ASSOCIATION OF RESPIRATORY TECHNICIANS AND PHYSIOLOGISTS

ISSUE NO 18 FEBRUARY 1983

BREATH

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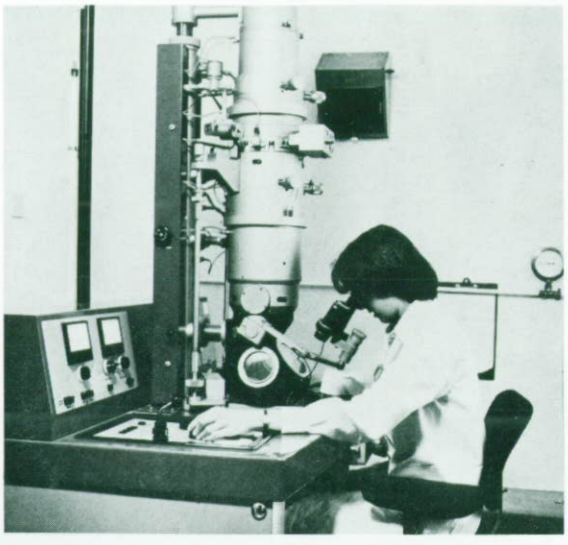

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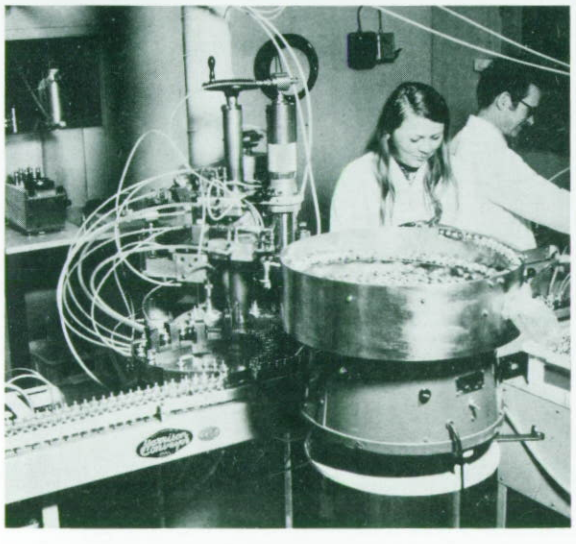

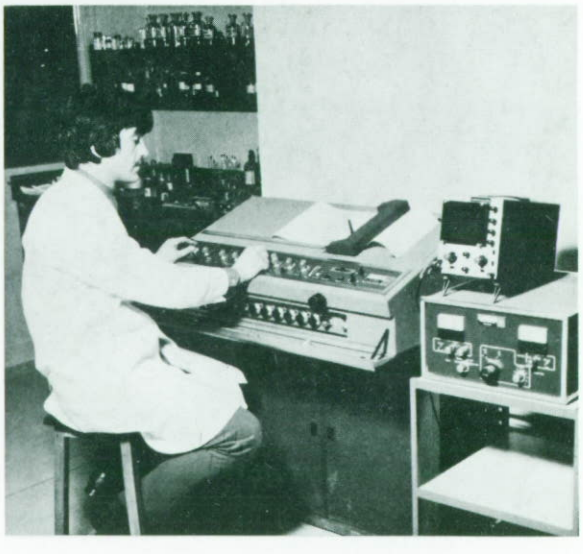

Significant advances in therapy from Original British Research

EDITORIAL

Advances and retreats

Allowing our gaze to wander gently over the current medical scene, we cannot be other than amazed at the contrasts between the great advances that have been made in some areas and the failures to be seen elsewhere.

For some striking examples of technological progress we may scrutinize the business of replacing defective parts of the human body. We can now supply skin, blood vessels, joints and bionic arms and legs with computer controlled motors. Artificial kidneys have been with us for years and the kidney transplant is a commonplace and successful operation. The membrane oxygenator can function as an artificial lung at least in short-term experiments though we must admit that lung transplants have not yet proved themselves. A heart transplant is headline news every time it occurs, together with an item by item account of the money spent and of its sources. And now we have the artificial heart developed in the USA and used for the first time in a 61 year old man with severe heart disease and no other hope of recovery.. This, like the other 'artificial' devices, still requires a large external unit, placing severe restrictions on the patient's life. No doubt they will in the course of time be scaled down to a reasonable size. One problem remains: which patients are to reap the benefits? Those who can raise the money, those that deserve it most, or those who happen to be in the right place at the right time? For a forthright answer, ask someone who has waited two years for a hip replacement.

And now look at the advances made possible by the New Genetics! The structure of many genes can now be determined and it is possible to isolate the gene responsible for production of a particular protein or hormone (such as growth hormone or insulin), to insert it into the reproductive mechanism of a micro-organism to be grown in large-scale cultures. The product can then be manufactured in large quantities and administered to appropriate patients.

A second major advance has been the production of the 'gene-specific' probe which can be used for the diagnosis of inherited disorders, particularly in the unborn child. Pioneering work has been done in the disorders of haemoglobin; in the field of respiratory disease we can now identify cases of muscular dystrophy, that sad disorder which ends in ventilatory failure in early adult life. Alpha$_1$antitrypsin deficiency which can cause neonatal hepatitis or emphysema later in life can at present be detected by sampling the umbilical cord blood of the foetus at about eighteen weeks of pregnancy, a procedure which carries a small but definite risk to the unborn child. It will, before long, be possible to identify the deficiency simply by taking a small sample of the 'trophoblast' the very early embryonic tissue that surrounds the developing foetus and later becomes the placenta; this procedure would enable the diagnosis to be made at a very early stage of pregnancy.

There is the possibility of detecting individuals affected by cystic fibrosis, one of the commonest hereditary disorders, with about 35 new cases being born each year. The technical possibilities are thus very large, but heavy burdens are laid upon the parents themselves who have to take grave decisions with respect to unborn or planned children and it seems inevitable that the answers to such moral dilemmas will trail way behind advances in medical science.

So much for the dilemmas imposed by advances in medical science — but what about the retreats? One need only to turn yet again to the subject of tobacco smoking, where our Editorial research staff have as usual been burrowing away to bring in the latest news — or non-news as it happens. We find yet another of these 'voluntary' agreements between tobacco companies and government to cut spending or advertising in posters and cinemas. The companies are to spend eleven million pounds on an organisation called the 'Health Promotion Research Trust'; this sounds a worthy body but there's just one catch. Yes, the Trust will not fund any research on the effects of tobacco products! The reason given for this protection of the interests of the shareholders and employees; the former we could leave to take care of themselves. Redundancy among employees is a matter of concern but to keep the matter in proportion we should look at redundancy in all industries and perhaps allot our sympathies in proportion to the usefulness of the products.

We must comment yet again on the paltry nature of these contributions when compared to the monetary turnover in the tobacco industry. Sir Richard Doll (quoted in 'World Medicine' recently) used the word 'trivial' and who should know better? He has also pointed out the power of television as an advertising or propaganda weapon. In the United States the antismoking lobby obtained equal television time with the cigarette advertisers with a resultant drop in tobacco sales. The manufacturers fought back, got all advertising banned whereupon sales promptly rose again. So it shows that these campaigns actually work. In this country the new television Channel 4 has a statutory requirement to make health promotion programmes so let's hope we hear some powerful arguments on the morality of cigarette smoking!

BREATH

The Editors of Breath express their thanks to all those who have made possible the publication of the journal; to Mr. Boughton of our printers, Stevens Brothers, for his co-operation in the production; to Mrs. Mary Ewing for invaluable secretarial help, to our advertisers for their support and to our contributors for their excellent articles.

ACCURACY in PULMONARY MEASUREMENT

Allen C. Norton
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Summary
The measurement of pulmonary function requires careful consideration of the accuracy of the instruments and procedures. Measured values differ to a variable extent from the real values and both systematic and random error can occur. *Systematic error* can be reduced by correct calibration. *Random error* arises from three instrument characteristics, drift, nonlinearity and noise and the accuracy specification should reflect the sum of these errors. A given error may not be acceptable depending on the physiological function being evaluated. A deviation of 2% from the true value may be acceptable in measuring inspired oxygen concentration in the clinical setting but would be unacceptable for measurement of oxygen consumption and respiratory quotient, which call for an accuracy of 0.1% or better. Workers in this field should be fully aware of the limitations of their instruments and of the accuracy required for various applications.

What is accuracy?
The idea of accuracy implies that there is some 'real' value which can be measured. But as in Plato's cave real objects are not perceived directly and are known only by their shadows; in pulmonary measurement we can never know the exact values we attempt to measure but only the estimates given by our analysers. The concept of accuracy is thus the extent to which our measurements approximate the apparent 'real' value.

The amount by which our estimate differs from the 'real' value is the error of measurement. The nomenclature in this field has become reversed so that when a 10 litre volume yields a value consistently between 9.5 and 10.5 litres, we regard this as an accuracy of 5% rather than as an error of 5%. The term 'precision' is closely related to accuracy and refers to the extent to which a series of measurements of the same value are repeatable. Precise measurements are not necessarily accurate; thus serial measurements of a 10 litre volume as 7.9, 8.0, 7.8, 8.0 and 7.9 litres would be precise but hardly accurate. On the other hand, values of 9.0, 9.6, 10.3, 9.7 and 10.6 would be more accurate but not so precise. Errors arise in both sets of measurement; in the first (more precise) set there is a *systematic* error while in the second (more accurate) set there is *random* error.

