Hearing and balance disorders

Achieving excellence in diagnosis and management

Report of a Working Party 2007

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ROYAL COLLEGE OF PHYSICIANS OF LONDON
11 St Andrews Place, London NW1 4LE

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Contents

Members of the Working Party

Professor Linda M Luxon BSc MBBS FRCP (*Chair*)
Professor of Audiological Medicine, University of London, UCL Institute of Child Health and Consultant Audiological Physician, National Hospital for Neurology and Neurosurgery, London

Ms Foluke Ajayi BSc MSc MBA CS
Healthcare Science Professional Officer, Department of Health, London

Dr Lesley Batchelor MB BCh MSc MFFP FFFP FRCPCH
Consultant Community Paediatrician in Audiology, Macclesfield District General Hospital

Professor Michael Gleeson MD FRCS
Professor of Otolaryngology and Skull Base Surgery, National Hospital for Neurology and Neurosurgery, London.

Professor Tim Griffiths BM Oxfd MRCP(UK) MA DM FRCP
Professor of Cognitive Neurology, University of Newcastle

Dr Gordon Hickish VRD MB ChB DCH FRCGP
General Practitioner, Christchurch, Dorset.

Professor Sue Hill PhD MRCP
Chief Scientific Officer, Department of Health, London

Dr John Irwin MBChB MSc MRCP
Consultant Audiological Physician, Ninewells Hospital, Dundee

Dr Rob Low BSc MSc PhD
Consultant Clinical Scientist (Audiology) and Director of Audiology Services, Royal Sussex County Hospital, Brighton

Dr Deirdre Lucas MBBS FRCP
Consultant in Audiovestibular Medicine, Nuffield Hearing and Speech Centre, Royal National Throat Nose and Ear Hospital, London

Professor Ian McDonald MB PhD FRCP FRCOphth
Professor Emeritus of Neurology, Institute of Neurology

Dr Peter Overstall FRCP
Consultant in Geriatric Medicine, Age Care, County Hospital, Hereford.

Dr Ewa Raglan MD (Hons and Dist) LRCP MRCS DLO FRCS FRCP
Consultant Audiological Physician, Department of Audiology and Audiological Medicine, Great Ormond Strret Hospital for Children and St George's Hospital, London

Dr Sheila Shribman MA MB BCHIR MRCP FRCPCH
Consultant Paediatrician, Immediate past Registrar RCPCH

Ms Amy Skipp
Head of Research, the National Deaf Children's Society

Professor SDG Stephens BSc MBBS MPhil FRCP LHMSA
Honorary Professor and retired Consultant Physician

Mr Kevin Wyke
Director of Professional Development, British Academy of Audiology

Those who were consulted and/or gave evidence

Mr Brian Barney
Educational Audiologist

Dr Timothy Beale
Consultant Radiologist, Royal National Throat Nose and Ear Hospital

Dr Maria Bitner-Glindzicz
Reader in Clinical Genetics, UCL Institute of Child Health

Mr Simon Blake
Educational Audiologist

Dr Rosalyn Davies PhD FRCP
Consultant Neuro-otologist and Audiological Physician, National Hospital for Neurology and Neurosurgery, London

Professor Adrian Davis
Lead for England on New-born Hearing Screening Programme (NHSP) and training requirements for Modernising Hearing Aid Services (MHAS), Institute of Hearing Research, Nottingham.

Dr Elizabeth Graham
Consultant Medical Ophthalmologist, National Hospital for Neurology and Neurosurgery and St Thomas' Hospital, London

Mr David Hartley
Teacher of the Deaf (TOD), British Association for Teachers of the Deaf (BATOD)

Dr Peter Hindley
Consultant Psychiatrist

Dr Angela King
Royal National Institute for the Deaf

Dr Joanna Lawson
Geriatrician, Royal Victoria Infirmary, Newcastle

Mr Roger Lewin
Private Hearing Aid Dispenser

Ms Anne McDonnell
Clinical Specialist – Physiotherapy, National Hospital for Neurology and Neurosurgery, London

Dr Helen Miller MBChB MRCPsych MD
Consultant Psychiatrist, National Deaf Service, South West London and St George's NHS Mental Health Trust

Mr Robert Parkinson
National Deaf Children's Society

Mr David Pilkington
British Deaf Association (London Branch)

Dr Andy Reid
British Society of Audiology (BSA)

Ms Lynne Roberts
Senior Specialist Speech and Language Therapist (SALT) (deafness) – on behalf of the Royal College of Speech and Language Therapists

Dr Glenis Scadding
Consultant Immunologist, Royal National Throat Nose and Ear Hospital, London

Dr John Stevens
Consultant Radiologist, National Hospital for Neurology and Neurosurgery, London

Ms Joanna Upcott
Hearing Therapist

Professor Lucy Yardley
Professor of Psychology, University of Southampton

Foreword

The publication of this report is timely in the context of the recent National Audiology Plan, the House of Commons Health Committee report, *Audiology services*, and the current 18-week commissioning pathways for hearing loss and imbalance/dizziness.

Hearing loss and balance disorders are hidden handicaps with profound personal, occupational and economic consequences. At least half of the population suffer such symptoms during their lifetime, and yet service provision has not been given the priority it deserves (House of Commons Health Committee report, 2007). Recent government and third-sector initiatives have striven to improve both the speed and quality of service, particularly in the area of hearing aid provision, but children and adults with more complex hearing disorders, balance disorders, falls, adolescents moving from paediatric to adult care, and the multiply handicapped require the provision of better hearing and balance services.

