HOSPITAL ENGINEERING

January/February 1978

The Journal of the Institute of Hospital Engineering

International Conference - Lisbon


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Editor
Christopher Tanous

Art Editor
Bob Rixon

Advertisement Manager
Janet Rich

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The Institute of Hospital Engineering,
20 Landport Terrace,
Southsea, Hants. PO1 2RG, England
Telephone:
Portsmouth 23186 (STD 0705 23186)

Secretary
J. E. Furness, VRD*

HOSPITAL ENGINEERING

Vol. 32 No. 1

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Contents

2 Institute News

5 International Federation Conference — Lisbon

11 Estmancode — A Practical Philosophy?

14 A Mathematical Model to Determine Facility Needs for a Radiological Department

Earl A. Simendinger

Louis A. Tuzi

Terence F. Moore

26 Product News

Institute News

34th Annual Conference

Royal Hotel, Cardiff, April 26-28, 1978

The Conference
is the 34th Annual Conference of the Institute and will be held at the Royal Hotel, Cardiff.

The contributions being made by the Department of Health and Social Security and the Welsh Health Technical Services Organisation are noted with appreciation by the Institute.

Conference Registration
Application forms have been sent to members, and are available from the Secretary of the Institute.

VISITORS from other societies and organisations, and from the hospital service, are welcome to attend any session of the Conference.

Payment of expenses — Hospital Service.

In accordance with the authority given in Circular HM (54) 55, officers may be granted special leave with pay to attend conferences on work with which they are concerned. Travelling and subsistence allowances at the usual rates may be paid to officers, provided that approval to attend has been obtained from the Employing Authority.

Conference Dinner Dance
will be held at the Royal Hotel, Cardiff, on the evening of Thursday, April 27, 1978.

Ladies' Programme
A special Ladies' Programme has been arranged, as shown below. An introductory meeting will be held in the Royal Hotel on the first morning of the Conference.

Hotel Accommodation
Special arrangements, and terms, have been agreed with the Conference Hotel in regard to accommodation for delegates and wives. For details see Conference Application Form.

Tickets
for the Conference and the Conference Dinner Dance, and registration for accommodation at the Royal Hotel, should be obtained by application on forms available from The Secretary, The Institute of Hospital Engineering, 20 Landport Terrace, Southsea, PO1 2RG.

Wednesday, April 26

10.15 a.m. OFFICIAL OPENING by
THE RIGHT HONOURABLE THE LORD MAYOR OF CARDIFF, COUNCILLOR DAVID PURNELL
Introduced by
J. R. HARRISON, Esq, CBE, CEng (Fellow)
President, The Institute of Hospital Engineering

10.30 a.m. 'SOME APPLICATIONS OF NUCLEUS SOLUTIONS'
Speakers: P. JAMES, FRIBA, DipArch
E. A. DALEY, RIBA
Hospital Design Partnership
P. A. TYLER, FINucE, FIHospE
M. ASHRAE, MRSH
Austen Associates
Chairman: D. P. PICKUP, BSc(Eng), CEng, FICE, FIMunE, AMBIM, FIHE,
Director of Works,
Welsh Health Technical Services Organisation

2.30 p.m. 'A REVIEW OF STERILISATION TECHNOLOGY AND DEVELOPMENTS'
Speaker: S. A. GIBBONS, BA, CEng, MIMechE, MCIBS,
Trent Regional Health Authority
Chairman: R. BAKER, BPharm, BSc(Econ), FPS, MBIM,
Superintendent Inspector of Medicines Inspectorate,
Department of Health and Social Security

Evening CIVIC RECEPTION

Thursday, April 27

10.00 a.m. THE RATIONAL USE OF ENERGY
Speaker: R. MANSER, BSc(Eng)(Hons), CEng, MIMechE, FIEE, PPI HospE,
Assistant Chief Engineer,
Department of Health and Social Security
'DEVELOPMENT AND USE OF ENERGY AUDIT FOR HEALTH SERVICE BUILDINGS'
Speakers: E. BRETHERTON, CEng, MIMechE, MCIBS,
Assistant Regional Engineer
R. A. BRIGGS, BSc,
Main Grade Engineer
Chairman: J. CONSTABLE, CBE,
Regional Works Officer,
West Midlands Regional Health Authority

2 p.m. Discussion on 'ENERGY AUDIT

2.30 p.m. 'CONSERVATION THROUGH SITE GENERATION'
'A CONCEPT'
Speaker: R. G. KENSETT, CEng, MIMechE, MCIBS, MInstF, FIHospE, AMBIM,
Assistant Chief Engineer
'OPERATION EXPERIENCE'
Speaker: D. GRIFFITHS, BA, CEng, MIMechE, MIHospE,
Main Grade Engineer
Chairman: E. A. JOHNSON, CEng, MIEE, FIHospE,
Chief Engineer
Welsh Health Technical Services Organisation

7.30 p.m. for 8 p.m. CONFERENCE DINNER DANCE

Friday, April 28

10.30 a.m. 'NOISE CONTROL IN HEALTH BUILDINGS'
Speaker: T. WAGSTAFF, MSc, BSc(Eng), CEng, MIMechE, FIHospE, MIoA,
Principal Acoustics Engineer,
Department of Health and Social Security
Chairman: T. A. NICHOLLS, BSc(Eng), CEng, MIEE, HonMIHospE,
Chief Engineer,
Department of Health and Social Security

12.15 p.m. CONFERENCE CLOSURE by
J. R. HARRISON, CBE, CEng(Fellow),
President,
The Institute of Hospital Engineering

Ladies' Programme

Wednesday, April 26

9.30 a.m. Introductory meeting to the Ladies' programme (in the Royal Hotel, Cardiff)
10.00 a.m. Coach departs
10.30 a.m. Visit CREIGAU POTTERY
11.00 a.m. Scenic trip
12.30 p.m. Lunch at VALLEY HOTEL, BAVERSTOCK HEADS
2.00 p.m. Coach departs for Scenic trip via BRECON BEACONS
2.45 p.m. Afternoon tea at MOUNTAINS HOTEL
3.15 p.m. Coach departs
4.30 p.m. Arrive Royal Hotel, Cardiff

Thursday, April 27

9.45 p.m. Coach departs
10.00 a.m. Conducted Tour of CARDIFF CASTLE
11.00 a.m. Coach departs
11.15 a.m. Visit LLANDAFF CATHEDRAL
12 Noon Coach departs
12.15 p.m. Lunch at PLYMOUTH ARMS, ST. FAGANS
1.45 p.m. Coach departs
2.00 p.m. Visit to WELSH FOLK MUSEUM, ST. FAGANS (Afternoon tea will be available at the Museum)
3.30 p.m. Coach departs
4.00 p.m. Arrive Royal Hotel, Cardiff
NB Those Ladies who prefer this afternoon to be free may be transported to the Royal Hotel, Cardiff, immediately after lunch

Friday, April 28

10.00 a.m. Coffee, Royal Hotel, Cardiff
MORNING FREE FOR SHOPPING AND SIGHTSEEING IN CARDIFF
12.15 p.m. CONFERENCE CLOSURE

'As you were' – Registration with the Engineers' Registration Board

Subsequent to the note published at the foot of page 4 of the December 1977 issue of *Hospital Engineering*, the Engineers' Registration Board has now announced that registration renewal slips **WILL NOT** again be issued for 1978 (as was the case in 1977). The ERB announcement states:

'The Co-Ordinating Committee has approved in principle a simplified procedure for re-registration based upon a re-designed registration card which would have continuing validity.

However, the re-designed registration card is not yet available from the Board.

In these circumstances the renewal slip issued as valid to December 31, 1976 should be considered as continuing to be valid until the new registration cards are issued by the Board.

In case of specific need, confirmation of valid registration can be obtained from the sponsoring Institute'.

Retired Members – Annual Conference

Retired Members are reminded that to encourage their attendance at the Annual Conference, Council has agreed that they be charged a purely nominal Conference registration Fee of £5.

Needless to say, accommodation charges are entirely separate and are a matter for the individual.

'New Year's' Honours List

Congratulations to R. Duncan, MIHospE, Assistant District Engineer, Westminster Hospital, on the Award of the MBE in the New Year's Honours List.

Mr. Duncan.

West of Scotland Branch

Syllabus 1978

Visit to Longannet Power Station: Thursday, February 23.
Annual General Meeting: April 27, GGHB;
May 25, Reserved for papers by branch members (subject to be notified), GGHB.

All sessions will be held in the Conference Room of the Greater Glasgow Health Board Offices, 351 Sauchiehall Street, Glasgow, commencing at 7.30 p.m. Entry is by the the Holland Street entrance.

Branch Committee

Chairman:	D. BRADLEY
Vice-Chairman and Minute Sec.:	W. M. JACK
Hon. Secretary:	T. M. SINCLAIR
Hon. Treasurer:	D. E. MOSS

Committee Members:

J. CADENHEAD	A. McDOUGALL
B. D. EDGAR	A. PETERS
A. GRAY	J. G. VERNON
D. HORNE	

Elections to Council, 1978

These will be held in accordance with the appropriate Articles of Association.

At the Annual General Meeting to be held on April 28, 1978, the following Members of Council will retire, by way of normal rotation (in accordance with Articles 81 and 82).

R. G. FREESTONE	Area Member — East Anglia and East Midlands
P. JACKSON	Area Member — Wales
D. H. MELLOWS	Area Member — North West
B. A. HERMON	General Member
K. W. WILSON	Nominated Member

Only B. A. HERMON is eligible for re-election in his respective category.

To Comply with the relevant Article, actual Ballot Papers are being sent only to paid-up Corporate Members.

List of Council Nominees

Nominated as

B. A. Hermon, CEng, MICE, FIMechE, FCIBS, FIHospE — General Member
Regional Works Officer,
South West Thames Regional Health Authority
Member of Council 1967-77
Member of Bursary Committee 1977
Member of Education Committee 1968-1977
(Chairman 1974-77)
Member of Finance & General Purposes Committee 1972-77
Member of International Affairs Committee 1975-77
(Chairman 1975-77)
Member of Publications Committee 1967-74
(Chairman 1971-74)
Member of Publications Committee 1971-74

S. Ratcliffe, CEng, MICE, MIMechE, FIHospE — Nominated Member
Assistant Chief Engineer,
Department of Health and Social Security

The Institute of Hospital Engineering One-Day Symposium
'Making the best use of the NHS Estate'

to be held at The Institution of Electrical Engineers, 2 Savoy Place, Victoria Embankment, London, on Wednesday, March 15, 1978

The recent economy drive in the National Health Service has highlighted the need to conserve energy, materials and labour and to make the best use of existing capital assets. The restraints on capital call for a change in emphasis on the overall pattern of projects. A reduction in the amount of new construction could be accompanied by an increase in upgrading and change of use. The Department of Health and Social Security is examining, with the Health Authorities, this aspect of Estate Management.

Programme

CHAIRMAN: T. NICHOLLS Esq: BSc(Eng), CEng, MIEE, HonMIHospE
Chief Engineer, Department of Health and Social Security
with SPEAKERS from the Works Division, DHSS.

10.00 Assembly and Coffee

10.30 'WHAT IS ESTATE MANAGEMENT?'
An attempt to define the content of estate management and to discuss the information required by the estate manager

11.30 'MATCHING THE EXISTING BUILDING STOCK TO CHANGING NEED'
Relating the service need to the existing building and land stock, and innovating and adapting wherever possible, with examples.

13.00 Break for lunch

14.15 'COST INCENTIVES AND CONSTRAINTS'
Examining the cost implications of using existing building stock.

15.00 OPEN FORUM

16.00 CLOSE

Tickets, inclusive of lunch, cost £10, and are available from the Secretary, The Institute of Hospital Engineering, 20 Landport Terrace, Southsea, Hampshire, PO1 2RG

5th International Congress of Hospital Engineering

Lisbon, Portugal
May 28 - June 2, 1978

The Congress is being held at the Gulbenkian Foundation in Lisbon, (Fundaçao Calouste Gulbenkian, Avenida de Berna - Lisboa 1), while the registration of participants and the official reception are to be held at the Hotel Sheraton. The programme is given below:

Attendance

Copies of the Official Registration Form and the booking form for hotel accommodation, for official visits and for post-Congress tours are reproduced on pages 6-8. They should be sent, with the due remittance, to the organisers at the address on page 5. Note that there are considerable reductions for early registration, especially before March 1, and before May 1. Before booking hotel accommodation direct, members should also consider the package facilities to be offered by Thomas Cook Ltd., as mentioned below in the paragraph *Travel & Accommodation.*

Travel and Accommodation

As the arrangements offered by the Congress organisers do not include a travel and hotel package, enquiries have been made in the UK through Thomas Cook, who are prepared to arrange a fixed price package providing the numbers are sufficient. Anyone interested in this arrangement should contact Thomas Cook directly, at the following address: —

Mr. P. Burton,
Thomas Cook Ltd,
Operations Controller,
Group Travel Service,
Thorpe Wood,
Peterborough PE3 6SB
0733-50 2594

Ask for Mr. Burton and refer to Institute of Hospital Engineering booking for IFHE Congress in Lisbon.

Congress Dinner

It will be seen that the cost of the Congress Dinner to be held at Casino-Estoril is to be fixed later. This may cause intending delegates to be reluctant to commit themselves to a booking. We have been advised by the Congress organisers that the cost of the dinner will be very reasonable, and because the venue has a capacity limit, preference will be given to those making early bookings.

Programme

Sunday, May 28

Registration of participants at Hotel Sheraton
Meeting of IFHE Council

Monday, May 29

Registration of Participants at Fundaçao Gulbenkian (Metro: SÃO SEBASTIÃO; PALHAVÃ)

morning: Official opening of Congress
Coffee and refreshments. Informal contacts

afternoon: Conference sessions — Subject 1: HOSPITAL PLANNING AND PROGRAMMING
Coffee
Discussions

evening: Reception at Hotel Sheraton

Tuesday, May 30

morning: Conference sessions — Subject 2: MODERN HOSPITAL CONSTRUCTION
Coffee
Discussions

afternoon: Conference sessions — Subject 3: INDUSTRY AND HOSPITAL EQUIPMENT
Coffee
Discussions

Wednesday, May 31

Organised visits to hospitals
Group 1 — Lisbon (afternoon)
Group 2 — Alcoitao (visiting Estoril, Cascais, Sintra) (all day)
Group 2 — Evora (all day)
Group 4 — Coimbra and Figueria da Foz (all day)
Group 5 — Porto (all day) — by plane
Note: Except for Group 1, participants will pay extra for travel

Thursday, June 1

morning: Conference sessions — Subject 4: HOSPITAL ENGINEERING SERVICES
Coffee
Discussions

afternoon: Conference sessions — Subject 5: SAFETY AND COMFORT
Coffee
Discussions
General Assembly meeting

evening: Dinner at Casino Estoril

Friday, June 2

morning: Conference sessions — Subject 6: HOSPITAL MAINTENANCE
Coffee
Discussions

afternoon: Conference sessions — Subject 7: HOSPITAL ENGINEERS INSIDE THE HOSPITAL. HOSPITAL ENGINEER TRAINING
Discussions
Farewell. Coffee
Closure of Congress

Saturday, June 3

Social activities to be arranged

Social Programme

Sunday, May 28

Registration at Hotel Sheraton

Monday, May 29

10.00-12.30: Official opening of Congress. Coffee. Informal contacts
19.00: Reception at Hotel Sheraton

Tuesday, May 30

morning: City Touring

Wednesday, May 31

Visits to Hospitals and Tourism (see notes below)

Thursday, June 1

morning: Visit to 'Three Castles'
21.00: Dinner at Casino Estoril

Friday, June 2

afternoon: Visit to Gulbenkian Museum. End of Congress

Organisers

COMISSÃO ORGANIZADORA DO 5.° CONGRESSO
Associaçao Portuguesa de Engineering Hospitalar
Av. Miguel Bombarda, 133, 5.°-B
LISBOA - 1
PORTUGAL

Site of Congress

Fundacao Calouste Gulbenkian
Avenida de Berna — LISBOA - 1
(Bus — Lines n.° 16-26-30-56)
(Metro — SÃO SEBASTIÃO; PALHAVÃ)

Simultaneous Translation

Portuguese — English — French
(Eventually Italian will be added)

Tourism and Hotel Accommodation

EUROPEIA, Agência Turística, Lda. (1)
Avenida da Liberdade, n.° 231
Telef. 53 61 21 LISBOA - 2
(Metro — ROTUNDA) PORTUGAL

Bank

Banco Nacional Ultramarino (1)
Avenida Duque de Ávila, 2-A
LISBOA - 1
(Metro — SALDANHA) PORTUGAL

Official Carrier

TAP — Transportes Aéreos Portugueses
Praça Marquês de Pombal, 3-A
Telef. 57 50 20
(Metro — ROTUNDA) LISBOA - 1
(1) Also at site of Congress PORTUGAL

Further Information

Anyone requiring further information about the Congress arrangements should write to or telephone: Mr. K. W. Ashton, 3 Fernwood Road, Sutton Coldfield, West Midlands B73 5BG. 021-704 5191.