Calibration
Most modern pulmonary instruments are *direct reading*, that is, they give an output on a recorder or meter in terms of concentration, flow, pressure or other units. (One still occasionally finds instruments of the *comparator* type in use where the reading from an unknown is compared directly with a standard sample.).

Calibration of a direct reading instrument has the effect of reducing a systematic error whereby the readings would tend to be too high or too low. As an example, let us take an infra red CO_2 analyser as typical of a direct reading instrument. Calibration requires two basic steps: First, sample a CO_2 free gas and set the meter to zero: second, sample a gas of known CO_2 concentration and use the gain or span control to set the meter to that value. (In some instruments the zero and span settings interact so that the procedure needs to be repeated for proper calibration.) This two-point calibration procedure can be considered as

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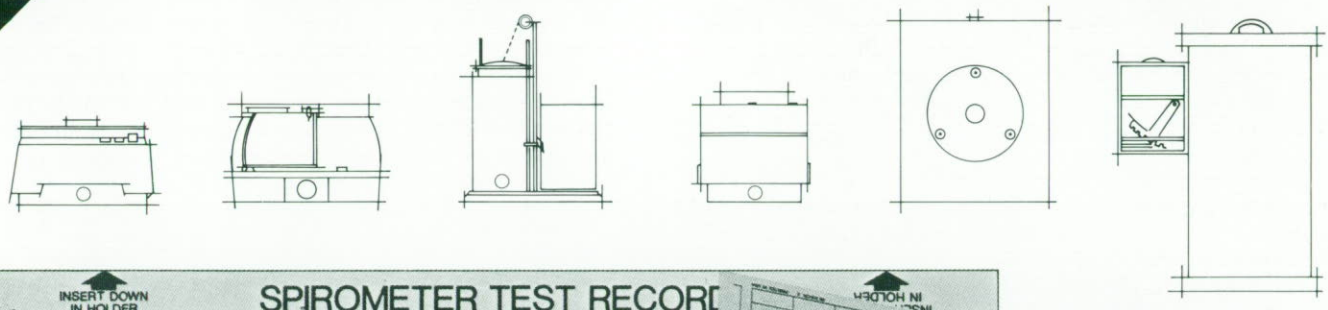

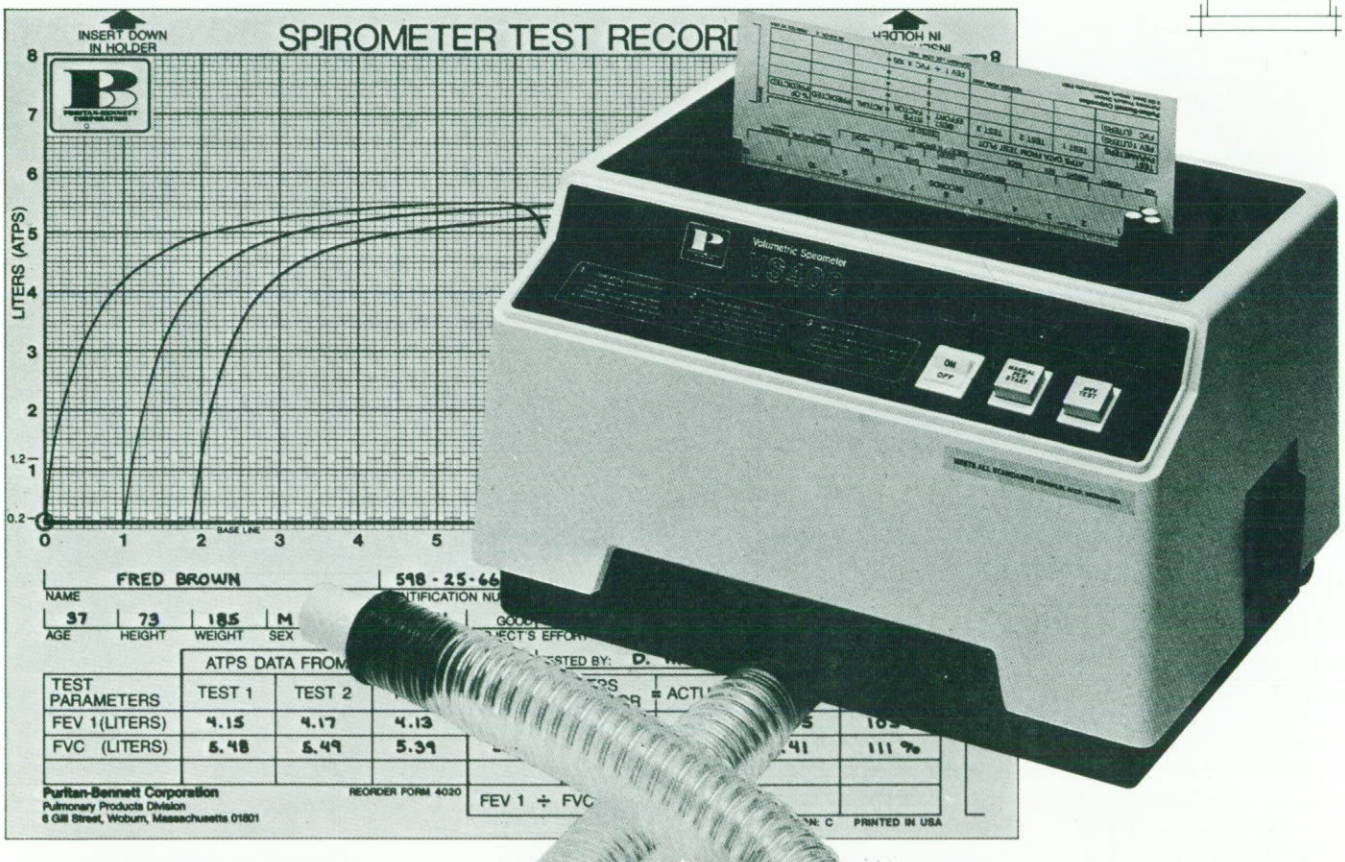

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adjusting the intercept and slope of a linear equation of the form

$$y = ax + b$$

where **y** is the instrument reading, **a** the gain setting, **x** the output of the sensor and **b** the zero setting.

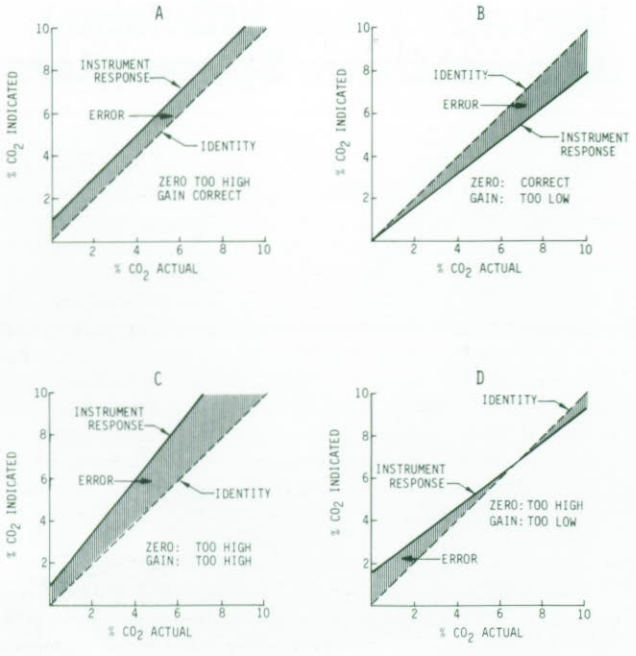

Fig. 1 Effects of errors in setting of the zero and gain controls of a CO_2 analyser. In correct adjustment, the instrument response would fall on the line of identity.

A. The zero control has been set too high so that the instrument reads systematically 0.5% too high throughout its range.

B. The gain control has been set too low so that the error increases at successively higher CO_2 concentrations though zero is correct.

C. Both gain and zero controls have been set too high; all readings including zero are therefore too high, with increasing errors at the higher values.

D. Zero has been set too high and gain too low. At low concentrations the instrument reads too high, but too low at high concentrations. At one point, however, (7%) it reads correctly.

Four combinations of improper settings of the CO_2 analyser controls are shown in Fig. 1. The situation shown in Fig. 1D often arises when the gain control has been adjusted to indicate the value of the calibration gas but the zero offset has not been properly adjusted. However carefully the procedure is performed, the fact remains that the accuracy of calibration is no better than the accuracy with which we know the true concentration of the calibration gas; the same principle of course holds for any analytical instrument.

Precision analysed gases can be purchased but experience shows that even these may have been incorrectly analysed or labelled. Careful workers will usually insist on independent analysis of their calibration gases. The direct volumetric methods such as those of Haldane or Schölander are to be preferred as they do not depend upon our knowing the concentration of some other gas. Even these methods are subject to error and there is no easy solution to the dilemma of accurate analysis of calibration gases.

Random Error

Random error, which cannot be eliminated by the foregoing methods of calibration, is what manufacturers usually cite in specifying accuracy, on the assumption that the instrument has been correctly calibrated and is free from systematic error. Random error arises from three sources: drift, nonlinearity and noise.

Drift refers to long-term changes in the operating characteristics of the instrument and can arise from changes in the temperature or pressure, electronic instability and many other sources. Drift may affect the zero, the span or both, and specifications of an instrument's accuracy should include values for both span and zero drift. Such errors are eliminated whenever the instrument is calibrated but any drift that has occurred since the most recent calibration must contribute to the error.