This report has been produced by a multidisciplinary working party, which heard evidence from a wide range of stakeholders. Proposals include a networked model of care with multidisciplinary working patterns, manpower requirements and recommendations for training across all levels and disciplines of medicine. Also emphasised is the need to standardise the curricula and assessment of clinical competencies of all relevant healthcare disciplines to produce a flexible, appropriately skilled and responsive workforce. The Royal College of Paediatrics and Child Health and the British Geriatrics Society support this initiative, which will form the basis of future discussions.

The patient-centred recommendations aim to improve patients' quality of life by providing rapid, high quality care in a cost-effective manner. Multiple referrals, inappropriate and expensive investigations and absence from work will be reduced. The successful outcome of management for the hearing-impaired and balance-disordered patient, with return to full social and occupational activities, is the primary objective. This report gives us a real opportunity to achieve that aim.

October 2007

Ian Gilmore
President, Royal College of Physicians

Executive summary and recommendations

Audiovestibular medicine is the medical discipline concerned with the investigation, diagnosis and management of disorders of hearing and balance, including tinnitus, in both children and adults. In addition, some specialists are concerned with overall communication and the management of speech and language disorders in children (phoniatrics). Indeed, in some European countries, audiovestibular medicine and phoniatrics are one specialty.

The internal ear and its connections serve two sensory mechanisms: hearing and balance. Hearing loss can affect people of all ages – from congenital hearing loss in the newborn to late onset hearing loss in older people. The condition affects learning and development, is socially isolating and also has economic consequences for those of working age. Balance disorders similarly occur from childhood to old age, are associated with all major illnesses (eg cardiovascular disease, cerebrovascular disease and diabetes) and affect 30–40% of the population by 60 years of age with significant occupational and healthcare costs. Yet the conditions causing hearing and balance disorders often remain undiagnosed or inadequately managed because of inappropriate referrals and the non-availability of a dedicated audiological/vestibular service, with appropriate specialist medical support.

Patients who should be referred to an audiovestibular physician supported by a specialist multidisciplinary team are frequently referred to ear, nose and throat (ENT) or neurology specialists because there is no audiovestibular physician or adequately staffed multidisciplinary team available in their locality.

This report reviews the needs of patients with hearing loss and balance disorders and makes recommendations for a reorganised multidisciplinary service model with improved medical support, an increase in audiovestibular physician numbers and a greater emphasis on the specialty in medical training.

Background

- Disorders of the ear represent 24% of all disabilities in the adult population.
- The World Health Organization has identified deafness as a non-communicable disease that is 'a cause of enormous human suffering and a threat to the economics of many countries' and that 'constitutes a major contributor to the burden of avoidable risk and disease' that require to be addressed with surveillance, health care and long-term care measures (WHO).[1]
- Of the UK adult population aged 18–60 years, 17% suffer significant hearing loss and this figure rises steeply with age (80% by 80 years). One in 1,000 children are born with a permanent hearing loss and this figure rises to two in 1,000 for children 9–16 years of age. The Newborn Hearing Screening Programme has identified some 50% more infants with permanent childhood hearing impairment at a much younger

age than were previously diagnosed. Some of these infants will have potentially treatable conditions.

- 10% of the adult population of the UK would benefit from hearing aid provision; less than half are provided with hearing aids.
- Forty per cent of people aged over 40 years experience symptoms of dizziness and/or imbalance. These symptoms are the most common reason for visits to a doctor by patients over the age of 65 years.
- Demographic changes in the population will increase the medical need in hearing and balance disorders, as has been outlined in the National Service Frameworks (NSF) for long-term conditions and for older people.
- The social, occupational and economic costs of hearing and balance disorders on the individual, society and health services are profound.
- Audiology services have been a low priority for PCTs.

Summary of prevalence in the UK

- At least half of the adult population suffer hearing and/or balance disorders at some point in their life.
- Four in 1,000 children in the 9–16 year age range suffer permanent hearing loss to some degree and 80% of children under 4 years have an episode of middle ear dysfunction.
- In the absence of dedicated services, the percentage of children with auditory processing disorders and balance disorders remains unknown.

Priorities and perceptions

Despite the prevalence of hearing and balance disorders, the provision of medical care has remained a low priority for the NHS. There are inadequate numbers of medical and non-medical personnel, and there is limited availability of test facilities and poor access nationally to the range of treatment and rehabilitation options.

Despite recent initiatives by both the Department of Health (DH) and charities to raise the profile of this large group of patients, patient satisfaction as judged by charity helplines and self-help groups remains low:

> *As we have realised, vestibular disorders are so often misunderstood by the general public as well as health professionals and we feel the need to raise this understanding and awareness of such a disabling condition.* (**www.labyrinthitis.org.uk**)

> *The vital nature of audiology services for deaf children and young people is not widely appreciated . . . and cannot be overstated.* (**National Deaf Children's Society, 2007**)

> *We think there are probably half a million people waiting for a hearing aid in the NHS right now. The reason we do not know, of course, is that neither the Department of Health nor the NHS collects waiting time figures.*
>
> (**John Low, RNID, House of Commons Health Committee Report, 2007**)

The scope and remit of the report

This report challenges the current provision of hearing and balance services. A restructured multidisciplinary approach is proposed and the role of the audiological physician is clarified. It is envisaged that following appropriate training across the professional groups, this model would ultimately be led through primary care and would raise the standard and availability of care for hearing and balance disorders to achieve the Government's objective of a health service that meets the stated needs of patients.