I. F. H. E.
F. I. I. H.

5º CONGRESSO INTERNACIONAL DE ENGINEERING HOSPITALAR

5th INTERNATIONAL CONGRESS OF HOSPITAL ENGINEERING

5ème CONGRES INTERNATIONAL D'INGENIERIE HOSPITALIERE

LISBOA – 28 MAIO – 2 JUNHO, 1978
LISBON – 28 MAY – 2 JUNE, 1978
LISBONNE – 28 MAI – 2 JUIN, 1978

Enviar o original, por favor, desde já e antes do dia 1 de Março de 1978 para:

Please return the top copy as soon as possible but not later than 1st March 1978 to:

Prière retourner ce original dès maintenant et avant le 1 Mars 1978 à:

COMISSÃO ORGANIZADORA DO 5.º CONGRESSO
Associação Portuguesa de Engineering Hospitalar
Av. Miguel Bombarda, 133, 5.º-B
Lisboa-1 — PORTUGAL

Boletim de inscrição • Registration form • Bulletin d'inscription

(Favor preencher em maiúsculas) (Please use block capitals) (Priére d'écrire en majuscules)

Nome (Name; Nom): ....

Prenomes (Forenames; Prénoms): ....

Titulos/funções (Titles/functions; Titres/fonctions): ....

Hospital/Organisação/Empresa: ....
(Hospital/Organisation/Company)
(Hopital/Organisation/Compagnie)

Endereço (Address; Adresse): ....

Cidade/Pais (Town/Country; Ville/Pays): ....

SOCIAL PROGRAMME

Acompanhantes (Accompanying persons; Accompagnants)

Nomes (Names; Noms) . . . .

Prenomes (Forenames; Prénoms) . . . .

Lingua preferida (Preferred language; Langue choisie):

Portuguès (Portuguese/Portugais) . . . . ☐ *Inglês (English/Anglais)* . . . . ☐

Francès (French/Français) . . . . ☐ *Outra (Other; Autre)* ....

Desejo inscrever-me para o jantar-dançante (no Casino Estoril) *em 1 de Junho 78* . . . . ☐
(I will attend the diner-dance (Casino Estoril) *on June 1, 78/Je participerai au diner-dansant* (Casino Estoril) *du 1 Juin 78)*
Preço a indicar oportunamente/Price to be indicated later/Prix à indiquer ultérieurement

Junto o meu cheque/ordem de pagamento no valor total pagável à ordem de: COMISSÃO ORGANIZADORA DO 5.º CONGRESSO
I enclose my cheque/money order for the total amount made payable to. . . COMISSÃO ORGANIZADORA DO 5.º CONGRESSO
Je joins mon chèque/mandat pour la somme totale, à l'orde de. . . . . COMISSÃO ORGANIZADORA DO 5.º CONGRESSO

Data (Date): ....

Assinatura (Signature): ....

	Inscrição antes de: (Registration before; Inscription avant) 1 de Março (March; Mars) 78	De 1 de Março a 1 de Maio, 78 From March 1 to May 1, 78 De 1 Mars a 1 Mai, 78 (late registration)	Depois de 1 de Maio 78 After May 1, 78 Aprés 1 Mai, 78 (late registration)
Congressistas (Participants)	US$ 120 — Esc. 4800$00	US$ 150 — Esc. 6000$00	US$ 200 — Esc. 8000$00
Acompanhantes (Accompanying persons; Accompagnants)	US$ 50 — Esc. 2000$00	US$ 70 — Esc. 2800$00	US$ .90 — Esc. 5600$00

HOTEIS (HOTELS): **EUROPEIA, Agência Turística, Lda.** — Avenida da Liberdade, 231 Lisboa-2 — PORTUGAL
BANCO (BANK; BANQUE): **BANCO NACIONAL ULTRAMARINO** - Av. Duque de Ávila, 2-A Lisboa-1 - PORTUGAL
OFFICIAL CARRIER: **TAP - Transportes Aéreos Portugueses** - Praça Marquês de Pombal, 3-A Lisboa-1 - PORTUGAL

SITE OF CONGRESS: FUNDAÇÃO CALOUSTE GULBENKIAN — LISBOA

Europeia
VIAGENS — TRAVEL
VOYAGES

5.° CONGRESSO INTERNACIONAL DE ENGINEERING HOSPITALAR
5th. INTERNATIONAL CONGRESS OF HOSPITAL ENGINEERING
5ème CONGRES INTERNATIONAL D'INGENIERIE HOSPITALIERE

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Prière retourner ce original dès maintenant et avant le 1er Mars 1978 à:

EUROPEIA AGÊNCIA TURÍSTICA, LDA.
Avenida da Liberdade, 231/235
LISBOA-2 PORTUGAL

TURISMO E HOTEIS	TOURISM AND HOTELS	TOURISME ET HOTELS
Boletim de Reserva	Booking Form	Bulletin de Reservation

Nome (Name; Nom): ....

Prenomes (Forenames; Prénoms): ....

Endereço (Address; Adresse): ....

Cidade/País (Town/Country; Ville/Pays): ....

Data de chegada (Arrival date; Date d'arrivée)............ Data de partida (Departure date; date du départ)............

I)—Transferes / Transfers / Transferts **TOTAL**

HOTEL/FUNDAÇÃO GULBENKIAN (SÓ IDA) EM AUTOCARRO—TODAS AS MANHÃS (4)
HOTEL/FUNDAÇÃO GULBENKIAN (ONE WAY) BY MOTORCOACH—EVERY MORNING (4)
HOTEL/FUNDAÇÃO GULBENKIAN (ALLER SEULEMENT) EN AUTOCAR—TOUS LES MATINS (4)

_____ pessoas/persons/personnes x US$ 7.00—Esc.: 280$00 . . . .

HOTEL PENTA/FUNDAÇÃO GULBENKIAN E VOLTA EM AUTOCARRO—TODOS OS DIAS (4)
PENTA HOTEL/FUNDAÇÃO GULBENKIAN AND BACK BY MOTORCOACH—EVERYDAY (4)
HOTEL PENTA/FUNDAÇÃO GULBENKIAN ET RETOUR EN AUTOCAR—TOUS LES JOURS (4)

_____ Pessoas persons/personnes x US$ 14.00—Esc.: 560$00 . . . .

II)—Alojamento e Pequeno Almoço/Bed and Breakfast/Logement et Petit Dejeuner

(Preços por quarto/noite; rates per room/night; prix par chambre/nuit)

HOTEL LISBOA SHERATON (*****)

Duplo/Twin/Double	US$ 43.75	Esc.: 1.750$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 33.25	Esc.: 1.325$00 x _____ noites (nights; nuits)	_____

HOTEL RITZ (*****)

Duplo/Twin/Double	US$ 36.50	Esc.: 1.460$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 24.50	Esc.: 980$00 x _____ noites (nights; nuits)	_____

HOTEL TIVOLI (*****)

Duplo/Twin/Double	US$ 36.00	Esc.: 1.440$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 24.00	Esc.: 955$00 x _____ noites (nights; nuits)	_____

HOTEL ALTIS (*****)

Duplo/Twin/Double	US$ 31.25	Esc.: 1.250$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 22.75	Esc.: 910$00 x _____ noites (nights; nuits)	_____

HOTEL LISBOA/PENTA (****)

Duplo/Twin/Double	US$ 18.75	Esc.: 750$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 13.25	Esc.: 530$00 x _____ noites (nights; nuits)	_____

HOTEL EMBAIXADOR (****)

Duplo/Twin/Double	US$ 16.25	Esc.: 650$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 11.25	Esc.: 450$00 x _____ noites (nights; nuits)	_____

HOTEL FENIX (****)

Duplo/Twin/Double	US$ 14.00	Esc.: 560$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 9.50	Esc.: 380$00 x _____ noites (nights; nuits)	_____

HOTEL ROMA (***)

Duplo/Twin/Double	US$ 15.50	Esc.: 620$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 11.25	Esc.: 450$00 x _____ noites (nights; nuits)	_____

HOTEL EXCELSIOR (***)

Duplo/Twin/Double	US$ 12.75	Esc.: 510$00 x _____ noites (nights; nuits)	
Simples/Single/Single	US$ 9.25	Esc.: 370$00 x _____ noites (nights; nuits)	_____

III)—Excursões com Visita a Hospitais/Excursions with Visit to Hospitals/Excursions avec Visite des Hopitaux

--4.ª FEIRA; WEDNESDAY; MERCREDI

Grupo/Group/Groupe 1—LISBOA—Hospital Geral; General Hospital; Hôpital Général—(de tarde/afternoon/après-midi)

_____ pessoas (persons/personnes) — Gratis

Grupo/Group/Groupe 2—ALCOITÃO—Hospital de Medicina Física e Reabilitação; Phys. Medic. and Rehabilitation Hospital, Hôpital de Medicine Physique et Rehabilitation—(dia inteiro/full day/jour complet)—com almoço/lunch included/avec dejeuner

_____ pessoas (persons/personnes) x US$ 10.50—Esc.: 420$00 _____

Grupo/Group/Groupe 3—EVORA—Hospital Distrital; District Hospital; Hôpital de District—(dia inteiro/full day/jour complet) (com almoço/lunch included/avec dejeuner)

_____ pessoas (persons/personnes) x US$ 14.00—Esc.: 560$00 _____

Grupo/Group/Groupe 4—COIMBRA—Hospital Pediátrico; Paediatric Hospital; Hôpital des Enfants
FIGUEIRA DA FOZ—Hospital Distrital; District Hospital; Hôpital de District
dia inteiro/full day/jour complet—(com almoço e lanche; with lunch and tea; avec déjeuner et thé)

_____ pessoas (persons/personnes) x US$ 18.75—Esc 750$00 _____

Grupo/Group/Groupe 5—PORTO—Hospital Psiquiátrico; Psychiatric Hospital; Hôpital de Psychiatrie
—de avião/byplane/en avion (Dia inteiro com almoço/full day with lunch/jour complet avec déjeuner)

pessoas (persons/personnes) x US$ 57.50—Esc.: 2.300$00 _____

IV)—Excursões Post-Congresso / Post-Congress Tours / Tours Post-Congres

TOUR 1—MADEIRA (3-7/6/78) — Passagem aérea, transferes, estadia e pequeno almoço em hotel de 5 estrelas no Funchal. Jantar típico com folclore/Air transportation, transfers, accommodation and breakfast at a 5 star hotel in Funchal. Typical dinner with folklore/Transport en avion, transferts, logement et petit déjeuner dans un hôtel de 5 étoiles à Funchal. Diner typique avec folklore.

Nomes dos participantes/Names of participants/Noms des participants

_____

_____

_____

_____

pessoas (persons/personnes) x US$ 135.00—Esc.: 5.400$00

Supl. para quarto simples (single suppl.; suppl. single)

pessoas (persons/personnes) x US$ 30.00—Esc.: 1 200$00

TOUR 2 ALGARVE (3-6/6/78) — Transporte em autocarro de luxo, alojamento em hotel de 4 estrelas, todas as refeições, excursão a Sagres, e jantar típico/Transportation by de luxe motorcoach, accommodation at a 4 star hotel, all the meals, excursion to Sagres and typical dinner/Transport en autocar de luxe, logement dans un hotel de 4 etoiles, tous les repas, excursion à Sagres et diner typique.

pessoas (persons/personnes) x US$ 106.25—Esc.: 4 250$00

Supl. para quarto simples (single suppl.; suppl. single)

_____ pessoas (persons/personnes) x US$ 19.00 — Esc.: 750$00 _____

Total a pagar/Total to be Paid/Total à Payer _____

Os preços em escudos só se aplicam aos participantes residentes em Portugal/Rates in Portuguese escudos are only applicable to participants residents in Portugal/Prix en escudos Portugais s'appliquent seulement aux participants residents au Portugal

Junto o meu cheque/ordem de pagamento no valor total pagável à ordem de: EUROPEIA-Agência Turística, Lda.
I enclose my cheque/money order for the total amount made payable to: EUROPEIA-Agência Turística, Lda.
Je joins mon chèque/mandat pour la somme totale, à l'ordre de: EUROPEIA-Agência Turística, Lda.

DATA (DATE) _____

ASSINATURA (SIGNATURE) _____

Committee of Enquiry into the Engineering Profession

As members will know, Sir Monty Finniston has been appointed Chairman of a Government Committee of Enquiry into the profession. The Council of Engineering Institutions (CEI), is arranging a series of conferences throughout the country, through its branch organisation. These are to enable wide discussion to take place among engineers upon the topics to be considered by the committee. The CEI emphasises that all members of the engineering profession are cordially invited to attend the meetings, and this applies particularly to those who are members of any organisation within the Engineers Registration Board. It is felt important that a balanced view should be presented to the committee.

A list of the dates and venues of the meetings already arranged is shown below. Further meetings may also be organised. In order that adequate facilities are available to those attending, it is necessary for admission to be by ticket only. Anybody who would like to be present is asked to contact the organiser of the appropriate meeting.