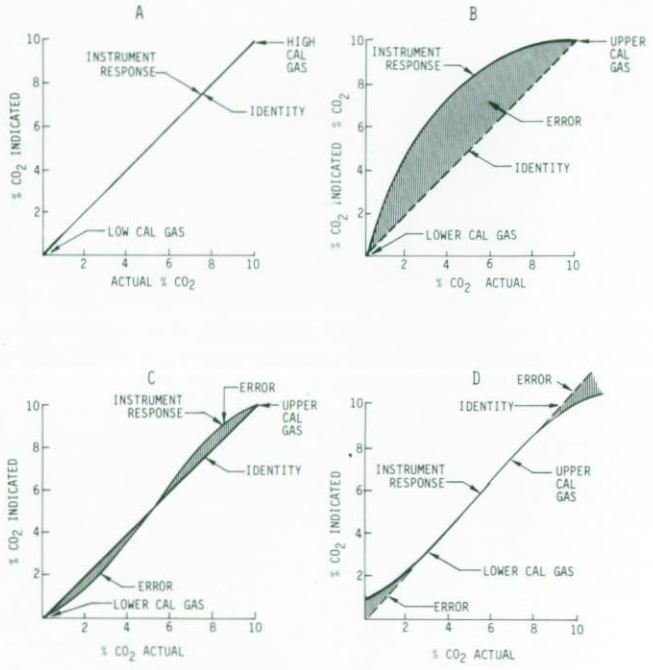

Fig. 2 Examples of linearity and nonlinearity in a CO_2 analyser. The shaded areas show the errors which would occur if linearity were assumed.

A. A completely linear response with correctly set zero and gain controls.

B. Logarithmic response: gain and zero have been adjusted to read correctly on calibration gases at 0% and 10% CO_2, the extremes of the operating range.

C. Partially linearised instrument: gain and zero have been set as in B.

D. Partially linearised instrument with the same characteristics as C, but calibrated with low and high gases in the expected range of measurement (3 and 7% CO_2).

Figs. 1 and 2 are reproduced by kind permission of the Editor of Respiratory Care.

Linearity refers to the ability of an instrument to give equal increments of output for equal increments of input, so that the instrument performance can be described by a linear equation. Some instruments still in use are non-linear and require the use of nonlinear meters, look-up tables or calibration curves to determine the true value. Modern analytical apparatus should provide a direct reading linear output and examples of linearity and nonlinearity in a

CO_2 analyser are shown in Fig. 2. Many instruments in common use are partially linearised as illustrated in Fig. 2C; the linearization is adequate though not ideal, the error being greater in some parts of the operating range. These errors can be minimised by doing a two point calibration within the expected range of measurement. This procedure is shown in Fig. 2D, the reading for the lower calibration gas being set by adjustment of the zero control and for the upper calibration gas by using the gain control. This is not a standard procedure on many instruments; the zero and span settings may interact in which case the calibration procedure will have to be repeated.

Noise: The term 'noise' refers to changes in the instrument's output that are not related to changes in the input. The noise originates either in the instrument or in the environment. In biopotential recordings, AC interference (50 or 60 Hz) is a frequent source of noise which can be reduced or elimated by proper grounding, shielding or attention to input impedance.

A common example of noise is the high frequency oscillation of some strain gauges used with pneumotachographs; here the source of noise is in the transducer rather than in the environment. Electronic filtering can be used to attenuate certain frequencies while allowing others to pass; one must know the frequency components of the events being studied in order to optimize the band pass so that noise is reduced to a minimum without impairing the fidelity of the response. In the strain gauge for instance the high frequencies can be filtered out, but there is a risk of attenuating the rapidly changing flow-rates encountered during a forced expiratory manoevre. It would be better to choose a transducer with a resonant frequency outside the band of respiratory frequencies.

The background noise of the analyser usually establishes the smallest detectable signal. Noise also contributes to measurement error as it introduces uncertainty into the reading. As noise signals are usually randomly distributed around the actual value, the error can be reduced by averaging several readings.

For a properly calibrated instrument in which systematic error has been reduced as far as possible, the three factors drift, linearity and noise contribute to the overall error (or accuracy). Thus an accuracy specification of 1% indicates that no reading will differ by more than 1% from the true value and that most readings will differ by much less than that. Manufacturers vary considerably in their use of accuracy specifications. Consider for example two oxygen analysers of about equal performance. The accuracy of one is stated to be 0.7% which is the sum of the errors from all sources, or 0.2% for short-term accuracy. The accuracy of the other analyser is claimed to be 0.01% which is simply the resolution of the digital meter and has nothing to do with its true accuracy.

What Accuracy is Needed?

The accuracy required from any analyser depends very much on the intended application. Let us suppose we have a relatively cheap oxygen analyser capable of measuring oxygen concentration to a 2% accuracy. If we were using this to monitor inspired O_2 concentration in a clinical setting it would seldom be of importance if the apparatus indicated (say) 35% O_2 where the true value was 33%. If, on the other hand, the same inaccuracy were to arise during determination of oxygen uptake during an exercise test, misleading results could be obtained.

Thus, if the true expired O_2 concentration were 16.0%, then assuming 15 litres/min as the expired volume, 20.9% as the inspired O_2 concentration, and 4.0% as the expired CO_2 concentration, the O_2 consumption would be 740ml/min. If, however, we estimated expired O_2 concentration to be 18.0%, then (keeping the other values constant) the calculated O_2 consumption would come to 430 ml/min, a very substantial error.

Acknowledgments

This article has been modified from a publication which originally appeared in Respiratory Care. We owe grateful thanks to the Editor of Respiratory Care and to Beckman Instruments Inc.

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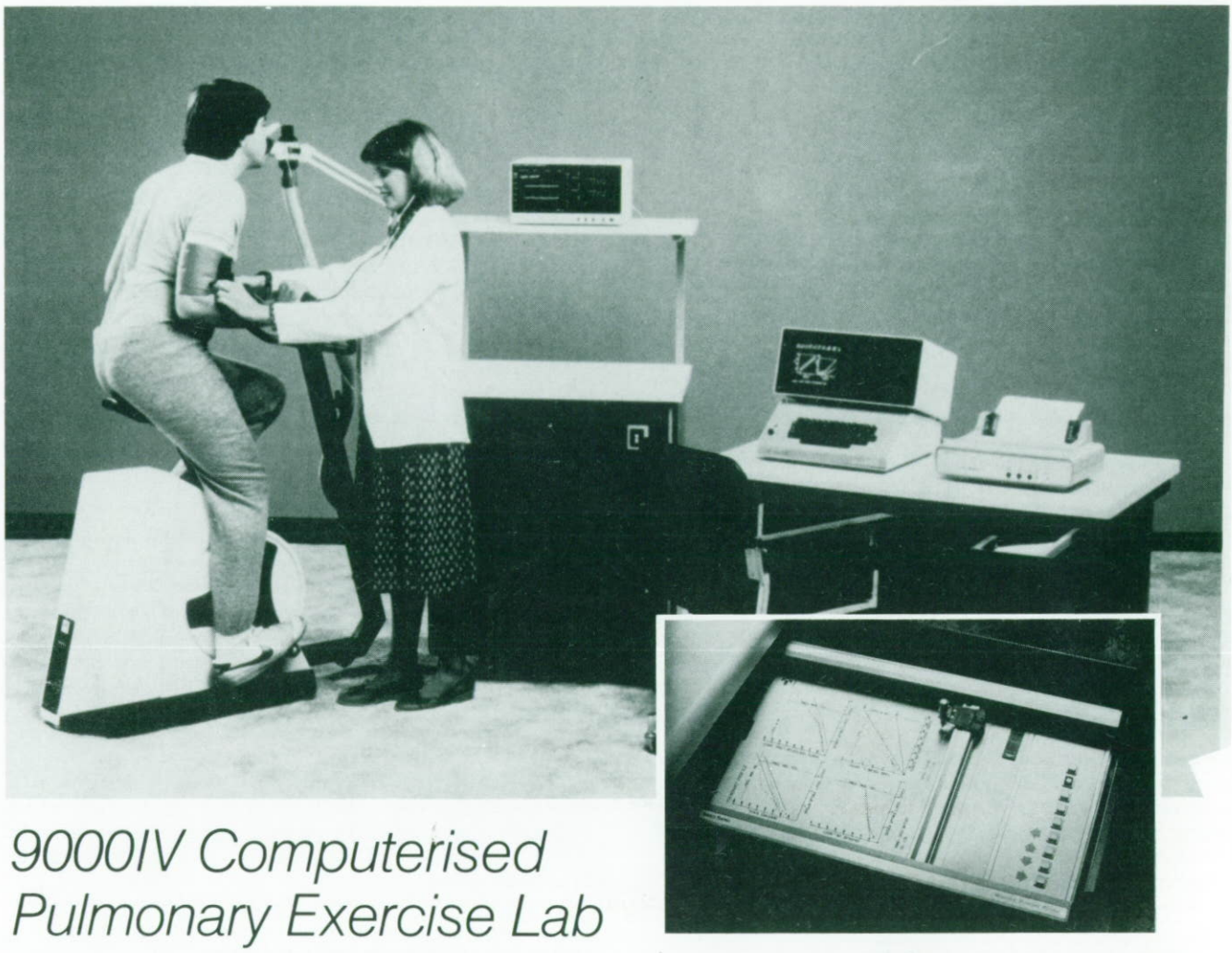

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DISTANCE LEARNING — A Scheme for Physiological Measurement Technicians

D. J. Keller
Department of Applied Science, Paddington College, London, W.2.

The National Certificate system of technical education has, over a number of years, provided a comprehensive educational programme designed to meet the needs of an identified group of technicians. Supervision of the National Certificate has recently passed to the Technician Education Council (TEC) who validate technical college courses leading to awards of Certificate or Diploma and Higher Certificate or Higher Diploma for a wide range of technicians.