In order to answer the remit of the Working Party, this document describes the work of audiovestibular physicians, the interrelationships with other medical and healthcare colleagues, and proposes changes in patterns of provision of service and patient care pathways in conjunction with 18-week commissioning pathways (www.18weeks.nhs.uk) to promote improvements in the speed and quality of care for patients with hearing and balance disorders. The training and proposed manpower required to implement these changes are outlined.

The membership of the multiprofessional working party, and the evidence presented to it, reflected the views of audiovestibular physicians and their consultant medical colleagues, as well as healthcare professionals and members of voluntary bodies whose skills or perspectives both overlap and are complementary to audiovestibular medicine.

The recommendations of this report are, therefore, addressed to the DH, deans of medical schools, general practitioners, commissioners, primary care trusts, hospital trusts and all professionals involved in the care of patients with hearing and balance disorders.

Role of the specialist physician in audiovestibular medicine

The report seeks to identify the role of the audiovestibular physician, which has assumed increasing importance as current scientific advances are translated into medical practice. The need for an enhanced medical input into the services provided one of the main impetuses for this report.

The role of the specialist physician, in both adults and children, is:

- to diagnose the aetiology of hearing loss, tinnitus and imbalance in isolated ear pathology or in multisystem disease
- to provide specific medical management and holistic medical care, and
- to ensure that there is audiovestibular medical input in the service provision and rehabilitation through the multidisciplinary team (MDT).

Deficits in the audiovestibular service

Hearing and balance services have developed piecemeal across the UK dependent on local expertise and resources. Only a handful of services provide complex audiovestibular investigations/rehabilitation, for example for auditory neuropathy or auditory processing disorders and full vestibular investigation and rehabilitation. Specific deficits in the service are listed below:

- There are no national audit figures as historically 'audiology' has been seen as a low priority healthcare need.

- There is marked geographical inequality in service provision, with clustering of audiovestibular physicians/paediatricians in specialist centres (London and Manchester) with no provision in the majority of the country.
- There is a paucity of dedicated audiology, tinnitus or vestibular clinics, with limited access to an integrated MDT comprised of the relevant complement of professional skills.
- In 2006 there was one audiovestibular physician per million population in UK. In Denmark the ratio is 1:125,000 and in Sweden 1:135,000.
- Despite the majority of patients suffering from conditions which are not surgically remediable, nor caused by central nervous system pathology, referrals are primarily directed to specialties recognised by the Department of Health to be overburdened (ie ENT and neurology).
- Appropriate medical expertise may not be available to patients presenting with audiovestibular symptoms in a non-medical audiology service, leading to limited diagnosis and treatment of relevant medical conditions and inappropriate, unnecessary and expensive investigations and additional referrals.
- With the loss of clinical medical officers working in the community, there is a shortfall in provision of community paediatric audiological services.

The cost/benefit consequences of hearing loss and balance disorders

The public health and socioeconomic costs of auditory and vestibular disorders have not been recorded. However:

- The cost benefit of early identification and habilitation of infants with profound hearing loss, facilitating integration into education, society and a full range of occupations is well recognised.
- Adult auditory rehabilitation programmes are also recognised to be cost effective in enabling adults to continue functioning both in the workplace and socially with consequent effects on psychological well being.
- Community-based studies in England and Scotland have suggested that 20–25% of the population experience symptoms of dizziness/vertigo, with one quarter losing time from work in one study and one half reporting some disability in a second study.
- According to the US National Institutes of Health, the mean number of physicians a patient with peripheral vestibular pathology visits before receiving a correct diagnosis is 4.5. A similar finding is reported from specialist balance centres in the UK. Frequently such referrals are associated with non-contributory expensive investigations such as MRI. The cost of delay in diagnosing the most common vestibular syndrome in older patients (benign paroxysmal positional vertigo) has been estimated at 253.62 euros per patient.

Training

The shortcomings of the audiovestibular service can be partly attributed to the lack of training opportunities. Specifically:

- There is minimal training in audiovestibular medicine (the investigation, diagnosis and management of hearing and balance disorders and labyrinthine involvement in systemic disease) at the undergraduate level, in general practice training programmes or specialist training for physicians and paediatricians.
- Neurologists, ENT surgeons, paediatricians and audiologists receive minimum training in the physiology and pathology of eye movement disorders, which are key to diagnostic vestibular assessment.
- There is no coordination in training programmes between the professional groups, leading to variability in standards of knowledge and competencies.
- There is only one academic unit of audiovestibular medicine in the country with a paucity of junior academic training posts.

Objectives of the report

The deficiencies in the service provision for hearing and balance disorders and particularly the lack of audiovestibular medical input into the service provided the impetus for this report. Three main issues are addressed.

1 **The scope of audiovestibular medicine, as distinct from otology/ENT and audiology, and the role of the audiovestibular physician in providing optimal national audiovestibular services**

Consultant audiovestibular physicians form an integral part of the MDT, which aims to provide prompt, accurate, resource efficient and effective care to patients with audiological and vestibular disorders. The unique role of the audiovestibular physician is two-fold:

(a) generically, as a consultant physician supervising the holistic care of the patient, and

(b) specifically, in the prevention and/or amelioration of pathology, aetiological diagnosis, interpretation of investigations in the context of medical care and medical treatment/management/rehabilitation.

This is increasingly important with respect to the translation of basic neuroscience research advances into the clinical domain: for example, pathological mechanisms, genetic mutations/molecular expression, neurochemical pathways of cell death and appropriate pharmacological intervention and biotechnology/bioengineering.