Plymouth (Devon/ Cornwall)	Feb. 14 1900 hrs.	Main Hall, Plymouth Polytechnic.	E. Howarth, Lansethen, Keveral Gdn, Seaton, Cornwall.
Cardiff (South Wales)	Feb. 24 1830 hrs.	To be advised	Organising Secretary, Inquiry into the Eng. Prof. S. Wales Inst. of Eng., Park Place, Cardiff.
Leeds (Yorkshire)	March 8 1430 hrs.	Rupert Becket Main Hall, Leeds University;	P. J. Allen, 276 Midland Rd, Royston, Barnsley, Yorks.
Glasgow (Scotland)	March 28 1400 hrs.	John Anderson Building, Univ. of Strathclyde, Glasgow G4 0NG.	Prof. D. G. McKinley, Dept. of Civil Eng., Univ. of Strathclyde, Glasgow, G4 0NG.
Cambridge (Eastern)	April 4 1830 hrs.	Eng. Labs., Univ. of Cambridge, Trumpington St.	D. G. Petch, 231 Bergholt Rd, Colchester, Essex.
Southampton (Southern)	April 13 1500 & 1800 hrs.	Main Lecture Theatre, Medical School, Univ. of Southampton.	B. J. Hook, 141 Wilton Rd, Shirley, Southampton.
Newcastle (Northern)	April 19 1800 hrs.	Curtis Auditorium, Univ. of Newcastle-on-Tyne.	J. S. Raine, Towne House, Earsdon, Whitley Bay, Tyne and Wear.
Belfast (N. Ireland)	April 25 1430 hrs.	Queens University, Belfast.	Prof. B. Crossland, Ashby Institute, Stranmillis Rd., Belfast BT9 5AH.
Birmingham (Midlands)	May 4	University of Aston, Gosta Green, Birmingham.	S. A. Gregory, Chem. Eng. Dept., Univ. of Aston, Gosta Green, Birmingham.
Nottingham	May 18	To be advised	
Tunbridge Wells (Kent & Sussex)	May 25	Council Chambers, Town Hall, Tunbridge Wells.	A. S. Prior, 32 Mount Rd, Borstal, Rochester, Kent. ME1 3NH.
London	June 1 1500 & 1730 hrs.	Institution of Electrical Engineers, Savoy Place, London WC2R 0BL.	Secretary, IEE, Savoy Place, London WC2R 0BL.
Reading (Thames Valley)		To be advised	
Liverpool (Merseyside & (North Wales)		To be advised	

Hospital Engineering Bursary Award

The Institute of Hospital Engineering Bursary Award, announced on page 2 of our December, 1977 issue, will be £450 for 1978.

The purpose of the Bursary is to enable the Award Winner to engage in a study of some aspect of 'health care engineering' or obtain training or industrial experience, either in the United Kingdom or abroad.

The Bursary is open to any person of British nationality practising, or training to practise, as an engineer in the fields of design, maintenance or manufacture of equipment, or installations, used in health care establishments, who is over 17 and under 35 years of age.

Entry will be by way of a Paper and the subject for the 1978 Bursary Competition is 'Training for Health Care Engineering' AND ENTRIES MUST REACH THE OFFICE OF THE INSTITUTE (20 Landport Terrace, Southsea, Hampshire, PO1 2RG) BY APRIL 30, 1978.

The subject of the study which a candidate wishes to pursue need not be related to the subject of the competition but must be confined to the field of 'health care engineering'.

Full details, and the Rules, of the Bursary Award Scheme, and of the Competition (as appeared in the December, 1977, Issue of *'Hospital Engineering'*) AND ENTRY FORM, if required, may be obtained, ONLY, from: The Secretary of the Institute.

Supply Board Working Group

The Institute (of Hospital Engineering) was invited by the Department of Health and Social Security to offer written comment on the possible establishment, and subsequent operation, of a Supply Board.

We give below the comments offered by the Institute.

Need for a Supply Board

The experience of engineers working in both the design and maintenance of hospitals is that existing national and regional purchasing arrangements seem to absorb more time in sorting out problems of delivery and quality control than is usually the case with local purchasing. The financial savings often claimed for central purchasing, therefore, cannot be taken for granted.

Without knowing what the role of a Supply Board would be, it is difficult to determine whether it could overcome the present problems associated with central purchasing and central contracting.

If it is intended that the Board should confine itself to influencing industry in producing what the Health Service needs, and, perhaps, thereby rationalising the varieties and becoming more competitive on the export market, then this would be a useful role for a Board.

It does not seem necessary to set up a Board in order to improve the present system of central purchasing and contracting.

There needs to be a greater input from the users when contracts are drawn up and there needs to be close monitoring of the continuing viability of contracts over their full term. It is doubtful whether a Board is necessary to achieve these improvements.

There have been many instances in the past where, once a central contract has been established, other firms have been able to offer the same or a similar product at a lower price. There must not, therefore, be an organisation which is empowered to instruct NHS authorities to purchase from a central contract when they can obtain the product more economically through local contracts.

It is the experience of Engineers at Areas and Districts that a large proportion of materials and equipment can best be purchased locally according to the circumstances at any particular time. The present systems of budget control, cost limits and the accounting systems apply the pressures necessary to ensure economic purchasing. There are exceptions to this, and typical of these would be fuel oil and coal, paints, etc, some items of equipment used in catering and laboratories, fire fighting equipment and lighting tubes and bulbs.

Constitution of a Supply Board

If all the evidence taken by the Working Group suggests that there is a need for a Supply Board, its constitution must depend upon its terms of reference, but if these are to be kept on a high policy-making plane, as we believe it should be, then the Board needs to be made up of high-powered people with considerable experience in large scale purchasing.

The Board should be kept small and preferably have a balance of members drawn from industry and the NHS. It would be best to avoid appointing DHSS or NHS officers to the Board, leaving the officer advice to be fed in through specialist groups for decision by the Board.

Such officer advice should be drawn principally from the NHS user professions as opposed to general administration and supplies officers who are the providers of a supplies service.

The Chairman of the Board might be an industrialist or a retired high-powered serviceman who has had considerable experience with large supply organisations.

The Board should be appointed by the Secretary of State and be accountable to him for its policies. Its policies should be subject to scrutiny by the Committee on Public Accounts.

Working methods

The working methods should be determined by the Board itself, but it will need expert advice, and it seems reasonable that this should be obtained from the present advisory groups, perhaps with some modification to suit the Board's working methods.

It is doubtful whether it is necessary for the Board to commission agencies; it could ask the DHSS to undertake this work, who may in turn seek the assistance of NHS Authorities.

Function

The Board should not become involved in the management of the supplies function in the NHS, beyond issuing guidelines about the degree of central storage required to make the purchasing policies function.

It is the experience of members of this Institute that the greatest weakness in the supplies function in the NHS is not its purchasing methods, but the lack of effective storage and distribution services and a satisfactory stores accounting system.

Research and Development should not be a function of the Board; it should be left with the professionals within the Service under the control of the DHSS or Steering Committees drawn from the DHSS and NHS.

It should be one of the Board's roles to consider whether NHS demand should influence British manufacturers to satisfy the home market and to meet demands abroad and in this sense it should take into account the effect on the balance of payments.

Whilst the safety of equipment is of the utmost importance, it is difficult to see how the Board could go much further than ensuring that suitable standards exist and that they shall be specified. It must be left to organisations such as the British Standards Institute to establish the standards.

Relationships with Health Authorities

If the Board confines itself to establishing broad policies, it should put these to the DHSS, and it would be for the Department to advise Health Authorities, or for the Secretary of State to issue a directive if it should be appropriate to do so, We cannot see how the Board can issue mandatory instructions direct to Health Authorities which may conflict with the policies of the Ministers.

Staffing and finance

The secretariat should be kept small because, as suggested above, the detailed work should be undertaken by officers of the DHSS and the NHS. The secretariat need only service the Board meetings, administer the outcome and keep the members informed.

Maurice Burke Retires

One of the best known members of the Institute, Maurice Burke, OBE, AMIEE, FIHospE, retired at the end of 1977. He has been closely involved with training engineers in hospitals for many years, and was in at the very beginning of the Keele courses, in which he has continued to play a significant part. He was awarded the OBE in the 1976 Birthday Honours.

Maurice was born in Catford, South East London, in 1910. He was educated at Margate College and Bedford School. After leaving school he worked for a time in Marine Insurance and then in the wholesale drapery trade, before his first contact with engineering — working for 18 months at the Royal Airship Works at Cardington, near Bedford. There he worked on the assembly of the ill-fated airship the R101. He left to serve a five-year apprenticeship with a firm of electrical and radio engineers in Bedford, spending an extra year in the drawing office to qualify as a designer.

In 1934, he joined the London County Council (Chief Engineers Department). There he was employed on the design and supervision of engineering installations for the Council's hospitals, institutions, children's homes, etc. He left on the last day of 1939 to start 1940 as a draftsman in the Admiralty, based at Bath. He was later promoted to Senior Engineering Assistant, and was employed on the preparation of special equipment for use in warships. He was involved in the development of many specialist items for anti-submarine warfare. Later in the war much of his work was for Combined Operations, where he says he learnt how to cut through red tape! This work involved a certain amount of sea-going duties, so that he carried the rank of Lieutenant while at sea, and at the same time was a corporal in the Admiralty Home Guard Unit.

After the war, Maurice returned to the LCC until 1949, when he joined the East Anglian Regional Hospital Board. He started as a Senior Engineering Assistant to the Boards' architect, and was promoted to principal Assistant Engineer in 1958. He was then promoted to Regional Engineer. Starting with a staff of four, his department had expanded to 63 members by 1962. As Regional Engineer, he was responsible directly to the Board for all engineering matters in the region.

It was in 1962 that Maurice suffered a series of coronaries which would have laid low a lesser man. He has now entirely recovered, but at the time felt he ought to resign, and was then seconded to the Department of Health and Social Security in London on special duties connected with training, study group work, and so on. As a Regional Engineer, he was one of the individuals who inaugurated study groups, and has been involved with the training of engineers in hospitals since the early days. This included involvement with the Keele courses since their inception, and which involved close working with the Institute of Hospital Engineering.

Although the courses have now moved to the Hospital Engineering Centre at Falfield, the connection with the Institute has been retained. Maurice has acted as course director for the two courses annually for some years, and in spite of his retirement, he will still be doing so in 1978.

Maurice hopes that his retirement at 67 will not prevent his continuing to do work for the National Health Service and for the people in it. We are sure that this hope is echoed sincerely by the very many people who know Maurice, and that his family (he is married with two children and four grandchildren), will be able to spare him for the continued involvement which looks so very likely.

London Branch Meeting

Estmancode — A Practical Philosophy?

Thirty members of the London Branch heard a fascinating discussion on the Estmancode system at a meeting held at the Middlesex Hospital Medical School, on November 29 last.

The first speaker was Mr. D. B. (Jimmy) James, ARICS, MIPHE, Superintending Building Surveyor, DHSS, who explained the philosophy and intentions of the system. Mr. W. P. Ridgeway, ARICS AMBIM, Area Works Officer, Lambeth, Southwark and Lewisham AHA, then discussed his experience of the introduction of Estmancode.

The meeting was chaired by Leslie Davies, chairman of the Branch.

Mr. James began by pointing out that the present NHS Estate was the biggest devoted to one purpose in one ownership in the free world.

The management of such an Estate was a matter requiring considerable thought and planning, and engineers were frequently canvassed for their opinions on how this should be achieved. The Estmancode guidance resulted from the Woodbine Parish report and was intended to cover the full range of estate management, but priorities had resulted in the first sections published being concentrated on maintenance. However, attention was now being given to the wider aspects of estate management, and *The Way Ahead* (HN (77) 140) published by the Department, showed the degree of importance it attached to it. Mr. James handed round a two-page summary of the planned framework of Estmancode, but concentrated his remarks on those items that had already been issued.

Dealing with the forward planning elements of the code, he said that some people are not really enthusiastic about them, but if properly used, they can be extremely useful. If you manage to move away from crisis management to planned management you must obtain better value for money and use of resources by having established a system of priorities, and by being able to give advanced warning to treasurers (for up to five years) of likely maintenance expenditure. This must contribute to informed decision making by Health Authorities, and gives the engineer a chance to influence decisions more fully and to get a fairer share of the cake. It also gives the Authority itself knowledge not just of benefits but also of the penalties of a failure to act in time. By providing a moving "shelf" of projects there is a built-in flexibility. In recent times maintenance engineers have had to deal with the effects of expenditure cuts, but they should also be able to handle the provision of extra funds — if plans are already in existence then one will do best from extra allocations. This had indeed happened during the last year. The basic principle here, was that information based on need is much more authoritative.

Once money has been allocated, it was necessary to convert forward planning into current programmes. It should be borne in mind that reflation can lead to problems of supply when scarce resources of materials and labour are in greater demand.

Value for Money

In order to achieve value for money engineers should bear in mind two important things. First, they must get the standards right. Rather than working always to rigidly fixed standards, it was better to lay down guidelines on how line management should determine their own standards locally. The DHSS is now preparing decision models on, for example, for repair versus replacement decisions. Secondly, the effective spending of money must be considered.

Control of Expenditure

Discussing capital expenditure planning, Mr. James said that the Estate Management Information System (EMIS), a computer system for planned preventive maintenance and costings, was supported by the DHSS for national adoption. It might not be ideal, but is certainly very useful and should be employed even while it is still being developed. There is indeed a development working party at the Department who need to hear the experience of field users.

Contract

Finally, Mr. James mentioned the problem of deciding whether to use direct labour or contract labour. He mentioned that the guidelines issued by the Department (the Green Book), do not support one or other system entirely. He reminded his audience not to forget the indirect overhead costs of using direct labour, and mentioned that measured term contracts are now being developed both for building and engineering works. Guidance should be issued shortly.

Practical Applications

In reply, Mr. Ridgeway described Estmancode as the familiar red book — on the bookshelf. To hear Mr. James discuss it in such detail helped to bring it alive, off the shelf, and into use. However, it wasn't always easy to achieve collaboration in a situation controlled by the attitudes and aspirations of people from a wide variety of backgrounds. In the remarks that he was going to make he wished to be very general, but hoped that what he was going to say reflected the experience of the members present.

Capital Estate

Mr. Ridgeway said that the Capital Estate was both a resource and an asset. Looked at as a resource, he would like to see a closer integration with the DHSS planning system. In his own area, there were Health Care Planning Teams. These tended to stop short when needs had been established, so that a gap grew up between the planning of services and the planning of actual works projects. It was crucial that Health Services are planned on the basis of defined needs, but it was short-sighted for plans to concentrate on improving services without taking into account the need to improve or replace the basic fabric of those services — for example, boilers.

The Estate as a Capital Asset

Mr. Ridgeway discussed the possibility of selling off parts of the Estate to gain capital. When hospitals had been closed, they have often been retained as residences, rather than being considered as assets which could be realised. Also, administrators tended to forget the continuing need for maintenance when former hospital buildings were being used for other purposes. There were also dangers in allowing "temporary requirements" to become permanent.

Estmancode

If it had taken seven years to produce what had been issued to far, said Mr. Ridgeway, were the remaining sections only to be produced over the next ten years? He felt it was rather strange that another decade could be spent on issuing material to a Health Service without the money to ensure implementation.

Estmancode was guidance, but without enough authority or resources being given to Health Authorities for them to be able to carry it out. Mr. Ridgeway suggested that further sections be held back, and that the DHSS should deploy its resources to creating Action Teams who would help get the Estmancode sections already issued into use. He gave as examples of these Estate Records; the planning and control of expenditure; the Estate Management Information Service.

At present, Authorities are already stretched to carrying out the present requirement — what point, asked Mr. Ridgeway, was there in suggesting or requiring that they do more? Indeed, he said, with the current shortage of resources, for the DHSS to continue to develop Estmancode without implementing current sections amounted to a misuse of resources.