Most TEC programmes consist of a 'core' of basic studies covering the background material together with a 'specialist' or 'elective' subject relating to a single or to a group of specialist topics. For example, in the area of Medical Laboratory Technology, elective schemes such as Histopathology, Haematology, or Medical Microbiology, are available to cater for technicians working in these fields, while Physiological Measurement is the elective scheme covering a number of fields such as Cardiology, Respiratory Physiology, Audiology or Neurophysiology.

The Numbers Game

The criterion for making available any specialist topic has always been the number of students requiring such an option. Technical colleges have always been conscious of the need to maintain minimum student numbers in classes or groups and these constraints have been brought sharply into focus by recent financial restrictions. While large specialist colleges have been able to offer all of the options within Medical Laboratory Science, other colleges give a restricted choice, perhaps providing a certain option only in alternate years, or running the first and second years of a particular option as a single group in rotation. Even large colleges can only offer Physiological Measurement as an elective subject to cater for different specialisms within this field. Typically a class of twenty Medical Physics (MP) or Physiological Measurement (PM) technicians taking a TEC Certificate course at a local college might consist of: 8 Cardiology students, 3 Respiratory Physiology, 3 Neurophysiology, 2 Medical Physics, 2 Perfusion, 1 Audiology and 1 Anaesthetics student. These ratios would vary from year to year and no one group could be viable on its own and treated as a single class for learning its specialist subject.

DHSS Training Memorandum

In 1981, the Department of Health and Social Security issued their now well-known Memorandum relating to qualifying procedures for both MP and PM technicians. This memorandum requires all MP and PM student technicians entering the profession with minimum qualifications of GCE 'O' level Certificates in English, Mathematics, Physics and one other relevant scientific subject, to take the TEC Certificate in Science (MPPM option) in order to progress to other technician grades. This event caused a consequent upswing in the number of students seeking a technical college course in MPPM; at Paddington the intake in September 1981 reached 60 compared with the previous year's figure of just below 30.

College Provision

Currently there are ten colleges in England, one in Northern Ireland, and two colleges in Wales (operating a joint scheme), who are aproved by TEC to offer the TEC Certificate in Science (MPPM option). See Table 1.

TABLE 1: Colleges approved by TEC to offer Certificate in Science (MPPM)

ENGLAND

Kitson College of Technology, Leeds
Matthew Boulton Technical College, Birmingham
Newcastle-under-Lyme College of Further Education
Newcastle-upon-Tyne College of Arts and Technology
North-East Liverpool Technical College
Paddington College, London
People's College of Further Education, Nottingham
Richmond College of Further Education, Sheffield
Salford College of Technology, Manchester.

NORTHERN IRELAND

Belfast College of Technology

WALES

Barry College of Further Education*
South Glamorgan Institute of Higher Education*
*(Operating a joint scheme)

The distribution of colleges over the country does not, however, relate to the location of hospital centres employing MPPM technicians. For example, Paddington is currently the only college in Southern England catering for this area of work and some student technicians have the double disadvantage of spending more than one hour travelling each way to and from college as well as paying the high costs of travel. Enquiries reaching Paddington from student technicians in hospitals in Southend, Ipswich, Colchester, Bedford, Oxford, Southampton, Guildford and Portsmouth show the urgent need to make this particular TEC Certificate qualification available over a wider area of the country.

Comparison of Study Modes

Conventional technical college modes of study for courses are: *Part-Time Day Release*, *Block Release*, *Sandwich* and *Full-Time*. From an educational point of view, both full-time and sandwich courses allow student technicians the opportunity of studying at a reasonable pace since lectures, demonstrations and practical work are undertaken in daytime hours only. The nearest equivalent to a full-time mode of study is seen in the various MPPM training schemes that already exist where student technicians combine a college education course with training in a number of MP and PM disciplines within the Health Service.

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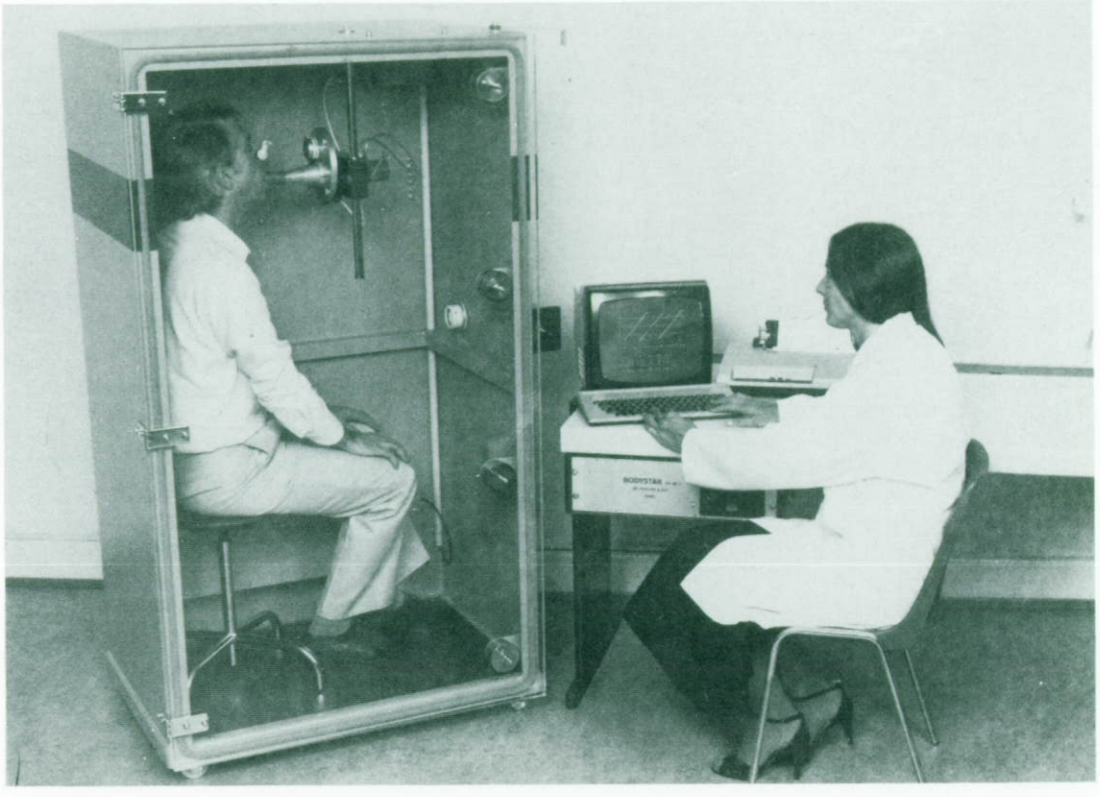

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Sandwich courses require a student attendance at college of more than 16 weeks in any one academic year while Block Release can take place in periods of less than 16 weeks. A typical Block Release course may be one week's full-time attendance at college in every month. This suffers from the educational disadvantage of compressing a given amount of study material into one week (probably using day and evening study), which is followed by a three-week gap between blocks in which the continuity of the programme is lost; a certain amount of 'revision' may thus be required at the beginning of each block of study.

Probably the most popular of technical college study modes is that of part-time day release, having a day of perhaps 10 hours in each week for the academic year of 36 weeks. The advantage of this study mode to employers is that they are able to organise their work-load to cope with the absence of student technicians on a given day in each week. From the educational point of view, the gap from one week to the next is not too large to affect the continuity of the course, but nevertheless a 10-hour day puts an excessive strain on the student.

When comparing study modes, one must consider the costs of travelling and accommodation. As the total length of continuous attendance at college increases, the accommodation costs also increase while the total travelling costs may fall, though this may be affected by the student's personal preference for spending weekends at home.

Alternative Systems

In TEC's educational philosophy, one of the main points is that, by identifying various groups of technicians, it is possible to provide programmes which are not only suited to a specific area of employment but also provide a basic study element which may be common to several different programmes. The consequence would be that a student technician could take the basic part of his TEC programme at a local technical college and complete the specialist or elective part at the specialist college, which may be some distance away. It is unfortunate that the total number of technical colleges able to offer even the basic elements of a TEC Certificate in Science programme has fallen recently in response to a fall in demand for various Certificate courses; consequently a number of courses which do not attain minimum enrolment numbers have been cancelled.

The foregoing trends provide the impetus to seek alternative educational systems, not usually associated with technical colleges. The scheme having the greatest potential is that of '*distance learning*'. Such systems, generally applied to non-practical subjects and usually linked to national examinations such as GCE, were pioneered in this country by correspondence colleges. The main disadvantage of such correspondence courses is the lack of direct interaction between the student and teacher so that such schemes are usually self-paced, the time of completion being linked to the speed at which the student works. Another problem with correspondence courses concerns methods of conducting the demonstrations, practical and project work associated with scientific and technological subjects.