2 **The role and value of the multidisciplinary team, and the need for and scope of medical input within the audiovestibular team**

The MDT is a well established, successful construct in the provision of audiological and vestibular care. Recent DH initiatives have expanded the role and numbers of healthcare scientists and highlighted overburdened medical disciplines. In addition, there is a policy shift to facilitate the provision of NHS care in the community for ease and speed of access. Within this model, the focus of the work of the audiovestibular physician is directed at supporting and integrating the skills of all members of the MDT, but particularly paediatricians, otologists and audiologists, to ensure both optimal use of resources and best clinical practice. This aim is achieved by integrated training, specialist medical assessment

and treatment for cases not successfully managed at the primary care level and robust multidisciplinary working across the proposed hearing and balance networks.

3 **The need for a new model for the provision of audiological and vestibular services which offers acute and chronic care to children and adults**

To meet the NHS targets of rapid, easy access to medical care, a three-tier multidisciplinary managed network of care for hearing and balance disorders is proposed. A healthcare scientist/GP-led primary care service will be developed and have access to and support from hospital centres, with audiovestibular physicians as part of the MDT. These centres, in turn, will be linked to tertiary centres with state-of-the-art facilities and medical and non-medical staff with supraspecialty expertise. This will enable rapid, high quality care close to the patient's home for the most routine cases, with seamless, prompt and direct access to supraspecialist care for complex cases, as required by current NHS directives.

Recommendations

Implementation of the recommendations, in the context of the large numbers of patients with hearing and balance disorders and the associated economic costs, would meet the requirements of the modern NHS by providing a cost efficient, accessible, high quality service led by primary care and ensuring optimal utilisation of the skills of all healthcare professionals.

The recommendations encompass three main areas:

1 *service provision:* to establish high quality and cost effective care for audiovestibular patients by establishing new working patterns and a coherent, networked model of care

2 *manpower:* to increase the number of audiovestibular physicians and paediatricians to meet the current medical need

3 *training:* to improve audiovestibular training across all levels and disciplines of medicine and integrate relevant training and assessment of competencies across related professions.

Service provision

- Clinical and academic audiovestibular physicians and paediatricians together with senior clinical and academic audiologists with a subspecialty interest and expertise, eg neuro-otology, electrophysiology or cochlear implantation should be based at the university/regional centres which have particular responsibility for teaching and research to both the medical and healthcare professions.
- Consultant audiovestibular physicians and paediatricians together with audiologists as part of a MDT should provide a broad service across the discipline and be based in specialist centres serving 250,000 per consultant physician.
- Audiologists should provide diagnostic auditory and vestibular services within the primary care/community service, while GPs, with additional training, should continue to provide medical care of the patient within this service.

- Given the current lack of training and knowledge in primary care, an audiovestibular service should initially be led in a top-down manner with consultant audiologists and audiovestibular physicians training and supporting those working at the community/primary care level who will ultimately lead the service. It follows that there would need to be an increase in the number of consultant audiovestibular physicians and senior audiologists at every level of the network.
- The Working Party advocates the formation of a national network of balance centres to address the current limited access to such services.

Manpower

- Ten new consultant audiovestibular physicians should be appointed over the next two years, in hospitals without medical support for audiovestibular services to lead the appropriate medical training and provide medical input to MDT. This figure takes account of the estimated 50% retirement of the current consultant workforce in the next 7 years.
- Five new funded training numbers should be allocated each year for the next 5 years. This would lead to approximately 200 audiovestibular consultants in 2016, ie approximately 1:300,000 population.
- Dialogue with the Royal College of Paediatrics and Child Health should continue in order to ensure appropriate training of specialists providing a paediatric audiovestibular service.
- Audiovestibular medicine posts in the F2 programme should be developed: three have been established to date. The transition of training from STI to ST3 level may be by competitive entry.

Training

- Additional academic departments should be established to lead training and research.
- Basic training in audiovestibular medicine should be introduced at both the under- and postgraduate medical levels and in relevant healthcare curricula.
- Audiovestibular training programmes and workshops should be developed for GPs (who it is envisaged will ultimately lead the service).
- Basic principles of audiovestibular medicine should be included in the curricula for MRCP and MRCPCH examinations.
- Integrated core modules of knowledge common to all healthcare professionals working in the field should be developed.
- A means of common assessment of competencies for core skills provided by a professional working in the field should be developed.

Reference

1 World Health Organization, May 2004. www.who.int/ncd/mip2000/documents/key_areas_en.pdf

Glossary

AAOO	American Academy of Ophthalmology and Otology
ABN	Association of British Neurologists
ABR	Auditory brainstem response
ACS	Association of Clinical Scientists
ADHD	Attention deficit hyperactivity disorder
A&E	Accident and Emergency Department
AGS	American Geriatric Society
AIHHP	Association of Independent Hearing Healthcare Professionals
APD	Auditory processing disorder
ASD	Atrial septal defect
AuD	Doctor of Audiology
AVP	Audiovestibular physician
BAA	British Academy of Audiology
BAAP	British Association of Audiological Physicians
BAAT	British Association of Audiological Technicians
BACDA	British Association of Community Doctors in Audiology
BDA	British Deaf Association
BGS	British Geriatric Society
BIH	Benign intracranial hypertension
BMT	Basic medical training
BNT	Basic neurosciences training
BPPV	Benign paroxysmal positional vertigo
BPT	Basic paediatric training
BSA	British Society of Audiology
BSL	British sign language
BST	Basic specialty training
BSc	Bachelor of Science degree
BSHAA	British Society of Hearing Aid Audiologists
BSHT	British Society of Hearing Therapists
CAC	Clinical assessment of competence
CbD	Case-based discussion
CCI	Centre for Change and Innovation
CCT	Certificate of completion of training