EMIS

Mr. Ridgeway thought that the computerised Estate Management Information System could be a great help in the next five to six years. The advantages were summarised in the Department's notice HN (77) 36. Two problems have arisen from experience to date. Firstly, the long timescale for implementation (2½ years). This period could be reduced by using extra resources during the development stage. An example of the need for 'Action Teams'. Secondly, maximum benefit is only obtained if staff at all levels from Clerical Officers up to Works Management are given proper training in the use and benefits of the system.

Summary

In conclusion, Mr. Ridgeway said that the environment for patient care is continually improving. The improvement in equipment added to the complexity of maintaining the Estate properly. The success of patient care is becoming more dependent upon a more professional Estate Management service. Despite his criticisms he welcomed the DHSS approach in giving guidance, but Works Officers needed a stronger voice and, without some help with the practical problems of implementation, it would take many years to get things right.

General Discussion

In a short discussion afterwards, the general tenor of members' comments was that they tended to side with Mr. Ridgeway when he suggested that there were considerable practical difficulties in achieving some of the suggested benefits that in theory flow from Estmancode. In his summary, the Chairman said that members certainly did not criticise what the Department was suggesting but they did find it frustrating to be unable to carry out current requirements. However, in counterpoint, a member did have the last word by suggesting that all that had been said by the practical engineers present was all very well, but that engineers can always find reasons why things cannot be done properly. He himself had had a very good experience with dealing with administrative colleagues, and was particularly encouraged by the great help that he had had by a newly introduced management accountant. By pooling their joint skills, both of them had felt that they were making far more progress than before. On this hopeful note the meeting closed, with all present feeling that they had a better understanding of the aims of Estmancode, and of how they might go about seeking to get the best from it.

A Mathematical Model to Determine Facility Needs for a Radiology Department

EARL A SIMENDINGER MHA MSIE *Associate Administrator, University Hospitals, Cleveland, Ohio.*
LOUIS A TUZI PhD JD *Professor and Chairman, Dept. of Industrial Engineering, Cleveland State University.*
TERENCE F MOORE MHA MBA
Executive Vice-President and Treasurer, Midland Hospital Association Midland, Michigan.

Evaluating purchase requests for new or replacement equipment from hospital department heads and members of the medical staff is, perhaps, one of the most frequent and difficult tasks for the administrator. He must evaluate the department's request, based on limited knowledge, because of his general administrative position and broad responsibility. Obviously, the on-line personnel and management are much more knowledgeable about the actual facts surrounding the real need for the request. This obvious advantage can often be easily used to persuade the administrator. However, most administrators are aware of this inherent imbalance of intra-department knowledge and they try to ask as many questions as possible to gain the knowledge necessary to make an accurate decision. The fact still remains, however, that all too often the right questions are not asked because of the administrator's lack of direct experience and knowledge in the department.

However, this is not the case for all requests. The attention provided for requisition analysis by administrators is directly proportional to its cost and impact. So is the probability that a correct decision will be made. As the cost goes up and the impact increases, so will the attention of the administrator and his staff.

Depending upon the magnitude of the requisition, the administrator has a number of tools he can employ to help him make a better and more accurate decision. For example, he may apply a cost-benefit analysis to the request, talk to other hospitals to determine what they have done, contact a private consulting firm for their analysis and recommendations, or he may even hire an Industrial Engineer to evaluate and determine actual needs. However, all require a significant amount of time on the part of the administrator or a large financial outlay for a formalised report.

Purpose and objective

The purpose of this article is to offer the administrator and his staff, or other decision-makers, a simple mathematical method which will assist him when making decisions about the number and type of diagnostic equipment needed for a hospital Radiology Department. The objective of this article will be to explain how to apply this model presented herein, so that administrators can utilise it effectively.

It is important to note that with some minor adjustments, such a model can be used in the decision-making process for other hospital departments.

The Radiology Department was chosen for three important reasons. One, the department supply expense, per department employee, is the highest of all hospital departments, primarily due to film expense. Secondly, few departments produce single or multiple purchase requisitions for equipment of greater cost. Thirdly, and perhaps most important, the administrator's knowledge about this particular hospital department is, in the opinion of the authors, one of the most limited.

Existing models

A review of the current literature produced five different mathematical models that have been applied to determine the type of equipment or number of radiographic rooms, or both, necessary to meet the current and, in some models, projected demands for a hospital Radiology Department.†

The five models cited were used as a basis in developing the model for this article. Through the integration of the better parts of the five models, the model described in this article evolved.

This model is superior in that it included several factors that the other five models excluded. Thus, the model is more accurate, comprehensive, and a better tool to base a decision on.

Model introduction

The first part of this model requires three separate phases. The first phase will determine the number of rooms needed presently by procedure category. There are four separate steps to completing the first phase.

The first step in phase one is a description of the variables that will make up the formula (*Equation I*), and how the data should be gathered to obtain accurate results. The second step is a formal introduction and description of the model formula (*Equation I*), and how to complete its computation. Third is a description of the data that were drawn from an actual application of this model in a hospital. This description of the application will be offered

†For an in depth review of the significant published works produced on radiographic demand analysis, refer to the following:

a. Roslyn Lindheim, *Uncoupling the Radiology System* (Chicago: Hospital Research and Educational Trust, 1971).

b. William G. Terry, "Pre-Planning Thinking", *Radiology* Volume XXXIX, Number 461 (May, 1973).

c. Richard C. Kebart, "Innovative Designs for a Diagnostic Radiology Department", *Radiology Technology*, Volume XLV, Number 4 (1974).

d. Robert B. Conrad, Dan A. Knee, James M. Meade, and Larry M. Parrish, "Utilization Study Saved Hospital from Needless Expansion of Radiology Facility", *Hospital Financial Management* (September, 1973).

e. James K. McNally, "What Work Measurement Can Accomplish in Radiology", *Hospital Financial Management* Volume XXVI (September, 1972).

throughout the entire article to provide a better understanding of its use and perhaps make it easier for others to apply. The fourth step in phase one is a summarisation of all the calculations by procedure category, which will be used to determine the total number of rooms and type of equipment needed to meet the current demands.

Independent variable description

The model utilises six variables in the formula (*Equation I*). The symbols that represent the variables and a detailed description for each are defined below:

A. Let, W% = *The per cent of procedures performed during peak workload period for a procedure category.*

$$W\% = \left(\frac{\text{No. procedures during peak workload period}}{\text{Total No. of procedures}}\right) 100$$

To determine this variable, the total number of procedures for a peak workload period is first determined. From this data, the percentage of procedures performed during the peak workload period is measured by determining how many were completed within that period. Saturdays are normal workdays and were included in the period; however, Sundays were excluded. For example: In a 27-day study period, the peak workload was from 8 am until 5 pm, which is representative of most Radiology Departments in hospitals. For example, in the case of chest procedures, the procedure category is calculated by taking the total number of chest procedures, 880 for the 27-day study period, and dividing by the actual count of procedures, 592, which were completed between the hours of 8 am and 5 pm, the peak workload period. Therefore, 67.3% of all chest procedures were completed within the peak workload period. This is calculated as follows:

$$W\% = \left(\frac{592}{880}\right) 100 = 67.3\%$$

B. Let, ΣPc = *Total summation of procedures into a given procedure category for a given study period.*

$$\Sigma Pc = \frac{\text{Total number of procedures}}{\text{Study period}}$$

Example: the total number of all types of fluoroscopic procedures performed for the 27-day study period measured 568. The ΣPc for this variable would then be 568.

$$\Sigma Pc = \frac{568}{1} = 568$$

C. Let, $\overline{Tc}$ = *Average time by procedure category.*

$$\overline{Tc} = \frac{\text{Total minutes}}{\text{Total procedures}}$$

Using the same fluoroscopic procedure example, all types of fluoroscopic procedures would be individually timed, including colon, gall bladder, and other fluoroscopic types of procedures. Times for each procedure would be kept for the length of the study period (27 days) to allow for enough procedure times to be representative. The total time for fluoroscopic procedures is then divided by the total number of procedures taken, to arrive at the average time by that procedure or fluoroscopic category. Example: 568 fluoroscopic procedures were taken during a total elapsed time of 9,458 minutes; the Tc would measure 16.65 minutes.

$$Tc = \frac{9{,}458}{568} = 16.65$$

D. Let, $\overline{P+C}$ = *Average preparation and clean-up time.*

$$\overline{P+C} = \frac{\text{Total preparation and clean-up minutes}}{\text{Total number of procedures}}$$

This is also calculated for each procedure category. Because preparation and clean-up times are traditionally not considered to be part of the actual procedure, they are not commonly considered in the calculations of radiology demand models. They do require the use of the diagnostic room and must, therefore, be included in the study to determine accurate results. For example, sometimes it takes a significant amount of time to set up an X-ray room to perform special procedures. Although some preparation can be completed in advance outside the room, the majority of work must be completed in the immediate diagnostic area. Also, other procedures will require much more clean-up time than just wheeling out the patient. Therefore, to arrive at an accurate $\overline{P+C}$, time parameters should be established on the amount of time required for this variable. Continuing with the fluoroscopic example, it was discovered that on the average seven minutes were required to prepare a room and eight minutes to clean up the room after use. On this basis, the $\overline{P+C}$ measured 15 minutes.

$$\overline{P+C} = \frac{850}{56} = 15$$

E. Let, C = *Capacity of one diagnostic room in minutes for the peak workload period for the study period.*

C = (Minutes in peak workload period) (length of study period).

This figure is found by multiplying the total minutes in the peak workload period for one day (between 8 am and 5 pm) times the study period (540 minutes times the 27-day study period) to get 14,580 minutes available for one room.

$$C = (540)\ (27) = 14{,}580$$

F. Let, Nc = *Number of diagnostic rooms needed for a peak workload period by a procedure category.*

Nc = Units − Room

Description of formula developed for mathematical model to determine number and type of diagnostic rooms needed.

Presented below is the formula (*Equation I*) which was developed for this mathematical model with the appropriate variables in place as represented by the above described symbols.

$$Nc = \frac{(W\%)\ (\Sigma Pc)\ [\ (\overline{Tc}) + (\overline{P+C})\ ]}{C} \qquad \textit{(Equation I)}$$

This formula (*Equation I*) is used for each procedure category separately. In the example case where the model was actually applied, there were four procedure categories used: special, fluoroscopic, radiographic, and chest. *Table I* summarises the actual data gathered for a 27-day study period. The table illustrates procedures by category, by

Table I.

Total number of procedures by number and procedure time

Type of procedure	Number of procedures	Individual procedure time in minutes	Average procedure time
I. Special procedures			
Arteriogram	6	120	
Bronchogram	1	11	
Fistulogram	1	95	
Myelogram	10	53	
Pneumarthrogram	1	60	
Salpingogram	3	30	
Venogram I	2	35	
Venogram II	2	65	
TOTAL	26	1,706	65.61
II. Fluoroscopic procedures			
Colon	141	13	
Esophagus	10	20	
Gall Bladder	181	6	
Gastro Intestional I	57	17	
Gastro Intestional II	179	30	
TOTAL	568	9,458	16.65
III. Chest procedures	880	2	
TOTAL	880	1,760	2.00
IV. Radiographic procedures			
Abdomen	43	7	
Ankle	148	6	
Bone Survey	1	24	
Clavicle	9	7	
Elbow	73	4	
Evacuation Film	160	2	
Facial Bones	31	7	
Femur	10	7	
Finger	113	2	
Foot	131	5	
Forearm	20	4	
Hand	132	3	
Heel	2	7	
Hips	21	10	
Intravenous Pyelogram	121	42	
Knee	121	4	
Kidney-Urethra-Bladder	60	6	
Laminogram	10	60	
Lower Leg	29	5	
Mammogram	38	46	
Mandible	13	18	
Nose	15	3	
Pelvis	44	18	
Ribs	46	12	
Scapula	2	5	
Shoulder	61	5	
Sinuses	17	14	
Skull	172	12	
Small Bowel	81	4	
Soft Tissue	2	25	
Spine	199	12	
Sternum	2	17	
Tempor Mandibular Joints	6	45	
Thumb	30	2	
Tibia	10	10	
Toes	32	3	
Torso	1	10	
Upper Arm	9	5	
Wrist	93	2	
Others	234	9.65	
Total	2,342	22,606	9.65

number performed in the period, and by average procedure time. The table provides the information necessary to determine the following two variables, ΣPc and $\overline{Tc}$. *Table II* below is the result of the time data taken for average preparation and clean-up time $\overline{P+C}$ by procedure category.

Table II. **Time by procedure category for preparation and clean-up time**

Special procedures	60 minutes
Fluoroscopic procedures	15 minutes
Radiographic procedures	7 minutes
Chest procedures	5 minutes

Table III is the result of the per cent of procedures performed during the peak workload period, W%.

Table III. **Per cent of procedures performed during peak workload period**

Special procedures	100.0%
Fluoroscopic procedures	99.6%
Radiographic procedures	67.3%
Chest procedures	67.3%

Finally, *Table IV* lists in summary form all the input data necessary to make the actual calculation.

Calculation explanation

The actual formula (*Equation I*) with the various figures based on summary *Table VI* is found below including calculation descriptions for each procedure category.

I. Calculation for Special procedure category

$$Nc_1 = \frac{(100\%)\ (26)\ [\,(65.61) + (60)\,]}{14{,}580}$$

$$Nc_1 = .22 \text{ rooms.}$$

II. Calculation for Fluoroscopic procedures category

$$Nc_2 = \frac{(99.6\%)\ (568)\ [\,(16.65) + (15)\,]}{14{,}580}$$

$$Nc_2 = 1.23 \text{ rooms.}$$

III. Calculation for Radiographic procedure category

$$Nc_3 = \frac{(67.3\%)\ (2{,}342)\ [\,(9.65) + (7)\,]}{14{,}580}$$

$$Nc_3 = 1.80 \text{ rooms.}$$

IV. Calculation for Chest procedure category

$$Nc_4 = \frac{(67.3\%)\ (880)\ [\,(2) + (5)\,]}{14{,}580}$$

$$Nc_4 = .28 \text{ rooms.}$$

Total diagnostic rooms needed $\sum_{i=1}^{4} Nc_4 = 3.53$ rooms.

Table IV.

Summary table of all input data to make the calculations for the number and type of X-ray diagnostic rooms needed

Procedure category	W% Per cent of procedures performed during peak workload period	ΣPc Number of procedures for study period by procedure category	$\overline{Tc}$ Category in minutes	$\overline{P+C}$ Average preparation and clean-up time by procedure category	C Capacity of one diagnostic room in minutes for peak workload period
Special procedures	100.0%	26	65.61	60	14,580
Fluoroscopic procedures	99.6%	568	16.65	15	14,580
Radiographic procedures	67.3%	2,342	9.65	7	14,580
Chest procedures	67.3%	880	2	5	14,580

Calculation description

Based on the above calculation, the need for a diagnostic room devoted to special procedures, with the appropriate equipment necessary to perform the number of procedures stated above for the peak workload period, measured .22 rooms. The fluoroscopic diagnostic rooms with the appropriate equipment measured 1.23 rooms. Further, for radiographic procedures the department would need to perform the present number of radiographic procedures for the peak workload period, this measured 1.80 rooms. Finally, the chest procedures measured .28 rooms. The four separate calculations are totalled to determine the total number of diagnostic examination rooms needed for the Radiology Department, to perform the number of procedures during the peak workload period. The final total measured 3.53 rooms.