The Open University has tackled these problems on a national basis and, given adequate resources, it should be possible to use modified methods developed by the OU to provide technical college courses over a large area of the country. Indeed, the Manpower Services Commission has, in a recent paper, proposed the development of an 'Open Tech'. Although the initiative for proposals to be included in such a scheme would come from the technical colleges, it would probably not apply to the provision of courses for state-employed student technicians as in the NHS.

Distance Learning in MPPM

To consider the possibilities of providing a distance learning scheme within the area of MPPM, it is first necessary to look at the unit breakdown of MPPM programmes. The TEC Certificate in Science (MPPM) programme currently offered by Paddington College, and based on TEC guidelines is shown in Table 2.

TABLE 2: TEC Certificate in Science (MPPM) — Programme of Units

Unit Number	*Unit Title*	*Unit Value*	*Unit Level*
01	Biology	1.0	I
02	Chemistry	1.0	I
03	Mathematics	1.0	I
04	Physics	1.0	I
05	Laboratory Safety	0.5	I
06	General and Communication Studies	1.0	GC
07	Physics	1.0	II
08	Mathematics (A)	0.5	II
09	Mathematics (B)	0.5	II
10	Chemistry	0.5	II
11	Medical Physics and Physiological Measurement	1.0	II
12	Cell Biology and Physiology	1.0	II
13	General Techniques and Safety	0.5	II
14	General and Communication Studies	0.5	GC
15	Medical Electronics and Ultrasonics	1.0	III
16	Physiology	1.0	III
*17	Medical Physics	1.5	III
*18	Physiological Measurement	1.5	III
19	General and Communication Studies	1.0	GC

*Optional units — students take ONE option only.

Referring to the programme in Table 2, it would probably be necessary for the specialist college to provide as a minimum provision, units 11, 13, 15, 16, 17 and 18 and possibly unit 12 in the form of distance learning packages, assuming that the remainder of the units contained in the programme could be provided by a 'local' technical college. A more logical approach would be for the specialist college to provide the whole programme of units as a complete package in order to ensure continuity of teaching within the programme and also to simplify the administrative arrangements concerning registration with the Technician Education Council.

Much of the material contained in the basic units of the programme is available in text books — in fact, there has recently been an increase in the number of text books specifically written for TEC-standard units. Although a large number of books are available covering specialist topics within Physiological Measurement, only certain sections would be directly applicable to student technicians. Indeed it is difficult to provide students with a comprehensive book list covering specialist areas in Physiological Measurement.

Relevant material is however already available in the specialist colleges in the form of Teacher's notes; Handouts such as diagrams and graphs; Overhead projector transparencies; 35mm (2 × 2) slides; 16mm films and prerecorded video casettes for both teaching and assessment of students' performance. The compilation of this material into package form for transmission to the student, would require consideration to be given to a balance between the presentation of material and the costs and accessibility of equipment. For example, the already accepted use of the written and diagrammatic material could probably be supplemented by the use of audio casettes but may not easily be extended to the use of video casettes unless casette recorder systems were to be made available to students. Although the use of video casettes is directly applicable to the theoretical aspects of the teaching schemes, only the principles of practical instruction can be covered by this means. Nothing, however, can take the place of 'hands-on' practical experience and unless effective solutions are provided for this aspect, the value of technical distance learning schemes will be lost. The Open University provides the teacher/student link by the use of tutorials which take place throughout the course.

Adopting a similar procedure, the technical college could offer the following facilities:

1. A complete set of material relating to the programme.
2. Telephone numbers and addresses for direct contact with programme or subject tutors.
3. A regular and rapid feedback of students' work with marks and comments.
4. Regular pattern of attendances at college for the following:
   (a) discussion with tutors on rate of progress, academic problems and administrative details.
   (b) for periodic assessments relating to the programme.
   (c) to undertake supervised practical course work.

While it would be essential to have an initial meeting between the student and the programme tutor, subsequent contacts between college staff and students could be arranged to suit the requirements of the particular student. For example, certain students could attend college on a series of single days, to include travelling time. Other students may require longer periods of attendance with residential accommodation. One further possibility would be for the students' local hospital or area hospital centre to provide facilities where they could undertake some supervised work such as assessments and perhaps even could receive guidance tutorials.

Conclusions

A distance learning system such as that outlined above would introduce several problems to technical college authorities. Currently the accounting of student hours of attendance at college provides the only means of establishing the staffing criterion. The development of distance learning packages by college staff would require a significant expenditure in time (remission from teaching), materials and other resources. The policy of flexibility to be adopted in distance learning systems, would mean that colleges should offer their facilities over an extended college academic year rather than the currently restrictive 36 weeks. Consideration would need to be given to the effect on other

colleges and the consequent viability of their courses, brought about by the introduction of a distance learning scheme at a particular college.

The problems associated with the use of a distance learning scheme for TEC Certificate in Science (MPPM) will to some extent, be offset by the advantages to the employers in terms of:

1. advertising the improved availability of such a course on a national basis.

2. involvement of DHSS, Regions or Areas and Departmental Supervisors in the linking of the educational scheme with an approved Training Scheme for MP and PM technicians.

These proposals for the introduction of a TEC Certificate in Science (MPPM) based on a distance learning system have received sympathetic consideration from various bodies concerned with the education and training of MP and PM technicians. It would, however, be useful to receive comments on the direct applicability of such a scheme in order to ascertain the number of students who would undertake such a programme.

DUPLICATE MEASUREMENTS OF CARBON MONOXIDE TRANSFER FACTOR AND ALVEOLAR VOLUME

D. P. Johns, P. D. Rochford, C. E. Barter, J. A. Streeton
Austin Hospital, Heidelberg, Australia

Summary

This study was undertaken to determine whether an interval of 3-4 minutes between measurements of TLCO is sufficient to flush He and CO gases inhaled during the previous measurement. Results were obtained from 113 patients who were divided into six groups according to the degree of airflow obstruction as defined by the FEV1/FVC ratio (FER). Statistical analysis showed no significant difference between the first and second measurements of VA or TLCO in any group with an FER greater than 49%. However, significant increases in the second measurement of VA and TLCO were found for the most obstructed groups, particularly with respect to VA. The observed differences were not explained on the basis of residual He or CO. These results may reflect a learning trend or a change in ventilation-perfusion matching in the lung.

Introduction

The measurement of the single breath carbon monoxide transfer factor of the lung (TLCO) requires the inhalation of air containing known concentrations of carbon monoxide (CO) and helium (He). It is common practice to quote the mean of at least two measurements of TLCO, the second being performed without a rest period apart from the 3-4 minutes required for gas analysis and preparation of the equipment for the next manœuvre.

The validity of the test rests on the assumption that CO back tension is negligible and that no helium is present in the lung prior to testing. The time interval between measurements must therefore be sufficient to ensure adequate flushing of CO and He from the lungs prior to the second manœuvre. This consideration is particularly relevant in patients with severe airflow obstruction in whom the distribution of ventilation is grossly uneven. For this reason it may be argued that a respite of up to 20 minutes is necessary for clinical evaluation of the TLCO and alveolar volume (VA).

This study was conducted to establish whether duplicate measurements of TLCO differ significantly when there is only a four-minute interval between measurements. The patients were placed into groups according to the severity of airflow obstruction and these groups were analysed separately. An attempt is made to explain any differences found on the basis of retained CO and He gases in the lung.

Method

The results of 129 patients seen consecutively in the laboratory for clinical evaluation of TLCO, VA and spirometry were analysed. Data on 16 (12%) of these patients were rejected for the following reasons:—

(a) twelve performed more than two TLCO manœuvres,
(b) three managed only a single manœuvre and
(c) one performed submaximally due to chest pain.

Therefore, only those patients who performed the test in duplicate on the first attempt were included in this study. Results were not excluded on the basis of poor repeatability, volition or cooperation.

The TLCO, VA and inspiratory vital capacity (VC_1) data on the remaining 113 patients were divided into six groups according to the degree of airflow obstruction as defined by the FEV_1/FVC ratio (FER) (Table 1).

Standard single breath TLCO manœuvres were performed in the seated position using a manual method similar to that described by Ogilvie et al[1]. Each patient inhaled a vital capacity breath of test gas containing approximately 10% He and 0.28% CO and held the breath for 10 seconds before exhaling. The initial 0.7-1.0 litre of the expirate was discarded and the next 0.5-1.0 litre captured as the alveolar sample. He and CO concentrations were determined with thermal conductivity and infra-red meters (P. K. Morgan UK). Immediately after completion of the first manœuvre, the equipment was prepared for the second test. In all cases the time interval between the first and second manœuvre was about 4 minutes. TLCO and VA were calculated as described by Cotes[2]. Spirometry was then performed using a rolling seal spirometer.

Table 1: Number of patients and mean FEV_1/FVC % (FER) for each group. Values for TLCO and VA are group means for the first manœuvre.