CHI	Commission for Health Improvement
CI	Cochlear implant
CJD	Creutzfeldt–Jakob disease
CSF	Cerebrospinal fluid
CT	Computerised tomography
CtP	Competence to practise
DGH	District General Hospital
DH	Department of Health
DIDMOAD	Diabetes insipidus, diabetes mellitus, optic atrophy and deafness (syndrome)
DOPS	Direct observation of clinical skills
ENG	Electronystagmography
ENT	Ear, nose and throat
EOG	Electro-oculography
ESR	Erythrocyte sedimentation rate
EU	European Union
FRCS	Fellow of the Royal College of Surgeons
GMC	General Medical Council
GP	General Practitioner
HAC	Hearing Aid Council
HCtP	Higher competence to practise
HI	Hearing International
HIV	Human immunodeficiency virus
HMSO	Her Majesty's Stationery Office
HPC	Health Professions Council
HST	Higher specialist training
ICATS	Integrated Community Assessment and Treatment Service
IHR	Institute of Hearing Research
MASW	Modernising Audiology Services in Wales
MCHAS	Modernising Children's Hearing Aid Service
MDT	Multidiscliplinary team
MHAS	Modernising Hearing Aid Service
Mini-CEX	Clinical evaluation exercise
Mini-PAT	Mini-peer assessment tool
M-level	Master's level
MMC	Modernising Medical Careers
MRC	Medical Research Council
MRCGP	Member of the Royal College of General Practitioners
MRCP	Member of the Royal College of Physicians

MRCPCH	Member of the Royal College of Paediatrics and Child Health
MRCS	Member of the Royal College of Surgeons
MRI	Magnetic resonance imaging
MSc	Master of Science degree
MSF	Multisource feedback
MTO	Medical technical officer
NDCS	National Deaf Children's Society
NF	Neurofibromatosis
NHSP	National Hearing Screening Programme
NICE	National Institute for Health and Clinical Excellence
NSF	National Service Framework
NSH	Medical Research Council National Study of Hearing
PCHI	Permanent childhood hearing impairment
PCT	Primary care trust
PDH	Prevention of Deafness and Hearing Impairment (WHO programme)
PGME	Postgraduate Medical Education
PMETB	Postgraduate Medical Education and Training Board
RCCP	Royal College of Clinical Physiologists
RCP	Royal College of Physicians
RCPCH	Royal College of Paediatrics and Child Health
RNID	Royal National Institute for the Deaf
SALT	Speech and language therapist
SHA	Strategic health authority
SNHL	Sensorineural hearing loss
SOM	Serous otitis media
StR	Specialty registrar
TAB	Team assessment behaviour
TMD	Tympanic membrane displacement
TORCH	Toxoplasmosis, Other Agents, Rubella, Cytomegalovirus, Herpes Simplex
TRT	Tinnitus retraining therapy
TTSA	Technicians, Therapists and Scientists in Audiology
UCL	University College London
UCLH	University College London Hospitals
UNHS	Universal neonatal hearing screening
VR	Vestibular rehabilitation
WHO	World Health Organization
WRT	Workforce Review Team, Department of Health
WTE	Whole time equivalent

1 Introduction

Remit

1.1 The remit of the Working Party was to:

- Define the role of audiovestibular medicine, as distinct from otology/ENT and audiology, and describe the unique role of the audiovestibular physician in providing optimal national audiovestibular services.
- Understand the role of the multidisciplinary team in the light of recent developments, and define the medical input of the audiovestibular physician within the team context.
- Provide a model for audiological and vestibular services offering acute and chronic care.
- Clarify pathways through primary to secondary and tertiary care provided by audiovestibular physicians, for adults and children within the frameworks of the multidisciplinary teams, in audiological and vestibular services.

Background

1.2 Audiovestibular medicine is the medical discipline concerned with the investigation, diagnosis and management of disorders of hearing and balance, including tinnitus, in both children and adults. In addition, some specialists are concerned with overall communication and the management of speech and language disorders in children. Indeed, in some European countries, audiovestibular medicine and phoniatrics are regarded as a single specialty.

1.3 Hearing and balance disorders will affect 20–50% of the population at some point in their life and these symptoms carry a significant personal, occupational and economic morbidity. Despite this the majority of doctors have little training and consequently limited understanding of this common group of conditions (Luxon, 1984).

Prevalence

1.4 The prevalence of hearing and balance disorders is surprisingly high.

- Disorders of the ear represent 24% of all disabilities in the adult population – the second highest cause of all disabilities (Department of Health, 1997).
- The prevalence rate of all hearing impairment in children has been estimated at 100–133/100,000 in recent UK studies (Fortnum and Davis, 1997; Fortnum *et al*, 2001), increasing throughout early childhood to 165–200/100,000 (Hall, 2004).
- One-third of those over 60 years have a hearing loss of 25 decibels or more (Steel, 1998).
- Tinnitus affects up to 20% of the population, with 5% describing the complaint as troublesome, while for 1% it is severe enough to have a significant effect on their quality of life (Davis, 1997).