When comparing the results of the calculations to the real world where the data were drawn and the model applied, the following observation should be pointed out. Based on personal experience by the authors, the Radiology Department uses all four diagnostic rooms very heavily during the peak workload period. Comparing this practical fact of high utilisation against the results of the calculations, the two correlate directly.

Cross utilisation factor

A specialised consideration remains to be explained, especially to readers who may not have experience within hospital Radiology Departments. Based on the four calculations mentioned, it might appear that six rooms would be needed, as opposed to the calculated total of 3.53 rooms. If a reader does not realise that some diagnostic equipment can be cross-utilised, he might erroneously interpret, based upon the above room calculations, that one or more rooms would be needed for each procedure category. For example, because it was determined that .28 of a room would be needed for chest procedures, it could be concluded that one complete room would be required to perform all of the examinations during the peak workload period. The same logic being applied to radiographic and fluoroscopic procedures would result in the total of six diagnostic rooms needed. This logic is incorrect. Because radiographic procedures can be taken in a fluoroscopic examination room as well as the special procedures rooms, cross-utilisation of rooms must be considered. However, not all procedures can be taken in each room. For example, fluoroscopic or special procedures cannot be taken in a radiographic room, since fluoroscopic capability must be included in the equipment. This part of the procedure requires intensification and must be available to perform fluoroscopic and special procedures. This capability and equipment is not found in what is normally called a radiographic diagnostic room. Chest procedures can be taken in most all diagnostic rooms, but special chest adaption units must be part of the equipment. Thus, a cross-utilisation factor must be considered when evaluating the results of the model calculations.

Additionally, when interpreting the total number of required rooms, one must make a judgement on how to translate these results into a whole integer in terms of rooms. Based on several discussions with the radiologist, it is an accepted practice that at least 50% of one room be available for increased fluctuations. Therefore, based on the above results, with the proper interpretation, the analysis indicates four diagnostic rooms are needed.

Projection of Patient Classification

Introduction

The second phase of the model provides for a projection of radiographic demands, in addition to the number of rooms and equipment needed to meet that demand in the future. The projection technique that was used for this model was linear regression analysis and was based on procedures by 'patient classifications'. This projected figure is then subdivided into procedures by category.

Projections

The three patient classifications used in this model, inpatients, outpatients, and emergency patients are traditional for most hospitals. Throughout the projection phase, patient classification will be used. For each of the three patient classifications, separate projections using linear regression analysis are made. Details of the patient classification, 'inpatient', will be presented first to illustrate the mechanics of the projection model.

Inpatient projection

One must first complete a history of demand based on procedures by patient classifications in order to use the linear regression equation. These data are usually available from the departmental statistical reports. The reports should provide the total number of yearly procedures performed on inpatients. Example, the data listed in *Table V* is the actual historical data drawn during the application of this model for all three classifications.

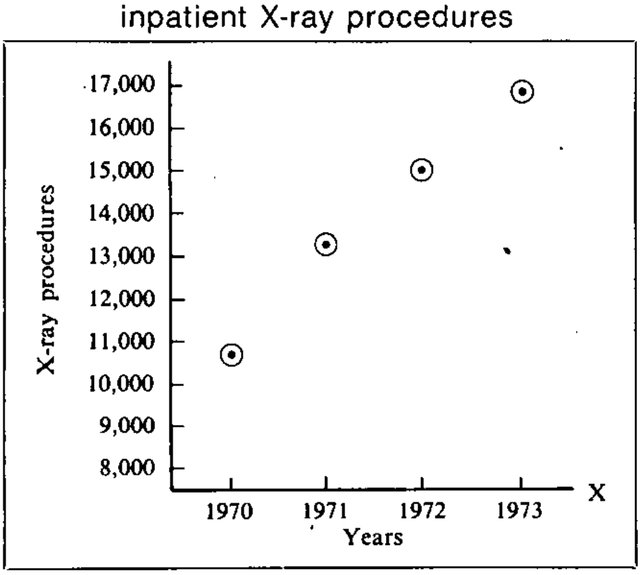
Table V.

Total inpatient, outpatient, and emergency patient X-ray procedures between 1961 and 1973

Year	Inpatient	Outpatient	Emergency	Total
1961	N/A	1,764	1,798	—
1962	N/A	3,800	1,590	—
1963	N/A	7,039	3,509	—
1964	N/A	8,300	4,384	—
1965	N/A	9,889	4,609	—
1966	N/A	10,121	4,793	—
1967	N/A	10,854	5,514	—
1968	N/A	12,592	6,414	—
1969	N/A	13,028	7,792	—
1970	10,563	11,360	8,502	30,425
1971	13,411	14,088	8,919	36,417
1972	15,107	15,199	10,299	40,605
1973	16,354	16,240	10,563	43,157

Unfortunately, only four years of historical data was available for inpatient classification. The records from 1961 to 1969 were lost and/or destroyed. Next a scatter diagram is constructed.[1] Based on the data from *Table V*, the scatter diagram for inpatient procedures appears as illustrated in *Figure 1*.

Figure 1. Scatter diagram for inpatient X-ray procedures



When using the linear regression analysis projection technique, three basic characteristics should be evident. One, analysis should utilise at least two variables to make a prediction for one variable.[2] Second, the construction of the scatter diagram should illustrate the effect one variable has on the other. Thirdly, a straight line should best describe the pattern of the points on the scatter diagram.[3]

The next step is to determine a line through the points that provides the best fit. This technique is called the Least Squares Method of determining the regression line.[4-5]

By the use of the general linear regression equation, $Y = a+bX$ (also the general equation of a straight line) and two standard equations that solve the values of a and b in the regression equation, the true linear regression equation can be established. The necessary data table appears below.

Table VI.

Regression data table for inpatient X-ray procedures

Year X	Inpatient Y	X^2	XY	Y^2
1970	10,563	3,880,990	20,809,110	111,576,969
1971	13,411	3,884,841	26,433,081	179,854,921
1972	15,107	3,888,784	29,791,004	228,221,449
1973	16,354	3,892,729	32,266,442	267,453,316
7,886	55,435	15,547,254	109,299,637	787,106,655

Further, the equation to solve for the a and b values in the regression equation are found below. The proper values for each of the variables in the equations can be found in *Table VI* for the inpatient procedures.

First, to calculate b let,

$$b = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{N(\Sigma X^2) - (\Sigma X)^2} \qquad \textit{(Equation 2)}$$

Second, to calculate a let,

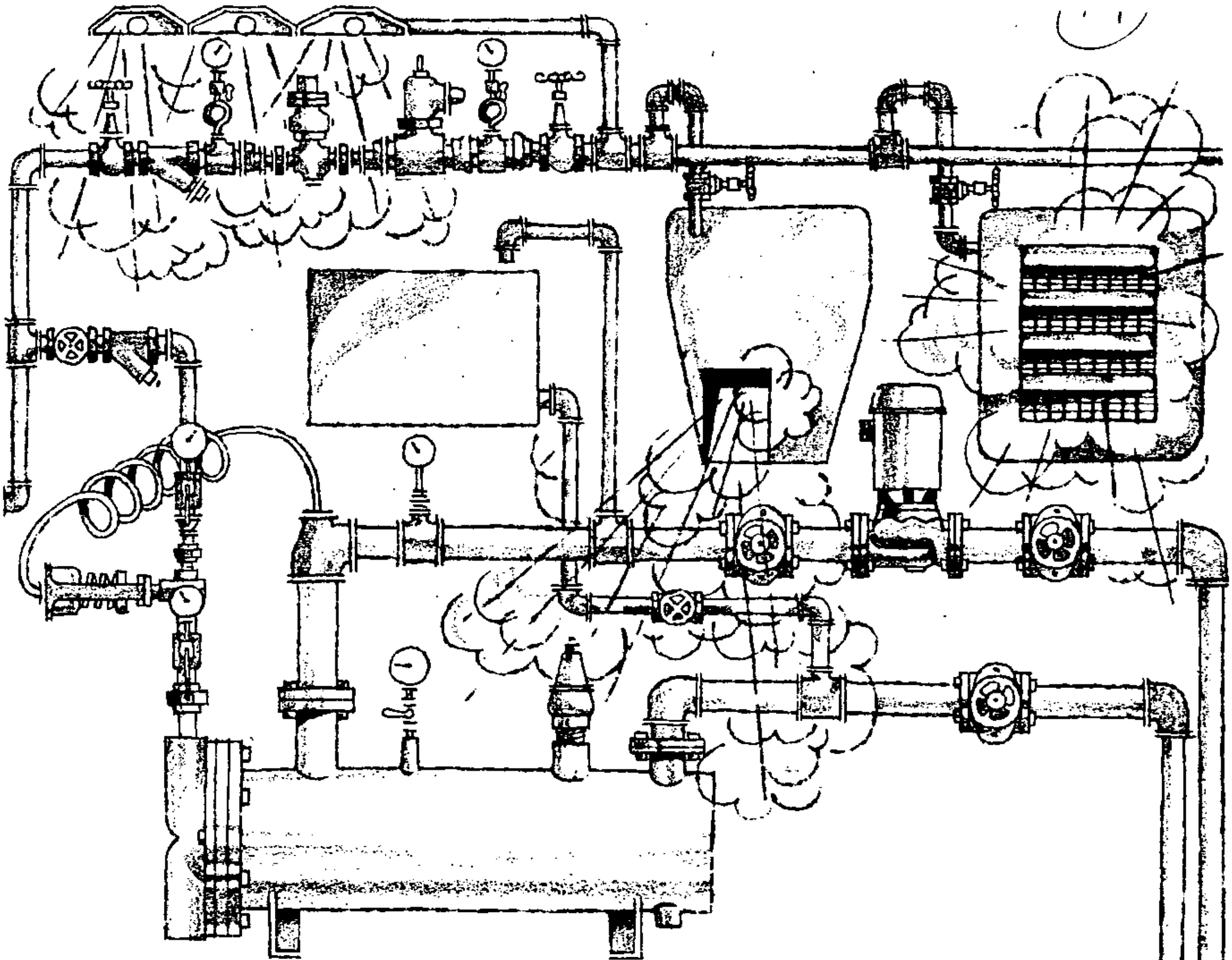
$$a = \frac{\Sigma Y}{N} - b\frac{\Sigma X}{N} \qquad \textit{(Equation 3)}$$

Based on the above formulas and the data from *Table VI*, inpatient procedures, the calculations can be made for the first classification. Listed below are the results of those computations.

Since, $Y = a + bX$,
$a = -3,745,594.60$
$b = 1,906.90$

Where X represents the year and Y the number of X-ray procedures. Now the regression line can be plotted.

For example, set X equal to the year of 1970, and Y equal to the corresponding number of X-ray procedures for the year, 10,798. This represents one point of the regression line. Next, let X equal 1973 and Y again equalling the corresponding number of X-rays procedures, 16,719. This represents the second data point on the regression line, etc. After all of the points are drawn on the scatter diagram, a regression line can be fixed thereon. In this example, the linear regression line is $Y = -3,745,594.60 + 1,906.90\,(X)$.



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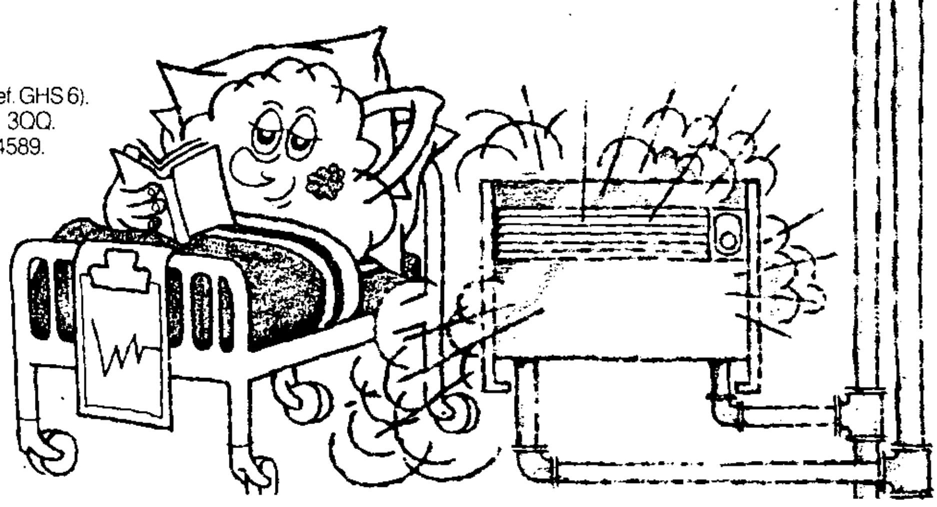

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Figure 2 illustrates the scatter diagram with the proper regression line included.

Figure 2.

Scatter diagram and regression equation for inpatient X-ray procedures

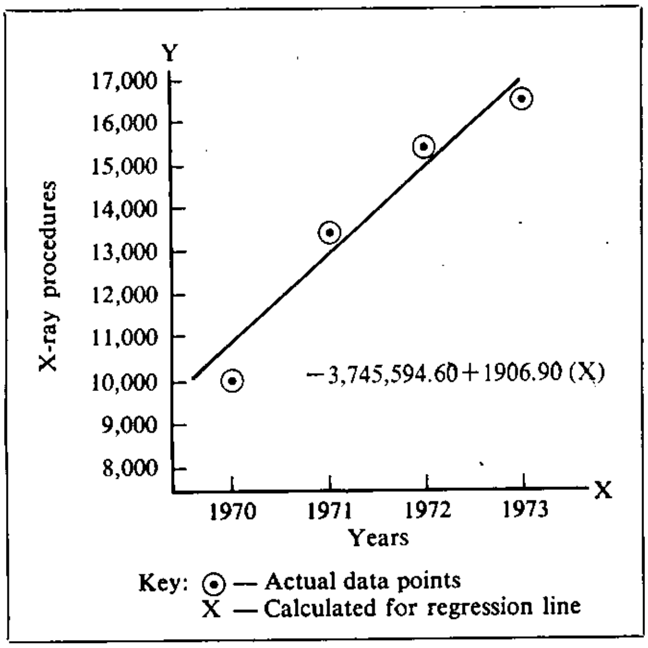


Table VII.

Regression data table for outpatient X-ray procedures

Year X	Outpatient Y	X^2	XY	Y^2
1961	3,528	3,845,521	6,918,408	12,446,784
1962	3,800	3,849,444	7,455,600	14,440,000
1963	7,039	3,853,369	13,817,557	49,547,521
1964	8,300	3,857,296	16,301,200	68,890,000
1965	9,889	3,861,225	19,431,885	97,792,321
1966	10,121	3,865,156	19,897,886	102,434,641
1967	10,854	3,869,089	21,349,818	117,809,316
1968	12,592	3,873,024	24,781,056	158,558,464
1969	13,628	3,876,961	26,833,532	185,722,384
1970	11,360	3,880,900	22,379,200	129,049,600
1971	14,088	3,884,841	27,767,448	198,471,744
1972	15,199	3,888,784	29,972,428	231,009,601
1973	16,240	3,892,729	32,041,520	263,737,600
25,571	136,638	50,298,339	268,947,538	1,629,090,976

These first several steps in the projection portion of this model, because of their difficulty and importance, bear repeating. To enhance better understanding, the steps to complete a scatter diagram for projection purposes are shown below.

