self-learning (self-improving) it is just a matter of the right number of examples to obtain results with a high sensitivity and specificity, or to prove that the parameters are insufficient for this problem.

Artificial intelligence does not overrule plausibility, but tries to explain what we understand or do not understand. To visit the caves of Cumae for us is a tourist highlight, but to derive reliable classifiers, or more general models, we prefer the recently developed machine learning techniques.

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Ethnicity and heart failure

The population-based heart failure study reported by Cowie et al. is an important contemporary epidemiological insight into the incidence and aetiology of heart failure. However, as with previous large-scale population-based heart failure studies, including the Framingham Study, much of the data are based on predominantly Caucasian populations. It is nevertheless important to highlight the influence of ethnicity on heart failure, as the disease process may be quite different amongst non-caucasian populations.

Ethnic differences in the aetiology, progression and prognosis of heart failure have been addressed in a number of hospital-based and population-based studies. In our survey of 7451 medical admissions to a Birmingham city centre teaching hospital serving a multi-ethnic catchment population, 348 patients were admitted with acute heart failure: 76% were White, 16% were Indo-Asian and 8% were Black/Afro-Caribbean. The commonest aetiological factors for heart failure were coronary heart disease and hypertension in white patients, hypertension and diabetes mellitus in Afro-Caribbean patients and coronary artery disease and diabetes mellitus in the Indo-Asians. These racial differences are consistent with the higher prevalence of hypertension and diabetes amongst black subjects and coronary artery disease amongst the Indo-Asian population. In view of the association with hypertension amongst Blacks, the prevalence of heart failure secondary to diastolic dysfunction is likely to be greater, especially if hypertensive left ventricular hypertrophy is present.

In the United States, the population-based mortality from congestive heart failure is 1.8 times as high for black men as for white men, and 2.4 times as high for black women as for white women. A recent retrospective analysis of data from the Studies of Left Ventricular Dysfunction (SOLVD) confirmed that black African-Americans with asymptomatic and symptomatic mild-to-moderate left ventricular systolic dysfunction had higher overall mortality rates, when compared to Whites. These rates were still higher even after adjustment for differences in age, sex, severity and cause of left ventricular dysfunction, concomitant diseases, treatment and socioeconomic class. Black subjects were also at higher risk of disease progression and the combined end-point of death from all causes and hospitalization from heart failure. Black

### Table 1

<table>
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<th>Trial</th>
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<th>Rules</th>
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<tbody>
<tr>
<td></td>
<td>Size</td>
<td>Errors</td>
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<tr>
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<td>26</td>
<td>9 (2.0%)</td>
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<td>1</td>
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<td>19 (4.2%)</td>
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<tr>
<td>2</td>
<td>33</td>
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<tr>
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<td>35 (7.7%)</td>
</tr>
<tr>
<td>5</td>
<td>27</td>
<td>46 (10.1%)</td>
</tr>
<tr>
<td>6</td>
<td>32</td>
<td>19 (4.2%)</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>17 (3.7%)</td>
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<tr>
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</tr>
<tr>
<td>9</td>
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<tr>
<td>boost</td>
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<td></td>
<td>(b)</td>
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</tbody>
</table>

*Table 1: column ‘cost’.*
patients with heart failure and hypertension also appear to respond less favourably to the ACE inhibitors, when compared to the combination of hydralazine/nitrates \[8\].

Although our understanding of the epidemiology of heart failure in the general (mainly Caucasian) population has improved significantly over recent years, further information is still required to fully address the influence of ethnicity on the epidemiology and management in patients with heart failure.

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References


Simplified echocardiography: an accurate and inexpensive method for the assessment of left ventricular hypertrophy

Left ventricular hypertrophy is commonly found in hypertension and confers a high mortality risk \[1\]. Patients with left ventricular hypertrophy should be identified and subject to vigorous medical treatment to prevent further cardiovascular complications. Although the specificity of the ECG in the diagnosis of left ventricular hypertrophy is 90% or more, the sensitivity is usually less than 50% \[2\]. Thus, there is a need for a more accurate, yet accessible and inexpensive method for the assessment of left ventricular hypertrophy. Standard echocardiography is the gold standard for the diagnosis of left ventricular hypertrophy, but is a limited resource and too expensive to allow extensive screening in hypertension.

We have previously reported that simplified echocardiography has a high degree of accuracy in the assessment of cardiac dimensions, left ventricular function, and valvular stenosis in patients with heart failure \[3\].

The accuracy of simplified echocardiography for the detection of left ventricular hypertrophy was assessed in 66 patients. A 5-min visual assessment using two-dimensional echocardiography was performed by a technician using elementary equipment without Doppler. Cardiac dimensions, left ventricular ejection fraction, and valvular stenosis were visually estimated without an actual measurement. Left ventricular mass was calculated using the Penn cube formula \[4\]. A myocardial mass of 230 g or more was considered as left ventricular hypertrophy, and was found in 42% of the patients. For the diagnosis of left ventricular hypertrophy, sensitivity, specificity, positive predictive value, negative predictive value, and accuracy were 80, 89, 86%, 84, and 85%, respectively, compared with standard echocardiography, performed blindly, immediately after the simplified examination (Table 1).

The total cost of a simplified echocardiogram is approximately 150 to 200 SEK (18 to 25), assuming 96 examinations during 24 hours per week, 40 weeks per year. The estimate includes time for paper work, further training, and quality control. In Sweden, the cost of a standard echocardiogram is between 1500 and 2500 SEK (110 to £190).

The accuracy in the diagnosis of left ventricular hypertrophy was superior to that reported for an ECG \[2\]. Simplified echocardiography also offers adequate assessment of left ventricular pump failure \[3\], commonly found in hypertension with or without symptoms of heart failure \[5\], and assessment of valvular stenosis \[3\]. Since simplified echocardiography is a highly accurate and inexpensive method for the diagnosis of left ventricular hypertrophy, it may prove to be feasible for screening of left ventricular hypertrophy and pump failure in hypertensive patients. We are currently investigating its value in hypertensive patients, and recommend others to do the same.

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Table 1 Diagnosis of left ventricular hypertrophy (LVH) by simplified and standard echocardiography. Numbers of patients with and without LVH by the respective method are given

<table>
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<tr>
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<th>LVH</th>
<th>Total</th>
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<td>38</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>36</td>
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<td>66</td>
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References