$\frac{FEV_1}{FVC}$ %	No. of patients	MEAN±SD $\frac{FEV_1}{FVC}$ %	TLCO (ml STPD/min/mm Hg)	VA (litres)
>79	21	85±4	19.9±7.9	4.1±1.5
70-79	24	75±3	19.7±8.4	4.7±1.2
60-69	22	64±3	17.3±6.5	4.4±1.1
50-59	14	55±3	15.3±4.9	4.7±1.3
40-49	17	45±3	15.7±4.7	4.8±1.3
<40	15	30±7	10.2±3.9	4.0±1.5

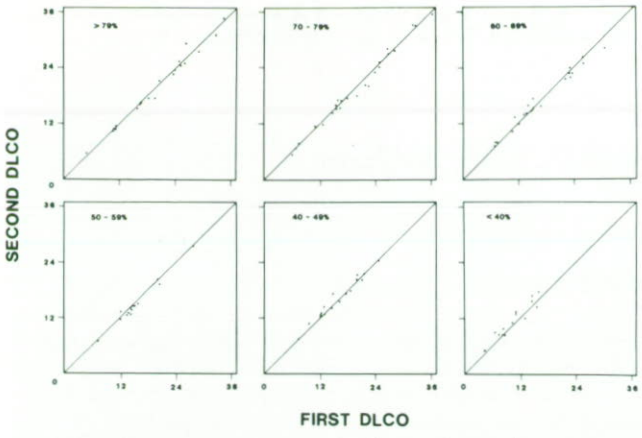

Figure 1. Correlations between the first and second measurement of TLCO (ml/min/mm Hg) for each FER group.

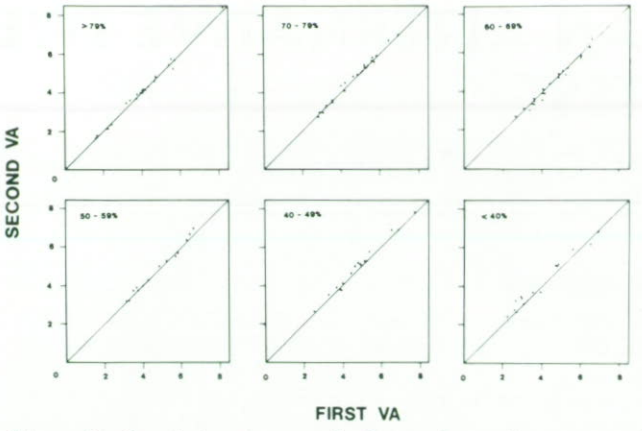

Figure 2. Correlations between the first and second measurement of VA (litres) for each FER group.

Results

Figures 1 and 2 show the correlations between the first and second measurements of TLCO and VA for each FER group. For groups with an FER of greater than 49% there was no significant difference in VA or TLCO. However, there were statistically significant differences between the first and second measurements in the two groups whose FER was less than 50%. In both of the latter groups the second measurement of VA exceeded the first measurement (Table 2). Furthermore in the group whose FER was less than 40% the second measurement of TLCO was on average 9% higher than the first ($P<0.01$).

In all groups with an FER outside the range of 60-79% the mean VC_I for the second manoeuvre was significantly higher than the first (Table 2). The mean per cent increase was greatest in the most obstructed group (8%).

Discussion

Our data show that a significant increase in the measurement of TLCO and VA can occur in patients with severe obstruction when the second manoeuvre is performed within four minutes of the first. These changes are in the opposite direction to those which would result from the presence of residual He in the lungs or from the development of a CO back tension in the pulmonary capillary blood. The second VC_I was greater than the first in four of the six groups, but only in the two groups with the lowest FER was the second VC_I substantially greater than the first. It was in these two groups that the second measurement of VA was seen to be the greater.

If a learning trend were responsible for the increase of the second VC_I, one might expect that all groups should be similarly affected. It is conceivable however, that a learning trend is promoted by the difficulty experienced by the patient in the test, and that this is greatest in patients with more severe airflow obstruction.

In the two groups with greatest increase of VC_I in the second test, the VA also increased suggesting a fuller inspiration to total lung capacity and therefore, greater stretching or recruitment of lung tissue. The finding that the TLCO increased significantly (9%, $P<0.01$) only in the group with the lowest FER probably reflects the proportionally greater change of VA in this group. However, it is unlikely that the 9% mean increase in TLCO was entirely due to an improved area for diffusion because the corresponding increase in VA was only 4.5%, which in normal subjects accounts for only half of the observed increase in transfer factor[3]. Improved matching of ventilation and perfusion due to the previous volume history may have contributed to the increase in TLCO.

References

1. Ogilvie C M et al (1957). A standardised breath holding technique for the clinical measurement of the diffusing capacity of the lung for carbon monoxide. J Clin Invest. *36* 1-17.
2. Cotes J E (1975). Lung Function; assessment and application in medicine. 3rd Edition. Blackwell Scientific Publications, Oxford.
3. Cotes J E and Hall A M (1970). The transfer factor for the lung; normal values in adults. *In:* Normal Values in respiratory function in man; ed Arcangeli P, 327-343. Panminerva Medica, Milan.

Table 2: Statistical details of the correlations between the first and second measurement of TLCO, VA and VC_I.

$\frac{FEV_1}{FVC}$ %	2nd/1st MANOEUVRE (%)			LEVEL OF SIGNIFICANCE		
	TLCO	VA	VC_I	TLCO	VA	VC_I
>79	98.6	100.2	102.9	NS	NS	<0.02
70-79	99.6	100.6	101.0	NS	NS	NS
60-69	100.6	99.5	100.0	NS	NS	NS
50-59	98.0	101.3	102.2	NS	NS	<0.02
40-49	102.4	102.1	104.4	NS	<0.02	<0.01
<40	109.3	104.5	108.1	<0.01	<0.05	<0.01

Paired t-test was used to determine the level of significance. NS: not significant ($p>0.05$)

AN ALTERNATIVE TWELVE-MINUTE WALK TEST

M. Ogier, S. Connellan, R. D. Steventon and R. S. E. Wilson
Royal Shrewsbury Hospital, Shropshire

Summary

A twelve-minute walk test on a treadmill was used to assess the effects of bronchodilators, given in two different doses to ten patients with chronic airflow obstruction. The patients found no difficulty in performing the test throughout which the ECG was continuously monitored. The walk distance increased in the majority of patients after bronchodilator therapy, though this was not significant at the 5% level. There was, however, a significant reduction in the Borg effort score. There was no difference in the pulse rate between the two doses of bronchodilator and ECG changes were rarely observed. We suggest that the treadmill walk test is a useful alternative to the standard twelve-minute walk test.

Introduction

The twelve-minute walk test has been widely used to assess the degree of disability and the effects of therapy on patients with chronic airflow obstruction (McGavin, *et al*, 1976). The test is usually performed with the patient free walking along corridors and the distance walked in a twelve-minute period is measured. An alternative treadmill test is described here which is used in our laboratory to assess the effects of bronchodilators in patients with severe chronic airflow obstruction who show small changes in static tests of ventilatory capacity.

Method

On the day of the test the patient, having taken no bronchodilator for at least four hours before the test, undertook a 'practice' walk on the treadmill. The treadmill speed was adjusted until it was at a comfortable pace as determined by the patient. The majority of patients readily adapted to walking on the treadmill and usually chose a speed between 1.5 and 2.5 kph.

After a rest two stop-watches were started and simultaneously the patient was asked to walk for as long as was comfortable and to indicate when a rest was needed. At this point the treadmill was stopped and one watch stopped to record the time walked. when the patient was ready to walk again both treadmill and stop-watch were restarted. This process was continued over a period of 12 minutes and by noting the time spent walking, the total walk distance could be calculated.

The patient was asked to carry out the test: (a) before treatment, (b) after bronchodilator from a standard aerosol or rotahaler, and (c) after nebulised bronchodilator, with about 30 minutes rest between each test until the heart rate returned to normal. Cardiac frequency and ECG were monitored using the Quinton ECG monitoring system. After each 12-minute walk test the patient was asked to indicate on a Borg scale the degree of difficulty experienced during the walk.

TABLE 1: Twelve-minute walk distance (metres)

Patient Number	Actual Walk Distance			Maximum Possible Walk Distance
	No Treatment A	200 μg Salbutamol (Aerosol) B	5 mg Salbutamol (Nebulised) C	
1	140	187	257	300
2	220	228	250	300
3	370	454	472	500
4	210	216	231	300
5	266	341	352	550
6	327	323	400	400
7	400	368	346	500
8	182	194	226	350
9	107	135	165	300
10	714	644	619	800
Mean	293	309	332	
SD	176.1	153.0	137.0	

Significance of differences between columns by paired 't' test: A vs B $P > 0.3$
B vs C $0.1 > P > 0.05$

Results

In our laboratory the test has been completed by over 100 patients. In only three of these patients was there ECG evidence of dysrhythmia or cardiac ischaemia. Ten patients selected at random are described here. All were smokers or ex-smokers, aged from 55 to 70 years. All had severe chronic airflow obstruction with FEV_1 ranging from 0.4 to 0.8 litres, and VC from 1.25 to 3.4 litres. Information obtained from the test is shown as follows:

Walk Distance (Table 1)
The average walk distance increased after 200 μg salbutamol aerosol though the change was not statistically significant. There was a further increase after 5 mg salbutamol from the nebuliser but again the change was not significant. There was a wide variation in patient response, some showing a substantial increase in walk distance after the bronchodilator while in others there was a reduction.

Borg Score (Table 2)
There was a significant decrease in Borg score after 200 μg salbutamol aerosol and a further significant decrease after the nebulised salbutamol.

Cardiac frequency (Table 3)
There was no significant change in cardiac frequency after either form of treatment.

Discussion

The use of the treadmill test has a number of advantages: it enables the patient to perform the test under standard conditions, in the privacy of one room and the distance walked can easily be calculated. The ECG and cardiac frequency can be monitored throughout the test so that ischaemic changes, dysrhythmias and exercise tachycardia can be detected; the safety of large doses of bronchodilators can be assessed, of particular importance in this group of patients many of whom are elderly with a long smoking history and who thus run a risk of ischaemic heart disease. No patient in our experience has failed to complete the series of walk tests.