A. Gather proper historical data on the variables by patient classification (inpatient, outpatient, emergency patient) (see *Table V*)

B. Construct proper statistical tables in specific form to use regression analysis techniques and formulas (see *Table VI*)

C. Construct scatter diagram and plot points based on historical data (see *Figure 2*)

D. Develop and solve regression equation: $Y = a + bX$
 1. Solve for (a) based on data table and equation 2
 2. Solve for (b) from data table and equation 3

E. Plot the calculated regression line on the scatter diagram

F. Analyse results
 1. Does the line best describe the pattern of points?
 2. Are most of the points close to the line?

The same steps were completed for the last two patient classifications. It is significant to note that at this point the projection on the later two variables would be considered statistically more accurate, because 13 years of historical data was available and used during the application of this model. The proper statistical data are shown in *Table VII* for outpatients, and *Table VIII* for emergency patient classifications.

Table VIII.

Regression data table for emergency room patient X-ray procedures

Year X	Emer. room patient Y	X^2	XY	Y^2
1961	1,798	3,845,521	3,525,878	3,232,804
1962	1,590	3,849,444	3,119,580	2,528,100
1963	3,509	3,853,369	6,888,167	12,313,081
1964	4,384	3,857,296	8,610,176	19,219,456
1965	4,609	3,861,225	9,056,685	21,242,881
1966	4,793	3,865,156	9,423,038	22,972,849
1967	5,514	3,869,089	10,846,038	30,404,196
1968	6,414	3,873,024	12,622,752	41,139,396
1969	7,792	3,876,961	15,342,448	60,715,264
1970	8,502	3,880,900	16,748,940	72,284,004
1971	8,919	3,884,841	17,579,349	79,548,561
1972	10,299	3,888,784	20,309,628	106,069,401
1973	10,563	3,892,729	20,840,799	111,576,969
25,571	78,686	50,298,339	154,913,478	583,246,962

The following illustrates the two scatter diagrams and regression equations for the last two variables. *Figure 3* represents outpatients and *Figure 4* represents emergency patients. The diagram illustrates the data points based on *Table V*, and the regression line based on the data found in *Tables VII and VIII* for each of the variables.

In all cases one can observe that the points have a linear relationship and the regression line best describes the pattern of the points.

Statistics

There are statistics that are utilised when measuring how close the regression line fits the actual points and, in turn, how statistically accurate the projection will be. The two basic statistics are: standard error of estimate, and correlation coefficient. The calculations for the above-mentioned statistics would be considered the second step in this projection portion of the model. The following two paragraphs will explain the results of each of these statistics for each patient classification.

Standard error of estimate

The method to set up this formula and make the actual calculations can be found in most statistic books; therefore, the authors will not duplicate this explanation.[6] The standard error of estimate, sometimes called standard

Figure 3.

Scatter diagram and regression equation for outpatient X-ray procedures

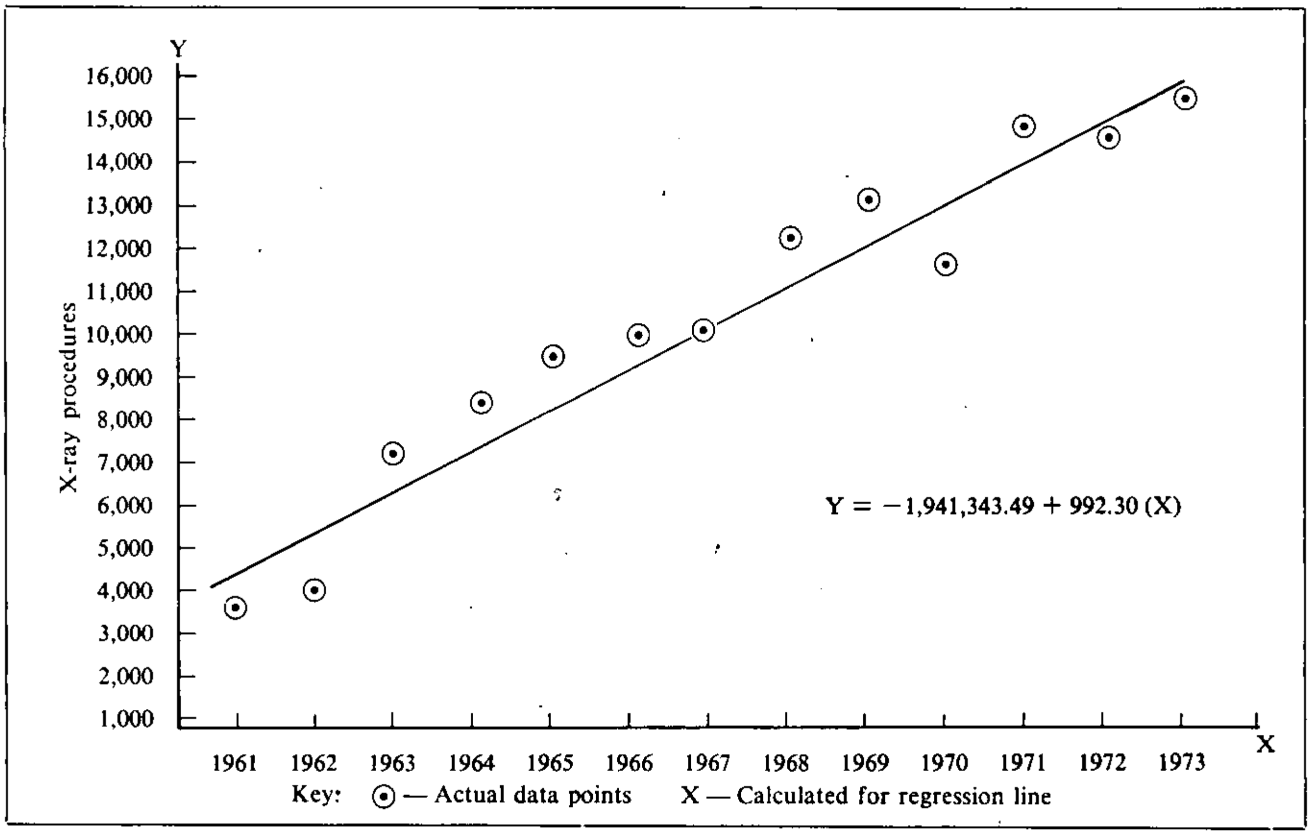
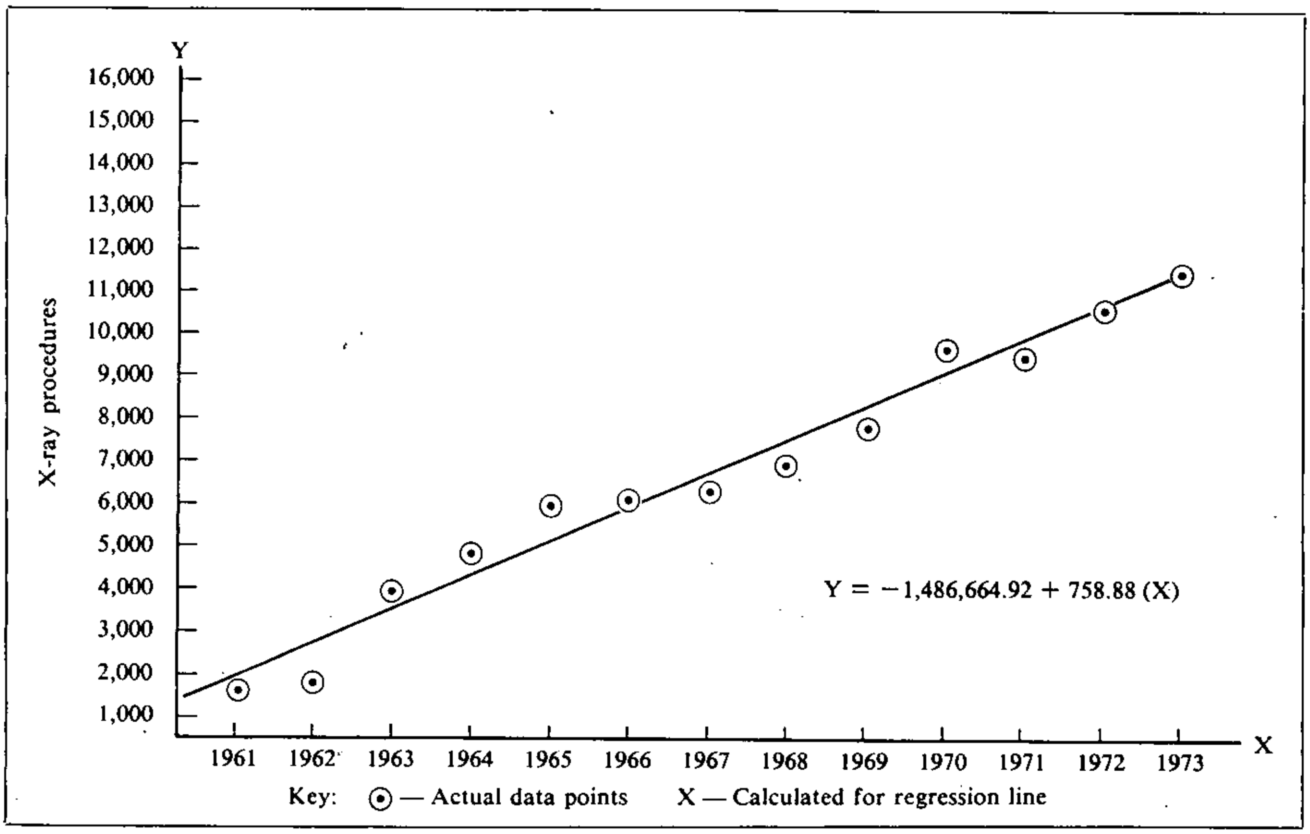


Figure 4.

Scatter diagram and regression equation for emergency patient X-ray procedures



deviation, measured 56.68 for inpatients, 1,149 for outpatients, and 868.5 for emergency patients.

Correlation coefficient

As with the first statistic, the detailed explanation, formulae and sample calculations can also be found in most statistic books and again will not be duplicated.[7] However, the correlation coefficient is the degree of association, relationship, or correlation between X — (Years), and Y — (radiographic procedures).[8]

For inpatient procedures, the correlation coefficient measured .98, for outpatients .96, and for emergency centre patients .98.

The correlation coefficient results were extremely high which helped confirm that the method of linear regression analysis would be justified.

There are a number of other statistics that can be used to refine this technique such as, confidence limits,[9] the use of the student distribution,[10] or the use of coefficient of determination and nondetermination.[11] All provide more statistical information and upgrade the model. However, although used in the application of this model, the authors will not, for the sake of space, detail these techniques. Once again, most books on statistics will provide the information needed to utilise them if desired.

It should be understood, if in calculating these statistics one arrives at a relatively high standard deviation and a low correlation coefficient, that perhaps the least squares method of regression analysis should not be used in this part of the model. Example, if a scatter diagram indicates a number of fluctuations over the years, perhaps an index regression or cyclic regression method should be used to best explain the data which, in turn, would make a better prediction. The point being, based on the actual trend in the data, the linear regression analysis method proves to be a statistically accurate prediction tool. However, other methods can be used to make predictions in analysing data based on varying data trends.

The third step in this phase requires making the actual prediction based on patient classification. The regression equation shall be used to make that prediction.

For each of the three patient classifications, the regression equation is calculated using the a and b values as illustrated below:

$Y = a + bX$

Inpatient: $Y = -3,745,594.90 + 1,906.90\,(X)$

Outpatient: $Y = -1,941,343.49 + 992.3\,(X)$

Emergency patient: $Y = -1,486,664.96 + 758.88\,(X)$

Next, substitute the year that is desired to be predicted for the (X) value in the regression formula. Then solve for Y using its corresponding X value. The Y value will represent the predicted number of patient X-ray procedures for that classification for that year. Example, the year 1985 was used in this application, and below are the results.

Inpatient: $Y = -3,745,594.90 + 1,906.90\,(1985)$
$Y = 39,601.90$

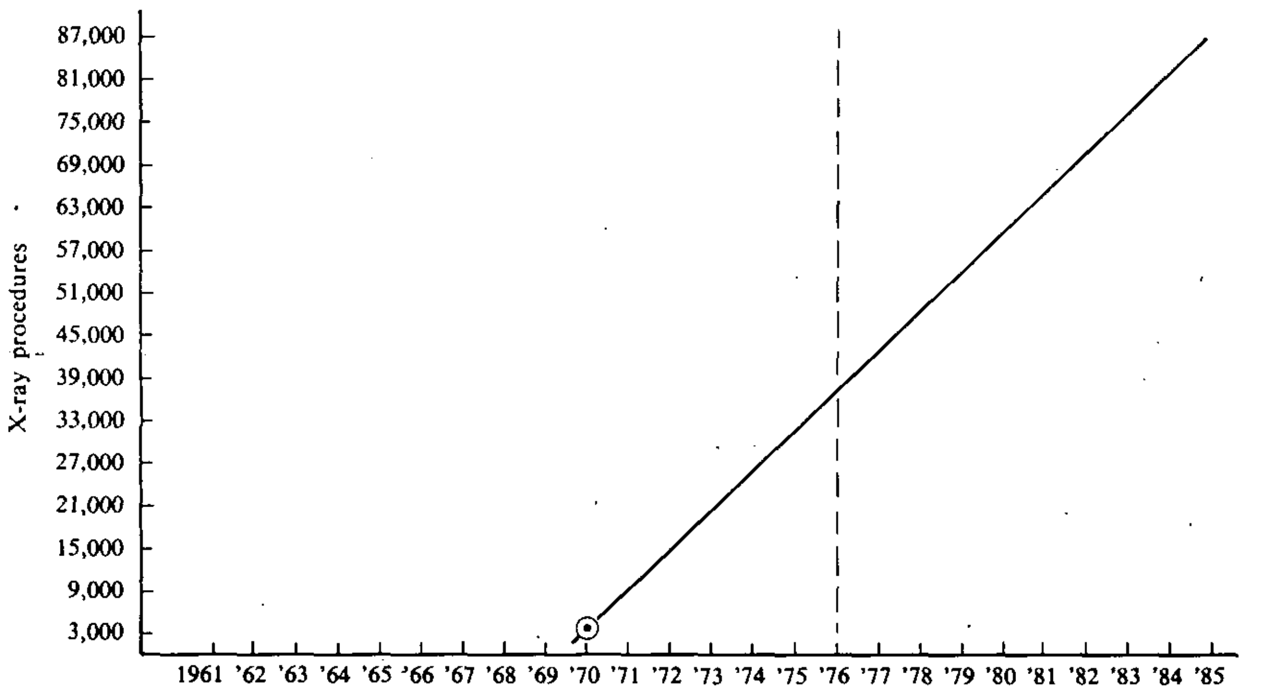
Outpatient: $Y = -1,941,343.49 + 992.3\,(1985)$
$Y = 27,777$

Emergency patient: $Y = 1,486,664.96 + 758.88\,(1985)$
$Y = 19,712$

Thus, the total predicted procedures for 1985 for each of the three patient classifications is computed, and measures 87,091. This is illustrated below in *Figure 5.*

Figue 5.