- Symptoms of dizziness or imbalance are experienced by 30% of the population by the age of 65 years (Roydhouse, 1974).
- One in four in the community have 'significant' dizziness at any given time (Nazareth *et al*, 1999).
- The German National Telephone Health Interview Survey 2003 defined the lifetime prevalence of vestibular vertigo at 7.8%, the one-year prevalence as 5.2%, and the incidence as 1.5% (Neuhauser *et al*, 2005).

Cost to the individual and the economy

1.5 Thus, hearing and balance disorders constitute an important compromise to the health of the population and impact on the economy of the health service and workforce, as is evidenced by:

- the cost of falls to the NHS and social services in people over 60 years old in 1999 which was £981 million (Scuffham *et al*, 2003)
- early 'retirement' and the loss of time from work (Eagger *et al*, 1992)
- repeated medical attendances and costly investigations (MacDonald and Melham, 1997)
- in 80% of affected individuals, vertigo resulting in a medical consultation, interruption of daily activities, or sick leave (Neuhauser *et al*, 2005).

Management

1.6 Patients with hearing and balance disorders have traditionally been managed by a variety of professionals including GPs, ENT surgeons, neurologists, audiologists and audiovestibular physicians. In recent years there has been an extension of the role of the non-medical practitioner, including audiologists whose training has radically changed. Thus, the context includes a number of drivers for change in healthcare:

- extending the role of the audiologist in the MDT
- ensuring maximal provision of primary-based medical care
- workload pressure on related disciplines: otolaryngology and neurology
- Modernising Medical Careers
- Agenda for Change
- 18-week commissioning pathways
- National Audiology Plan
- Improving access to audiology services in England.

Role of the audiovestibular physician

1.7 Against this background, the role of the audiovestibular physician needs to be clarified and redefined to enable more effective and efficient models of care to be developed. The Royal College of Physicians therefore established a multiprofessional, multiagency Working Party to address the unique role of the audiovestibular physician in supporting the provision of optimal audiovestibular services in the NHS, in collaboration with other related professionals.

2 Audiovestibular medicine

2.1 General internal medicine and the neurosciences form the basic foundation for the specialty of audiovestibular medicine, which was initially established as a sub-specialty of neurology in 1975. Entry into specialist training is open to doctors with MRCS or MRCGP qualifications, but a basic medical training in general medicine, paediatrics, neurology, geriatrics or rehabilitation medicine, with the MRCP or MRCPCH diploma provides the optimal background for a career in audiovestibular medicine.

2.2 There are 47 audiovestibular consultants and 30 specialty registrars in the UK, with clusters around the two centres of London and Manchester where audiovestibular medicine developed and became established in the 1950s and where the two training programmes are now centred (Fig 1).

Fig 1 National distribution of audiovestibular physicians. Circles denote the location of each audiovestibular physician, with 7 in Manchester, 3 in Sheffield and 26 in Greater London including 13 in Central London.

2.3 The majority of consultants are generalists, dealing with all aspects of the specialty for both adults and children, as there are not enough consultant appointments in most centres to allow adult and paediatric subspecialisation, which is the preferred option. In the larger teaching hospitals with more than one consultant, there tends to be subspecialisation in a particular area, eg adult neuro-otology or paediatric audiovestibular medicine. Paediatric specialisation must be the optimal goal and is the ideal recommended by the National Service Framework for Children (2004), the British Association of Audiological Physicians (BAAP, 2002) and the Royal College of Paediatrics and Child Health. Nonetheless, paediatric audiovestibular medicine is not currently a recognised specialty and for the purposes of this report audiovestibular physician refers to the medical consultant with a higher medical degree and a certificate of completion of training (CCT), based on 50/50 adult and paediatric audiovestibular medicine training. The recommended number of consultants (BAAP, 2002) is 2 practising (1 paediatrics and 1 adult medicine) per 500,000 population, although this number has been achieved in only a few health authorities to date.

Paediatric audiovestibular medicine

2.4 Audiovestibular medicine services for children include the diagnosis and management of those children with:

- permanent childhood hearing impairment, conductive or sensorineural, congenital, late onset or acquired
- tinnitus
- dizziness or other balance disorders
- complex otitis media with effusion where hearing and balance difficulties form a significant part of the clinical presentation affecting the child's development or progress
- speech and language disorders (in both the hearing and deaf child where differential diagnosis can be particularly challenging)
- auditory neuropathy and disorders of auditory processing, presentations of which are often subtle and difficult to recognise, requiring careful testing as well as a thorough knowledge of the range of childhood diseases and development (see Case 1, p5).

2.5 The key role of the audiovestibular physician practising in the paediatric field is in:

- clinical diagnosis of the conditions affecting the child's health, well-being, development, family life and achievements
- interpreting the test results in the light of clinical findings
- instituting treatment or preventative measures (where available)
- determining whether or not there are other risks to health and development (eg in some syndromes or post-infective conditions where other impairments or system deterioration may be more important to the child's health)
- advising the child and family of the prognosis and any risks to future family members, including advice on genetic counselling.

What paediatric audiovestibular medicine does not encompass

2.6 The essentials of measurement, hearing aid fitting, surgical opinion and intervention, speech and language assessment and therapy, psychological evaluation and educational advice are all undertaken by relevant highly trained professionals, with whom the audiovestibular paediatrician will be working in a multidisciplinary team.

Interdisciplinary teamwork

2.7 The National Service Framework for Children (Department of Health, 2004), supported by a number of initiatives and green papers (eg Change for Children (Department for Education and Skills, 2004a), Surestart, Right from the Start, Early Support Programme), has laid down:

- the principles of effective communication for child and family
- guidance on achieving comprehensive, consistent and seamless care within a designated multidisciplinary team without unnecessary appointments
- links with social services, local community professionals and other therapeutic and medical services.