TABLE 2: Borg Score

Patient Number	No Treatment A	200 μg Salbutamol (Aerosol) B	5 mg Salbutamol (Nebulised) C
1	16	13	7
2	13	13	9
3	17	9	5
4	15	10	8
5	13	12	9
6	13	12	11
7	9	7	6
8	17	16	15
9	19	17	15
10	13	11	11
Mean	14.5	12.0	9.6
SD	2.88	3.02	3.44

A vs B $P < 0.01$
B vs C $P < 0.005$

TABLE 3: Cardiac frequency

Patient Number	No Treatment A	200 μg Salbutamol (Aerosol) B	5 mg Salbutamol (Nebulised) C
1	102	78	80
2	72	73	73
3	87	85	95
4	80	90	94
5	95	90	97
6	68	64	96
7	90	74	80
8	115	120	120
9	94	96	86
10	87	93	86
Mean	89	86	91
SD	13.8	15.6	13.1

There is no significant difference between columns A, B and C.

The only disadvantages are the cost and necessity for housing the treadmill. Certain patients might find the test distressing though we have not found this. Nevertheless a certain amount of teaching is required.

By using the twelve-minute walk test, it is relatively easy to assess the response to a bronchodilator drug. We showed in fact that salbutamol had quite variable effects, the walk distance being substantially improved in some patients but reduced in others. Nevertheless, the Borg score was reduced in nearly all the patients whether or not the walking distance was improved. We conclude that the twelve-minute treadmill test is a useful and sometimes preferable alternative to the standard walk test.

Reference

McGavin C R, Gupta S P, McHardy G J R (1976). Twelve-minute walking test for assessing disability in chronic bronchitis. Br.Med.J. *1* 822

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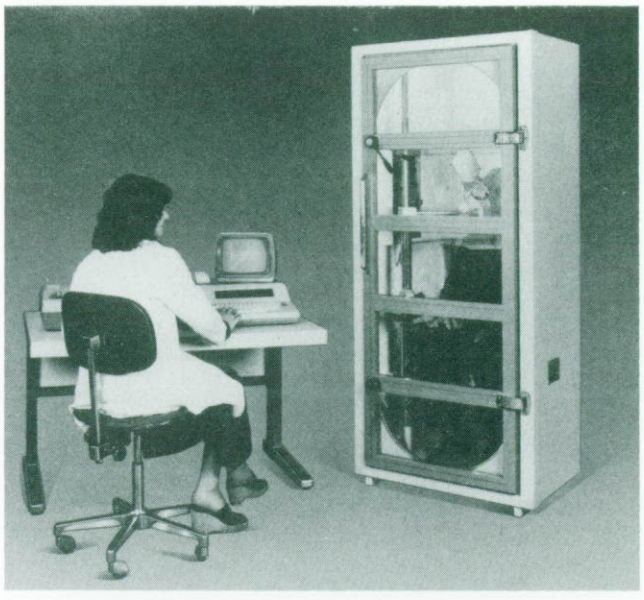
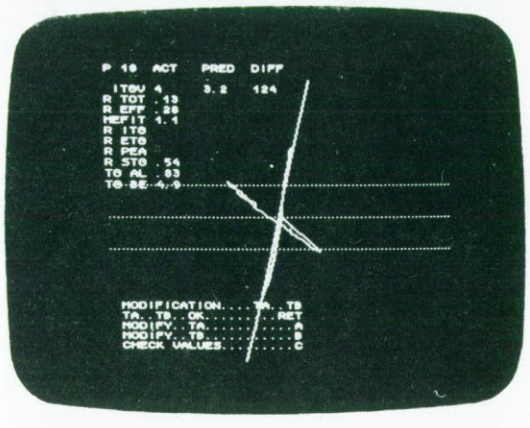
BODYSCREEN II





ID. # --2357--
NAME EICHLER
FIRST H.RUEDIGER

AGE [YEARS]	32	DATE	05.07.82
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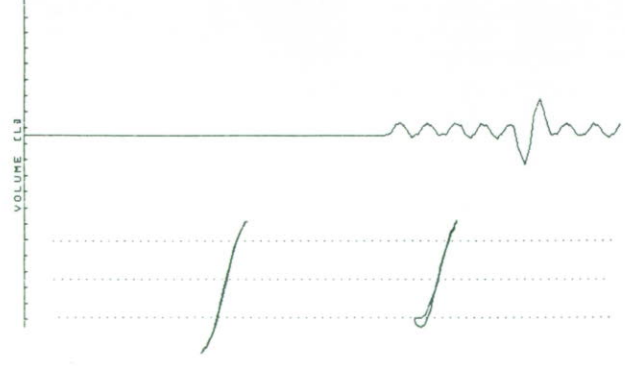
WEIGHT [KG]	98	BAR.PR.[MB]	1012
SEX	M	HUMID. [%]	56



BODYPLETHYSMOGRAPHY

PARAMETER # 11	PRED	1.ACT	%PRED	2.ACT	%PRED	%2/1
R AW.....KPA/L/S		.22		.3		136
SR AW.....KPA/S		.92		1.2		130
G AW.....L/S/KPA		4.4		3.3		74
SG AW.....S/KPA		1		.82		81
CORR.....%..		.87		.86		98
ITGV.....L..	3.2	4	124	4	124	100
RV.....L..	1.8	2.1	116	2.1	116	99
TLC.....L..	8	6.7	83	6.7	83	100
ITGV % TLC.....%..		60.7		59.7		98
RV % TLC.....%..		31.8		32		100
VC IN.....L..	6.2	4.5	72	4.5	72	100

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ANNUAL GENERAL MEETING OF THE ASSOCIATION

The Annual General Meeting took place on Saturday, 16th October 1982, at Harefield Hospital.

We owe grateful thanks to Peter Lockwood, Andrea Morgan and Hugh Lloyd for organising the meeting, to the speakers for their interesting papers, and to the caterers for providing an excellent lunch.

We owe particular thanks to the following firms for their generous sponsorship of the meeting, and for taking the trouble to put on excellent demonstrations of their products:

Beckman-RIIC
Corning Medical and Scientific
Garrick Equipment
Gould Medical
P. K. Morgan
W. B. Pharmaceuticals.

The following scientific papers were given by speakers from Harefield Hospital:

1. Maximal flow-volume curves using helium-oxygen mixtures: Peter Lockwood

Patients with bronchial carcinoma pose a number of problems when thoracic surgery is being considered. They may well be suffering from chronic obstructive bronchitis or emphysema in addition to the tumour and separation of the respective effects of these disorders by conventional lung function tests is a difficult task. The speaker discussed the theoretical basis for flow-volume curves using a helium-oxygen mixture and how such tests could help in solving the surgeon's dilemma.

2. The assessment of coronary artery disease using a computerised gamma camera system: Helen Fagg.

Techniques in nuclear medicine have made great strides in recent years and this talk gave us an excellent glimpse into the world of cardiological investigation. The function of the myocardium can be assessed with considerable precision by the use of intravenous radionuclides which can be located using a gamma camera.

With the aid of some excellent illustrations, it was shown how these techniques can be of the greatest value in the assessment of patients before and after coronary artery surgery. It was a salutary thought that — in this field — the eye of the operator is still a more effective tool than the computer!

3. Lung function and the management of the respiratory patient: Abdul Nath.

The introduction of more and more new techniques of respiratory assessment and above all, the advent of the computer have placed an ever increasing quantity of information at our disposal. In fact there may well be too much and we need to reappraise very critically the exact place of all our techniques. Some of our tests are research tools, others are merely interesting while others are crucial to the management of the patient.

Dr Nath showed us how sequential estimation of quite simple tests can give us extremely valuable information on the patient's progress in conditions as different as asthma and sarcoidosis.

4. An alternative to breathing: Edward Townsend.

This intriguing title concealed a memorable account of future prospects in respiratory intensive care. The artificial kidney is already with us, but the artificial lung has not yet arrived — at least so we thought until we heard about the extracorporeal membrane oxygenator. Mr Townsend told us of some fascinating experiments with this device; in the sheep it is capable of completely taking over the function of the lung, while the animal remains quite placidly in its pen in a normal state of health. Trials in the human are already under way and the method has been maintained for several days with eventual recovery in a number of patients. Improvement will naturally be required but the method is undoubtedly going to play an increasingly large part in the intensive care unit.

CHAIRMAN'S REPORT

Derek Cramer
Lung Function Unit,
Brompton Hospital, London, SW3.

First of all I would like to express my thanks on behalf of all members of the Association to Peter Lockwood, Andrea Morgan and their team for again arranging this meeting at Harefield Hospital. We are also indebted to our speakers, the firms who have sponsored the meeting and put on demonstrations, and to the caterers, all of whom have helped to make this a successful meeting. We are also most grateful to Sue Hill who organised an excellent Spring meeting at the General Hospital, Birmingham, last April.

Tax Relief

We are still in the process of trying to obtain tax relief for members' subscriptions and exemption from Corporation tax which is unfortunately proving to be a lengthy and involved procedure. This is the reason for proposing the amendments to Rule 2 of the Constitution (which relates to improvements in pay and conditions) so that the wording becomes acceptable to the Inland Revenue, allowing us to be recognised as a charitable organisation.