Combined total number of predicted X-ray procedures for 1985



Key: ⊙ — Actual data points X — Calculated for regression line

Conversion of predicted demand into predicted X-ray facility needs

The final phase of this model involves three steps. The first is to determine any appropriate adjustments of the breakdown of total predicted X-ray procedures into four 'procedure categories'. The next step is to convert the projections based on patient classification into 'procedure categories'. Third, the predicted procedure category figures are then inserted into the formula (*Equation 1*) which measures the number and type of radiology rooms needed for that prediction year.

Breakdown of total predicted X-ray procedures into procedure categories

The first step in accomplishing this conversion is to determine for the past several years the various historical breakdowns by 'procedure category' for total procedures. For example, in 1970 the X-ray Department's total examinations measured the following by breakdown procedure category:

0.69% — Special procedures
14.87% — Fluoroscopic procedures
61.37% — Radiographic procedures
23.07% — Chest procedures

100.00% — Total X-ray procedures

When investigating the year end department statistical summary report for 1971, 1972 and 1973, the variation in the above procedure categories averaged less than 1%. Based on this fact, it was assumed in this study that no significant variations would occur in the future that would alter the percentages as shown above. Thus, the established percentage for each of the above categories is applied against the projected total X-ray procedures for 1985, which measured 87,094. This total was then used to calculate the number of procedures by category to be expected for the year 1985 (see *Table IX* below).

Table IX.

Projected total number of procedures by category

Type of procedure	Per cent	Number* per month	Number per year
1. Special procedures	.69%	50	600
2. Fluoroscopic procedures	14.87%	1,079	12,948
3. Radiographic procedures	61.37%	4,454	53,458
4. Chest procedures	23.07%	1,674	20,688
Total procedures per month	100.00%	7,257*	87,094

* The totals are divided by twelve to be consistent with Equation 1.

It should be understood that shifts can occur and should be considered when the breakdown per cents are being computed, refined, and applied. For example, a new heart catherisation laboratory with the addition of new cardiologists on the medical staff can cause a significant upward shift in special procedures. This would, of course, increase the percentage weight given to the number of procedures performed for that procedure category. A second example, if a trend is identified and the historical data indicates a steady increase in the number of fluoroscopic procedures from year to year, by the application of simple interpolation, one can make appropriate adjustments to compensate for these trends. Once the total X-ray procedures are broken down into procedure categories, the second step in this phase of this model can be applied.

This step involves inserting the figures from the prediction procedure into the foundation formula. The calculations are completed in the same manner as shown above. The calculations will aid one to predict the number and type of rooms needed in the future.

It should be noted that the same formula (*Equation 1*) in the mathematical model is used to calculate the future number and type of rooms needed. It should also be noted that the other four variables, W%, $\overline{T}p$, $\overline{P+C}$, and C in the formula will remain constant, after they are first calculated as shown above in the first phase of this article.

The measurement of the fifth variable, ΣPc for 1985 was summarised in *Table 7.*

To perform the calculations, the projected number of procedures for the respective categories are introduced into the model formula (*Equation 1*) under that symbol ΣPc. The calculations are then performed for the desired results. Below is the formula and various calculations based on the projection data from the application of this model.

$$Nc_1 = \frac{(100\%)(50)\,[(63.19)+(60)]}{14{,}850} \quad \text{— Special procedures}$$

$$Nc_1 = .43 \text{ rooms}$$

$$Nc_2 = \frac{(99.6\%)(1{,}079)\,[(16.65)+(15)]}{14{,}580} \quad \text{— Fluoroscopic procedures}$$

$$Nc_2 = 2.33 \text{ rooms}$$

$$Nc_3 = \frac{(67.3\%)(4{,}454)\,[(9.65)+(7)]}{14{,}580} \quad \text{— Radiographic procedures}$$

$$Nc_3 = 3.42 \text{ rooms}$$

$$Nc_4 = \frac{(67.3\%)(1{,}674)\,[(2)+(5)]}{14{,}580} \quad \text{— Chest procedures}$$

$$Nc_4 = .54 \text{ rooms}$$

$$\sum_{i=1}^{4} Nci = 6.72 \text{ rooms}$$

Results

The results of the calculations measured that 0.43 of a room will be needed in 1985 for special procedures, 2.33 rooms for fluoroscopic procedures, 3.42 rooms for radiographic procedures, and 0.54 of a room for chest procedures. The grand total number of diagnostic rooms required for the peak workload period for 1985, for the Radiology Department, measured 6.72 rooms. A summary *Table X* of the projected radiology rooms and equipment needed for 1985 is offered on page 25.

Analysis of the results indicates that a total of seven X-ray examination rooms will be required in 1985 to meet the projected radiology demands during the peak workload period. One room for special procedures will be required, which is projected to cost approximately $450,000; two fluoroscopic rooms at an approximate projected cost of $280,000 per room; three radiographic rooms, projected

Table X. Summary of projected radiographic rooms and equipment needed for 1985

Number of examination rooms needed	Type of Diagnostic room	Total rooms needed for 1985	Adjusted rooms needed based on cross utilisation	Per cent of rooms left over and available for use by another category	Alternate examination utilisation
1	Special procedures	.43	—	57%	Fluoroscopic procedures
2	Fluoroscopic procedures	2.33	1.76	24%	Radiographic procedures
3	Radiographic procedures	3.42	3.19	81%	Flexibility
1	Chest procedures	.54	.54	.46%	Chest procedures only

cost $180,000; and one chest room at $85,000. Total projected equipment cost measured $1,635,000.†

Summary

In summary, a mathematical model has been developed, tested, and applied which measures effectively the number as well as the type of radiographic rooms needed to meet the current and projected radiographic demand for a typical health care facility.

The model first required a projection of radiographic procedures, based on historical data. Secondly, the projected total by patient classification was subdivided into procedure categories. Finally, the projected categorised radiographic procedures are introduced into the formula (*Equation 1*) and is shown below:

$$Nc = \frac{(\%W)(\Sigma Pc)\,[\,(\overline{Tc}) + (\overline{P+C})\,]}{C} \qquad (Equation\ 1)$$

The formula is applied to each procedure category. The grand total for each of the four separately calculated categories will measure the total number of rooms and type of facility needed in the future.

$$\sum_{i=1}^{4} Nci$$

Conclusions

In conclusion, perhaps the reader might question the use of such a detailed mathematical tool to apply in the decision-making process for radiology equipment. The authors would, however, like to re-emphasise that, as stated at the very beginning of this article, as cost and impact increase so should the attention of the administrator. The importance of calculating the correct number of diagnostic rooms for the Radiology Department to meet future demand is, of course, acute. An incorrect decision would not only have a far-reaching adverse cost impact within the department, but throughout the entire hospital as well in terms of cost and utilisation factor.

Secondly, with the cost of one radiographic diagnostic room easily exceeding $200,000, the time and effort required to develop the data and apply such a tool in the decision-making process can be easily justified.

The mathematical model developed for this article improves upon other existing mathematical methods for calculating the number and type of radiographic equipment. This results from the inclusion of variables such as preparation and clean-up time in the mathematical model, in order to ensure greater accuracy of predictability.

†Based on discussions with several radiology equipment vendors — projected estimated costs to 1985.

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Product News

Mechanically Sealing Pressure Test Points

The present-day method of regulating heating and chilled water distributing systems to achieve the design output, is by proportional balancing of the water flow quantities, using two valves normally provided on circuits and sub-circuits for isolating and regulating purposes.

The isolating valve requires to be of a type for which the makers provide charts giving the pressure drop (frictional resistance) through the valve, corresponding to varying quantities of water flow with the valve fully open.

The valve must be equipped with a correctly fitted pressure nozzle (test point) at the inlet and outlet, which is suitable for rapid attachment of a manometer or differential pressure gauge, which is moved from valve to valve until all the required differential pressures are achieved, by adjusting the companion regulating valves. The test points are then capped off.

The Property Services Agency of the DoE who originated the technique and the IHVE Code 'W' both require the pressure test points and the manometer attachments to be self-sealing to prevent escape of water from the system and to retain water in the manometer hoses when moved from valve to valve.

When fitted on medium or high temperature hot water systems, the test points and attachments must be suitable to withstand these conditions, and the test point must additionally be fitted with a mechanical back-up seal.

With the foregoing in mind, Maurice Binder, after months of research designed the 'Mechseal' (¼in) pressure test point, which is accepted by the PSA as fully meeting their commissioning requirements to HPHW.

This mechanically sealing pressure test point ensures safe, leakproof shut-off, with no needles to bend or break and no plugs to penetrate or leak.

Operation is by means of either manometer or pressure gauge adaptor being screwed onto the test point.

Both these have a primary seal which is engaged prior to the main flow being released, so that there is no leakage past the threads. The former embodies a non-return valve cutting off backflow from the manometer tube when disconnected.

At the same time a stainless trip bar lifts the non-return ball whilst in operation to avoid a hydraulic lock, and re-seats as soon as one starts to unscrew the manometer hose.

The test point and cap are in brass (other metals can be supplied) and the sealing medium is by way of a spring-loaded stainless steel ball which seats into a PTFE sleeve.

A retained nylon dust-cap has been designed which will be incorporated on future production runs.

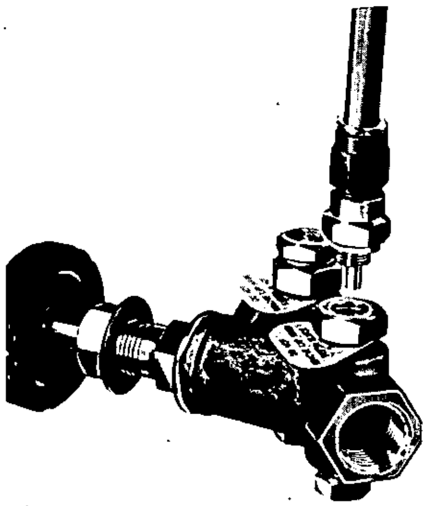
Also available, an extension piece, for use where valves are lagged.

Raybin Fixtures, 41 Burlington Road, New Malden, Surrey KT3 4LP. Telephone: 01-942 7871.

New Range of Commissioning Valves

Hattersley Newman Hender Ltd has recently introduced a range of cast iron and bronze commissioning valves incorporating self-sealing test plugs to facilitate regulation procedure by mass flow measurement recommended by the DoE Property Services Agency for commissioning of heating and chilled water systems.

Developed in close co-operation with the DoE, Hattersley Newman



The new commissioning valve.

Hender commissioning valves incorporate all metal, self-sealing test plugs which accommodate a new HNH Probe suitable for $^5/_{16}$ inch OD nylon tube connection to a manometer.

During commissioning, which should be carried out without heat, the HNH Probes are simply inserted into the test plugs and the pressure drop across the valve is indicated on the manometer. Hattersley Newman Hender provide reliable flow charts to enable the designer to determine the pressure drop signal across the valve to give the required mass flow of water and achieve optimum design performance.

This new commissioning now forms an important part of the PSA Standard Specification (M and E) No 3 1974, and has considerable advantages over former, inconsistent costly methods.

HNH Commissioning valves are a permanent part of the heating or chilled water system, since both the orifice valve complete with test plugs and the associated double regulating valve are also used for isolating purposes.

They will be available in sizes half-inch to two inches bronze orifice valves, Fig CV332, and bronze double regulating valves, Fig CV1332 and two-inch to eight-inch cast iron orifice valves, Fig CV4733 and cast iron double regulating valves, Fig CV4733DR.

Hattersley Newman Hender Ltd, Ormskirk, Lancs L39 2XG. Tel. Ormskirk 74281. Telex: 627571.

Identifying asbestos samples

Asbestos pollution monitoring to ensure that the Asbestos Regulations are met necessitates the use of a microscope. Gallenkamp have available an instrument based on the Olympus Series BH system microscope which can be used both for counting asbestos fibres collected on a membrane filter and for the identification of different types of asbestos fibre.

The equipment for counting purposes includes an Olympus BH microscope with X40 phase contrast objective and graticules as recommended in the Asbestos Research Council Technical Note No. 1. For the identification of different types of asbestos in a bulk sample the following are supplied: an Olympus BH microscope with 30W Köhler illumination, rotating stage and trinocular head, attachments for dispersion staining and attachments for polarisation with or without first order red tint plate. A comprehensive outfit both for identification and counting using the same microscope is also available.

Accessories include a closed-circuit television system. This system is very compact and facilitates viewing of speciments during counting, as well as allowing more than one person to observe the sample at the same time. It can also be used in conjunction with a particle size analyser.

For further information or for a demonstration, contact: *A. Gallenkamp & Co Ltd, PO Box 290, Christopher Street, London EC2P 2ER. Tel. 01-247 3211.*

Electric Steam Generators

Medisco Equipment Limited, of Windsor, Berkshire, has introduced a range of compact electric steam generators which can supplement or replace expensive-to-run central steam generating plant.

Known as the Amsco 'Powerpak', the new units are particularly suitable for use with hospital sterilisers and similar equipment where a steady steam pressure for short periods is required.

Eleven models are available, the smallest of which, the LB10, will produce up to 34.5lbs/hour of steam and the largest, the LB180, 621 lbs/hour. Operation is automatic, steam pressure being pre-set, according to requirements, and maintained at between 15 and 100 psi and build-up time to, say 80psi, is only seven to ten minutes. The LB steam generators are on, of course, only when steam is being used and this presents the opportunity to economise both on water and electricity.

Although the generators are comparatively small and installation is relatively simple, the design incorporates several features which are worthy of mention. In order to eliminate the possibility of deposits building up over a period of time, the tank and pipework is always empty when the unit is not operating, an automatic drain-down and flush system being fitted. Furthermore, an efficient fail-safe water level controller and water pressure boost pump are fitted which make the generators virtually unaffected by mains water pressure.

As an option, the larger models, from LB20, can have the tank and pipework in stainless steel.

For mobile applications, such as cleaning operations, a wheeled version of the LB10 is offered.

The LB range of steam generators is said to be considerably less expensive than machines which are currently available.

For use either in conjunction with the steam generators on other suitable supply, Medisco also offer a steam gun set which is supplied with a detergent dispenser and which may be used with a steam/water mixture or steam only. These are complete with operator's gloves and a selection of nylon and stainless steel brushes.

Informative literature containing details and specifications of these products is available from: *Medisco Equipment Limited, 52-54 Peascod Street, Windsor, Berkshire. Tel. Windsor 67514.*

Lightweight Personal Air Sampler

Rotheroe and Mitchell have introduced a new personal air sampler designed to provide a compact lightweight unit for monitoring airborne pollution.

Weighing less than 1 lb, the C2000 can be hand-held, or used for applications which demand the air sample to be taken close to an operator's breathing zone. To do this, the device fits unobtrusively in the pocket or can be clipped to a belt or harness and is available with an extension lead and filter holder. This is attached to the operator's collar or lapel as close to the mouth as is convenient.

A small sliding vane pump draws air through the filter at a constant rate. The motor speed is accurately controlled electronically, and the flow is set by an in-line restriction valve,

adjustable over the range 0.5 litres/min to 2 litres/min. The device incorporates a flow gauge that allows the flow to be checked and reset as required.