Epidemiology of permanent childhood hearing impairment (PCHI)

2.8 Hearing impairment is the most common sensory impairment in humans with significant social and psychological implications.

- About 840 children are born each year in the UK with significant permanent hearing impairment (>40 dBHL in the better hearing ear) (Fortnum and Davis,1997).
- The prevalence of PCHI at birth is around 1.07 per 1,000.
- This doubles to 2.05 per 1,000 for children aged 9–16 years (Fortnum *et al*, 2001).

Case 1. Attention deficit hyperactivity disorder vs auditory processing disorder.

A right-handed 13-year-old boy was referred with difficulty understanding speech in background noise, easy distractibility in a noisy environment and problems with learning and attention. At 6 years he was referred to Great Ormond Street Hospital for assessment of attention deficit hyperactivity disorder (ADHD); it was recommended that a central auditory assessment be carried out as he was considered to demonstrate atypical features for ADHD.

Pure tone audiogram, tympanometry, acoustic reflexes, auditory brainstem-evoked responses and oto-acoustic emissions were normal. Oto-acoustic emission suppression by contralateral noise, assessing the efferent auditory pathway, gave abnormal results in both ears. Central auditory tests (dichotic digits, frequency pattern, duration pattern and gaps in noise tests) revealed circumscribed abnormalities indicating a specific auditory processing deficit in background noise. ADHD would tend to give poor results on all tests requiring concentration and children with suspected ADHD with auditory distractibility should have a central auditory test assessment as part of their diagnostic evaluation.

Instructions were given for auditory training that could be carried out at home and it was also recommended that background noise should be minimised as much as possible both at school and at home, when studying or conducting a conversation.

2.9 There are, in addition:

- 0.6 per 1,000 children with a unilateral hearing loss (Davis, 2003)
- 0.4 per 1,000 with a mild hearing loss (Davis, 2003; Bess *et al*, 1998)
- many more with a substantial high frequency loss, which is not always recognised
- about 16% PCHI which are acquired, progressive or of late onset, of which one-third are caused by bacterial meningitis (Fortnum *et al* 1997)
- an estimated 4–7% of children (in the USA) suffering from auditory processing disorders (auditory difficulties without audiometric abnormality) (Jerger and Musiek, 2000).

2.10 Of children with PCHI:

- 39% have at least one additional difficulty
- 20% have two or more additional difficulties, the commonest being cognitive impairment
- 13% have a systemic disorder (Fortnum *et al*, 1997)
- 10–40% have visual problems (Davis *et al*, 1997; Guy *et al*, 2003)
- at least half are known to have a genetic cause (Reardon, 1992)
- about one-third of these will have the recognisable features of a syndrome (Reardon and Pembrey, 1990).

2.11 Improved outcomes for children with congenital hearing impairment have been shown to be associated with confirmation and intervention by six months of age (Downs and Yoshinago-Itano, 1999). This research into the benefits of early identification led to the introduction of the Newborn Hearing Screening Programme (NHSP) in England, with equivalent programmes in Scotland and Wales, in 2002. Before this, despite earlier recommended targets (NDCS, 2000), the median age of identification of hearing loss was 17 months, with 50% remaining unidentified by 18 months (Davis *et al*, 1997).

2.12 Continuing vigilance, knowledge and integration of services throughout childhood remains vital for the identification of the 16% of children, who acquire or develop their deafness after the newborn period (see Case 2, p3).

Aetiology of hearing impairment

2.13 A major responsibility of the audiovestibular physician pending a paediatric service is to determine the aetiology of the deafness through:

- a careful clinical history and examination of the child (and sometimes family members) (see Case 3, p3).
- neurovestibular examination and testing to determine function of the whole labyrinth
- appropriate use and interpretation of radiology/imaging

Case 2. Erroneous test interpretation.

A 6-year-old girl presented to the audiovestibular medicine clinic with her father, who claimed she could hear nothing.

The history dated back 18 months when she had failed a school entry sweep test in one ear and been referred to a local ENT clinic. A diagnosis of mild, unilateral glue ear was made and she was managed conservatively. Some two months later, she woke saying that she could not hear. She was treated by her GP with oral amoxicillin for an ear infection, with no discernible benefit. She had started to wet herself during the day and her behaviour became increasingly difficult. She was referred to a paediatrician, who arranged an auditory brainstem evoked response at the local neurophysiology unit. The report stated 'normal waveforms and latencies at 90 dB', which was interpreted as normal hearing and the child was referred to child and family guidance for advice on her behaviour and daytime enuresis.

Her father remained convinced that she was having difficulty in hearing and, after ceaseless demands for a second opinion, she was referred to the audiovestibular physician approximately one year after the onset of symptoms. By this time her attention could only be gained by touch or visual stimuli and her previously well-developed speech and language had regressed. She was using her own gestures to convey meaning.

Clinically, there was no doubt that she was severely or profoundly deaf. This was confirmed on pure tone audiometry (at which she was very reliable). CT scan of the petrous bones demonstrated wide vestibular aqueducts with normal cochleae and she was fitted with high-powered post-aural hearing aids. Some years later, when cochlear implantation became available, she declined this option, having become very opposed to medical intervention.

Case 3. Management and diagnosis altered.