Royal Society of Medicine

During the course of the year, Jane Jones was approached by a Sub-Group of the Royal Society of Medicine who are interested in physiological measurement, the idea being that we should consider some form of affiliation. Other Associations, such as the cardiological technicians, already have backing from a medical organization and it seems that this might prove a useful liaison in the future. There is no

question of it becoming a 'take-over bid' as our Executive Committee considers that we are already firmly established and in no danger of losing our identity. Our views have been forwarded to the Royal Societyof Medicine through Jane Jones and negotiations will continue.

An Australian ARTP

We already have a couple of Australian members in our Association and I am pleased to announce that the Australasian Society of Respiratory Technologists (the ASRT) has now been formed and consists of members from Australia and New Zealand. Their Secretary has written to me, asking for our support in the form of exchanging views and papers and this clearly can only be of mutual benefit; I have also received the first number of the Journal called 'Volume'.

Education and Training

The In-Service Training Manual for Physiological Measurement Technicians is now being distributed; this is intended to be an aid to the training of the students and provides a record of the approved training received. The manual is now being introduced nationally, so as to standardise the level of competence.

An Education Sub-Committee is being formed within the Association. It will deal with all general aspects of technician training and will keep the manual up to date.

I would like to thank the Editor of Breath, Dr. Hutchison, and the Assistant Editor, Jane Jones, who have made 'Breath' into a most professional journal. I would also like to thank my fellow members on the Executive Committee who have put in a great deal of extra work over the year.

Finally, on a sad note, I regret to announce that one of our members, Mr. A. Bovington of the Westminster Hospital, died in June of this year. We send our sincere condolences to his family.

Newly Elected Officers

Chairman:	Derek Cramer (re-elected)
Secretary:	Gillian Lowe (re-elected)
Treasurer:	Gloria Holbrooke (re-elected)
Executive members:	Sally Gough (re-elected)
	Sue Hill (re-elected)
	Julian Williams
	Marion Geary

TREASURER'S REPORT

Annual General Meeting, October 1982.

The accounts for the past financial year have now been audited and circulated to all members. As in previous years our main expenditure is on travel and postage. These costs have risen considerably over the past year and take a large proportion of our membership fees. To keep our books in balance it would be a great help if subscriptions could be paid promptly. Catering costs for our twice yearly meetings are generously covered by donations from exhibitors. We are very grateful for their continuing support and glad to welcome some loyal companies at every meeting.

Breath continues to profit despite rising costs. Binders are now available for Breath. These are expensive but are being sold virtually at cost price so that we need to sell all of them to cover ourselves. I hope as many members as possible will buy one.

We have been assessed as being liable for corporation tax on the interest on our deposit account. We have applied for charitable status and the tax office has agreed not to press for payment until the outcome is known. If we are granted charitable status we will not have to pay tax on interest and the membership fees will be eligible for tax deduction. For our application for charitable status we will have to supply copies of the constitution, the accounts, the minutes of the inaugural meeting and as much background information about our activities as possible. This can be in the form of publicity material, pamphlets and press cuttings. If any member has material that could be of value, I would be very grateful if they could send it to me so that I can build up a dossier for the charity commission.

OBITUARIES

ANTHONY BOVINGTON, FIMLT.

Anthony Bovington was the chief technician in the Pulmonary Function Laboratory in the Department of Thoracic Medicine at Westminster Hospital. He died at home in his garden unexpectedly on June 12th, 1982.

He was born in July 1924 at Gravesend and after being at school at Gravesend and Chelsea, he trained under Sir Alexander Fleming at St. Mary's Hospital, Paddington.

From the time he first went to take charge of the Pulmonary Function Laboratory at Westminster Hospital he became an institution. He had a remarkable breadth of knowledge about laboratory matters and was always eager to turn his energies to solving problems for the doctors and other staff. All this he did with a modest and kindly professionalism.

His hobby was radio communications; he was not just a "ham" operator, but was an expert at building and maintaining radio and other electronic equipment. This expertise was a great help when he computerised the measurement and reporting of pulmonary function in his laboratory as early as 1973; this was probably the first such system to operate routinely in the United Kingdom.

He was always reluctant to recognise that he had been suffering from some ill health for a number of years — and would never excuse himself from any activity on this account. His colleagues at work had a great affection for him and held him in the very highest regard. He was a devoted family man and was much loved by his wife and two children who survive him.

Dr. Peter Emerson

GLORIA GESSEY

We announce with great regret the recent death of Gloria Gessey after a long illness. Members will recall her long and devoted service on behalf of Physiological Measurement Technicians and of the ARTP, of which she was a founder member; she was a regular attender at Association meetings in spite of her failing health. A full appreciation will appear in a later issue.

The Morgan Roadshow

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ARTP NEWS

Spring meeting of the Association

This is to be held on Saturday the 16th April in Liverpool. Further information and the programme will be sent to members at a later date. Meanwhile any enquiries about the meeting or the exhibitors should be addressed to;
Barbara Peattie,
The Cardiac Department,
The Hospital College,
Royal Liverpool Hospital,
Liverpool L7 8XT.
Tel. 051-709 0141.

Training workshop to discuss the national training manuals — their implications and use.

This will be held on Friday the 4th March at:
The Postgraduate Training Centre,
Derbyshire Royal Infirmary.

This workshop is aimed at Heads of Departments and Senior Staff involved in training. All enquiries should be directed to:
Gillian Lowe,
Cardio-thoracic Unit,
Derbyshire Royal Infirmary,
London Road,
Derby.
Tel. 0332 47141.

BREATH GREETS VOLUME

Volume is the journal of the Australasian Society of Respiratory Technology which was formed last year. The objectives of the Society are very similar to those of the ARTP and a letter of greetings and good wishes from our Chairman, Derek Cramer, has appeared in their last issue. Thinking back to our own early days as a photocopied Newsletter we must congratulate the Editor of Volume on an excellent production and send them our warmest good wishes for the future.

CORRESPONDENCE

THE ROYAL SOCIETY OF MEDICINE AND THE ARTP

The Royal Society of Medicine (RSM), as your readers will know, has recently been having discussions with the ARTP on the training of Physiological Measurement Technicians. The Council of the Section of Measurement in Medicine of the RSM contains a number of chest physicians and respiratory physiologists; we have felt for some time that, although the current day release college courses and the new in-service training programmes do provide reasonable training, there is some lack of instruction about the diseases suffered by the patients who attend lung function laboratories.

Some regions (notably NE Thames) have made laudable attempts to correct this deficiency, by holding twice yearly study days but as a section we are interested in exploring the need for a short autumn course of 6 to 8 lectures lasting an hour or two; these could be held at the RSM headquarters near Oxford Circus, which would be convenient for technicians from all four Thames regions. The subjects would include diseases of the airways, interstitial lung disease and control of breathing among other topics and would be suitable for both students and qualified technicians.

We would have to cover the Society's expenses but I doubt if this would mean more that a nominal fee which should in any case be reimbursed by the employers. We would be interested in any comments which ARTP members may have on the feasibility of such a scheme, and we hope that we are not imagining a need which does not really exist!

Martyn Partridge
Section of Measurement in Medicine
The Royal Society of Medicine
London W1M 8AE

COVENTRY HEALTH AUTHORITY
WALSGRAVE HOSPITAL

BASIC GRADE
PHYSIOLOGICAL MEASUREMENT TECHNICIAN

Applications are invited from suitably qualified technicians for the above post in the Cardiothoracic Unit of this modern general hospital.
The person appointed will assist with routine respiratory function testing and the monitoring of cardiothoracic surgery. Salary £4204 rising by annual increments to £5381 per annum. Further details, application forms and job descriptions available from Sector Administrator, Walsgrove Hospital, Clifford Bridge Road, Coventry, CV2 2DX. Closing date 21st February.

NOTTINGHAM HEALTH AUTHORITY
QUEENS MEDICAL CENTRE
UNIVERSITY HOSPITAL

Senior Chief Physiological Measurement Technician
(Cardiac Department)

Salary: £8036-£9387 (increase pending)

Applications are invited for the above post at this modern teaching hospital which currently has 789 beds increasing to 1200 by 1984.

The Cardiac Department provides a full range of invasive and non-invasive cardiological and respiratory investigations.

Applicants should have wide experience in all the appropriate physiological measurement techniques.

The department consists of 7 qualified Physiological Measurement Technicians and 6 Cardiographers and the Senior Chief Technician must be able to demonstrate some previous managerial experience.

Nottingham is a pleasant city within easy reach of attractive surroundings. The hospital is within 2 miles of the city centre which provides excellent social, recreational and educational facilities and good shopping centres.

Temporary accommodation is available on site.

Job description, application form and further details are available from: Mr J A Williams, Administrator (Personnel Services), University Hospital, Queens Medical Centre, Nottingham, NG7 2UH. Telephone (0602) 700111 ext. 3781.

Closing date: 4 March 1983

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Breath is the journal of the Association of Respiratory Technicians and Physiologists. Original articles, reviews, correspondence or comment on subjects of scientific or general interest may be submitted to the Editor: D C S Hutchison, Chest Unit, King's College Hospital, London SE5 8RX. Material should preferably be typed on one side of the paper only, in treble spacing throughout. Photographs should be of good contrast, printed on glossy paper and unmounted. Tables and legends to figures should be typed on separate sheets.

Applications for advertisement space and for rates should be addressed to: Jane Jones, Respiratory Laboratory, London Chest Hospital, Bonner Road, London E2.

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