The C2000 is powered by nickel-cadmium rechargeable cells which give it a continuous operating time of ten hours or more, thus easily covering the normal shift period. When the batteries need re-charging, a LED on the front flashes continuously. The small charger, separately available, plugs in to re-charge the unit in less than 14 hours. *Rotheroe and Mitchell Ltd, Greenford, Middlesex.*

Short Form Guide to Electrical Range

Hellerman Electric — which now has a catalogue of over 2,000 tools and accessories for wire and cable handling — has published a short form guide to its product range.

Designed to provide electrical and electronics engineers with an easy reference to the many techniques of conductor treatment, the guide is supplied with a postage-paid number coded reader enquiry card.

Called a Product Finder, it covers all the key elements of the Hellerman Electric product ranges for wire and cable identification, marking, stripping, heat shrinkable sleeves, moulded shapes, securing, trunking and circuit testing, backed by the tools for the job.

Brief details of PCA — a recently introduced solder iron resistant wire — and a custom made cable design and manufacturing service, are also given.

Hellerman Electric, Gatwick Road, Crawley, West Sussex RH10 2RZ. Tel. Crawley (0293) 28888. Telex: 87163.

ITT value miniaturisation

To combat ever-increasing costs, the Systems Division of ITT Controls embarked last year on a policy of reducing size and weight in a number of its major product ranges in a concerted effort to hold, and in many cases, reduce prices to users. This policy is beginning to pay off, and has created new scope for the products themselves, since miniaturisation has made usage possible in situations where the larger standard products could not previously be considered. The Company sees this as a major breakthrough and is now introducing a new range of Miniature Valves having a selection of clip-on actuators.

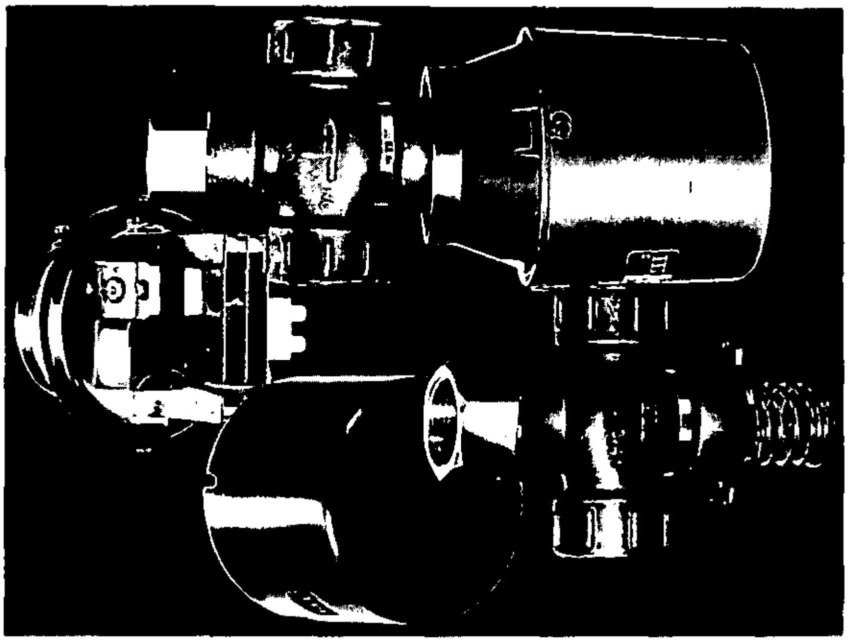
This innovation gives heating and ventilating system installers an unprecedented flexibility in building system installations because valves can now be delivered either as complete items (with appropriate actuators) or as bodies only, for assembly in the system, the actuators being clipped on in a matter of seconds at a suitable time prior to commissioning. An important further advantage, from the supply point of view, is the simplicity of changing a valve body from Pneumatic to Electric, two position, or alternatively reversible actuator, or vice-versa. The valves themselves are available as either two or three way in sizes 10, 15 and 20mm ($\frac{3}{8}$in, $\frac{1}{2}$in and $\frac{3}{4}$in) with internal BSPP threads or external UNF threads for screwed connections and the bodies are of bronze. The body variety facilitates two-way normally closed, two-way normally open and three-way mixing applications.

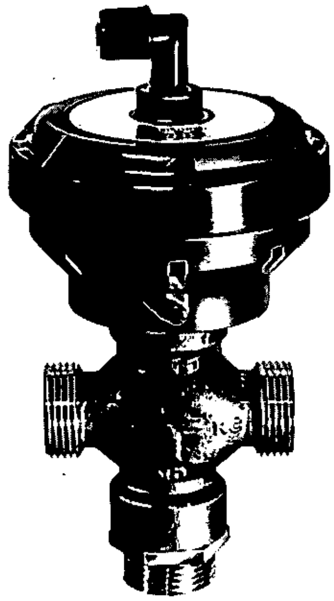
The three main classifications are:

Type PKV Valve fitted with pneumatic actuator with operating pressure 0.2 to 1.0 bar (3 to 15 psig) in zone applications for proportional control of chilled water and hot water flow through either induction or fan-coil units.

Type EKV with electric two-position actuator, having a spring return action and optional manual operating facility, and available with 24, 110 or 240V 50/60 HZ motors, for electrically controlled zoning of chilled water and hot water flow through either induction units or fan-coil units.

Type ERKV with electric modulating actuator having a reversible motor





Above: *ERKV valves assembled and stripped, and (right), a PKV valve with pneumatic actuator.*

and available with 24, 110 or 240V 50/60 HZ motors, for modulating control.

ITT Controls, Systems Division, 333 West Street, GLASGOW G5 8JE. Tel. 041-249 2191.

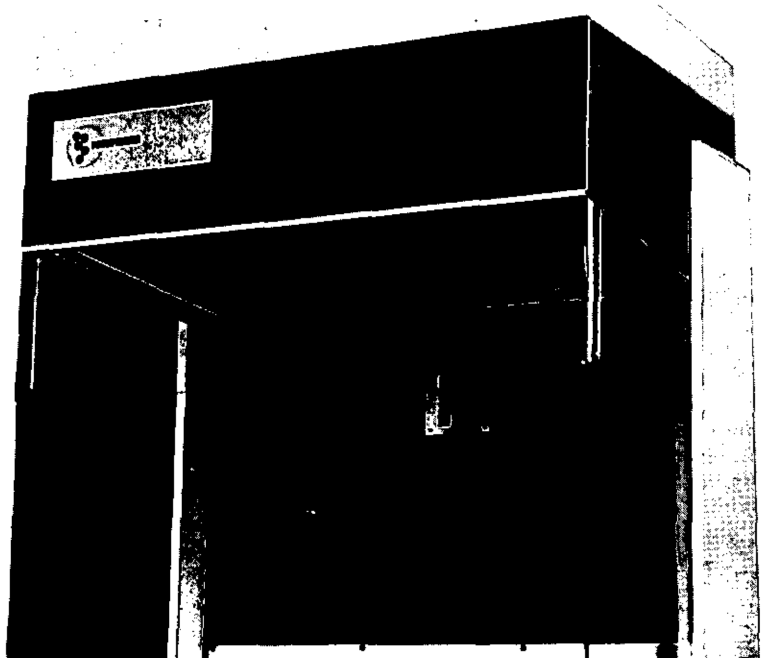
Bench Mounted Lamina Downflow Work Station

Pathfinder (Environmental) 1974 Ltd., Solent Road, Havant, Hants, critical atmosphere contamination specialists, recently introduced the new R133/6V range of bench-mounted lamina downflow work stations.

Designed to meet US Federal Standard 209B, Class 100, or better (less than 100 particles of 0.5 micron or larger per cubic foot of air), R133/6V is a low cost packaged unit which allows operator freedom normally associated with equipment of much greater cost. Featuring easy operator access and top mounted, high efficiency filters, R133/6V has air flow of 90ft/min (0.45m/sec) and is fully recirculating with 10% front air make-up. The fully balanced, maintenance free fan system has been specially designed to ensure minimum vibration and a low sound level in the region of 60dB (A scale) at 1 metre.

Operating from a single phase 220/240V, 50Hz electrical supply, R133/6V is housed in a sound and vibration absorbing, waterproof Trespa board casing, laminated with white, red and grey melamine, the largest unit in the range measuring 1200mm high by 1924mm wide by 903mm deep. The work surface is perforated stainless steel and side screens are of clear perspex. Optional extras include 15 watt, U/V bacterical tube and fittings, stainless steel drip tray below the work surface, removable front panel, tubular base assembly and air flow meter.

Pathfinder (Environmental) Ltd, Solent Road, Havant, Hants. Tel. 08012 3661/4.



The Pathfinder work station.

Classified Advertisements

APPOINTMENTS AND SITUATIONS VACANT

GWYNEDD HEALTH AUTHORITY
Area Works Department, Caernarfon

AREA ENGINEER

Applications are invited for the above new post. Gwnedd is a single-district Health Authority, where a District General Hospital of 520 beds is under construction. Salary scale: £6,405 (x 5) - £7,716 plus £291 plus second supplement.

Applicants must be Corporate Members of one of the Institutions of Civil Mechanical, Electrical or Electronic and Radio Engineers. They should have sound knowledge of engineering design and construction, preferably in a large undertaking concerned with construction, operation and maintenance of sophisticated engineering plant, equipment and services in a health or social services context; also a good working knowledge of engineering techniques and standards. Detailed mechanical and electrical knowledge over part of this field is desirable. Applicants must have acceptable managerial experience.

The Area Works Officer, Mr. A. Hardy, will be pleased to answer enquiries, and may be contacted at the Area Works Department, Bodfan, Eryri Hospital, Caernarfon, Gwynedd. Tel. Caernarfon 4668.

Application form and further information is available from: Area Personnel Officer, Gwynedd Health Authority, Coed Mawr, Bangor, Gwynedd LL57 4TP. Tel. Bangor 51551, ext. 277.

Closing date: February 20, 1978.

WILLIAM HOLDER AND PARTNERS
Consulting Engineers

William Holder and Partners are London-based Consulting Engineers. Due to the continued growth of their Engineering Management consulting division vacancies have arisen as follows:

Senior Engineer

(Management, Operation and Maintenance)
Salary up to £7,000 p.a.

A Senior Mechanical/Electrical Engineer (M/F), preferably Chartered, is required with experience in the operation and maintenance of hospital and similar engineering building services. The preferred age is between 30-35 years. The appointment will involve functions within the division of the practice involved in Engineering Management, Plant Operations and Maintenance Consultancy.

Senior Assistant Engineer

(Planned Maintenance Systems)
Salary: £4,200 to £5,000 p.a. (negotiable)

These positions offer excellent prospects for Engineers (M/F) to work on a variety of projects involving development and implementation of Planned Maintenance Systems. Experience is necessary in management of maintenance in hospital or industrial building services. Knowledge of work measurement techniques would be an advantage. Age 25-30. Qualifications — HNC, FTC or equivalent.

Please apply for both appointments to: D. G. Potter, William Holder and Partners, 81 Blackfriars Road, London SE1 8HA. Telephone: 01-928 9351.

TAYSIDE HEALTH BOARD
(Dundee District)

SECTOR ENGINEER

Following the promotion of our present Sector Engineer, we are looking for a suitably qualified engineer to join the District Engineering Service. Applicants should have completed an electrical or mechanical engineering apprenticeship, and hold an HNC in Mechanical or Electrical Engineering, with endorsements of other approved qualifications.

The salary scale is £4,371 p.a., rising by annual increments to £5,262 p.a., plus £499 p.a. Phase I and II supplements. New entrants to the National Health Service would enter the scale at the minimum. Whitley Council conditions of service apply.

Application forms, job descriptions and further particulars may be obtained from the District Personnel Department, 15 Dudhope Terrace, Dundee DD3 6HH (telephone Dundee 21953, ext. 261). In reply please quote reference SB/85. Closing date for receipt of completed forms is February 20th, 1978.

BIRMINGHAM AREA HEALTH AUTHORITY (TEACHING)

ASSISTANT AREA ENGINEERS

Salary: £4,870 - £5,761

Applications are invited for two third-in-line posts within the Area Works Department.

The persons appointed will assist the Area Engineer throughout the whole range of his duties, covering all engineering aspects in the general field of maintenance, operation of plant, energy management and capital works. One post will be primarily concerned with the execution of capital works.

Applicants should have a good knowledge of engineering work to Health Service buildings together with demonstrated managerial ability and be able to work effectively with colleagues in and outside their own discipline.

Applicants should be qualified in accordance with PTB par. 2531.

Further information on the posts may be obtained from Mr. D. W. Hill, Area Engineer, telephone 021-235 3719.

Application forms and job description available from the Area Personnel Officer, Birmingham Area Health Authority (Teaching), Alpha Tower, Suffolk Street, Queensway, Birmingham B1 1TP, telephone 021-235 4786. Closing date: 24th February, 1978.

Kensington and Chelsea and Westminster Area Health Authority (Teaching)
North East District (Teaching)

HOSPITAL ENGINEER

required at the Middlesex Hospital

Applicants should have experience in mechanical and electrical engineering and proven managerial ability. Duties will include the implementation of a planned preventive maintenance system and the management of a large direct labour force of engineering and building disciplines.

Applicants should possess a higher national certificate in mechanical or electrical engineering.

Salary: £4,662-£5,197 inclusive of all allowances.

Requests for application forms should be made in writing to: Mr. H. C. Stanley, ARICS, District Building Officer, The Middlesex Hospital, Mortimer Street, London W1N 8AA. Tel. 01-636 8333, ext. 7566.

KING EDWARD VII HOSPITAL
Midhurst, West Sussex

Resident Engineer

Applications are invited for this post which will become vacant shortly on the retirement of the present holder. The successful candidate will be responsible for the maintenance and efficient operation of engineering services, buildings and fire protection throughout the Hospital and associated buildings. Applicants should have a sound knowledge and experience of automatic oil-fired steam boilers, operating theatres and laundry equipment, including air conditioning plants, lifts and water pumping services. They should have served an engineering apprenticeship and hold a recognised certificate or diploma in engineering. Applicants should also have had administrative experience and be capable of managing an Engineering Staff of 20, maintaining a 24-hour service.

The salary will be based on the scale £4,338 to £4,780, plus £200 per annum "On Call" Duty Allowance. An unfurnished house is available. A contributory pension scheme is in operation and NHS superannuation benefits are transferable.

Application forms and a job description can be obtained from the Hospital Secretary.

another first from Polymark

the Trans-ef

BATCH CONTINUOUS WASHER

Excellent washing action — achieved by unique inner drum design.

Optimum loading ratio (1:30) Output rates from 600 to 1750 kg dry work per hour.

No-compromise unit constructions principle — easily extensible with individual units.

Little maintenance required.

Reliable transfer system from unit to unit.

Arranged to allow constant supervision and checking of the entire washing process. Measuring temperatures, taking samples, supplying power, adding washing agents and auxiliary agents – all possible with the Trans-ef dual drum at any point, at any time, without any complication.

Trans-ef — maximum degree of automation, positive separation of batches, flexible programming to suit each application (even variable during washing), adaptable to any loading or unloading system.

Trans-ef — incorporating all the advantages of today's laundry technology – a top class product at a realistic price.

Supplied in sections — trouble-free delivery and installation in any laundry.

Trans-ef — The first machine without bearings for the inner drum.

Extremely economical water consumption — thanks to the well known EF Contra-Flow Process.

Meeting all hygiene regulations. Suitable for installation into a cross infection barrier.

POLYMARK LTD., Jeddo Road, London W12 9EE. Tel: 01-743 1001. Telex: 267504