An 8-year-old boy presented from the ENT department with a request for further management advice when, after a third insertion of grommets in three years, his hearing in the right ear had deteriorated.

Detailed clinical examination revealed large asymmetric, dysmorphic external ears, with a right preauricular pit. There was a scar on the left side of the neck, which the family recalled was the result of the removal of a lump when he was nine months old. Pure tone audiometry showed a bilateral asymmetrical mixed hearing loss of moderate degree with a mild high frequency component on the left and severe mixed loss on the right. There was no evidence of glue ear. A diagnosis of branchio-oto-renal (BOR) syndrome was made.

CT showed the typical appearance of BOR with a widened vestibular aqueduct on the right but not on the left. Renal ultrasound showed a normal right kidney while the left was in the pelvis. Investigation of the family, unsurprisingly, revealed that his twin brother had similar but milder features, a much lesser degree of hearing loss and a horseshoe kidney. His mother had had a branchial sinus excised some 15 years previously (about which she had forgotten) and was found to have bilateral preauricular pits and a bilateral mild to moderate conductive hearing loss.

On reflection, she thought that she recalled that her father had 'holes in front of his ears'.

The boy was fitted with binaural digital hearing aids, offered support by the teacher of the deaf and is making better progress in school. The mother was referred to the adult audiovestibular physician for further assessment and is considering hearing aids. The family have declined genetic advice at present.

- regularly updated knowledge of clinical genetics
- appropriate use and interpretation of pathological data.

Middle ear disease

2.14 Some 80% of children under four years old have had an episode of otitis media with effusion (OME) at some time: there is a bimodal presentation which peaks at just under 2 and 4.5 years of age (Haggard and Hughes, 1991). Serious long-term problems occur in 1–2%, while 2–5% are fitted with ventilation tubes (grommets) before the age of 7 years (Haggard, 2004). Many children develop a temporary but significant conductive hearing loss due to OME. Although hearing aids can be used effectively (Ahmmed *et al*, 2002), the impact of OME on a child's well being, general health and progress is often underestimated and may only become apparent through a careful medical history.

2.15 The audiovestibular physician may provide valuable input in identifying and managing children

- whose OME has a medical cause
- whose presentation suggests OME but who actually have middle ear anomalies
- whose chronic middle ear disease leads to significant audiovestibular symptoms.

Sensorineural hearing loss

2.16 Over 50% of deaf children fall into one of several specific identified risk categories (Davis and Wood, 1992). The relative proportion of causes of hearing impairment has changed over the past 30 years because of advances such as immunisation, improved clinical care of very premature infants and sick children, genetic advances and testing, social change such as the increase in sexually transmitted infections (especially in adolescents and young people (Cross *et al*, 2005; Simms and Ward, 2006)), and the recognition of other types of hearing loss such as auditory neuropathy.

Cochlear implantation

2.17 Cochlear implants can help a significant number of children with severe to profound hearing loss, and recent work has demonstrated particular efficacy for children implanted under the age of 1 year. With time, the criteria for cochlear implantation have broadened and children with complex needs are now considered for implants. Debate has now opened as to whether bilateral implantation confers significant additional benefit. The audiovestibular physician should thus be involved, as part of the MDT, in aetiological investigation, selection and rehabilitation of children who undergo this procedure (NDCS and BCIG, 2005).

Tinnitus and hyperacusis in children

2.18 About 6% of normally hearing children report noises in their head and ears, while tinnitus was reported in 24% of hearing impaired children (Stouffer *et al*, 1992): this may be associated with academic, social, sleep and concentration difficulties (see Case 4, p9). Tinnitus may be the presenting feature of otological, intracranial, vascular and neurological conditions. The audiovestibular physician will consider the differential diagnosis and therapeutic pathway from a broad paediatric knowledge base within the MDT.

2.19 Hyperacusis may be a symptom of significant neurodevelopmental or psychological dysfunction, or more rarely otological pathology, but requires an integrated team approach to enable diagnosis and appropriate support for the child and family to function confidently.

Speech and language disorders in children

2.20 Developmental disorders of speech and language are the commonest neurodevelopmental condition in the early years (Law, 2000).

- About one in five parents of preschool children will be concerned about their child's speech development.
- 5–8% of children have delayed and/or disordered speech and/or language (Law, 2000) although figures vary from 1% to 32%, depending on age and method of assessment (Law *et al*, 1998).
- Some 10% of these have severe problems, likely to affect their continuing progress into adolescent and adult life (see Case 5, below).

2.21 There are a number of recognised neurological and neurodevelopmental conditions which can present with speech and language delay/disorder. Whereas it is axiomatic that any child with delayed speech and language should have their hearing carefully assessed (Busari and Weggelaar, 2004), consultants in paediatric audiovestibular medicine, working in combination with specialist speech and language therapists, audiologists and psychologists, may define the medical elements of relevance to the overall care of the child.

Case 4. Holistic tinnitus management.

An anxious, rather withdrawn 12-year-old boy presented with tinnitus. He was known to the service having sustained a total sudden loss of hearing at the age of 4 years. This was ascribed to mumps, affecting his good ear, and a Michel aplasia in the other ear discovered on imaging.

The tinnitus was described as a buzzing noise and was particularly troublesome when he was trying to sleep. Auditory amplification did not help, perhaps because it afforded him little benefit.

No specific cause for his tinnitus was found, but it was felt that he needed some strategies to enable him to minimise its effects. The clinical psychologist discovered that he was afraid of the dark. His father felt that, at 12 years, he should manage without a nightlight in his room. A compromise of a light on the landing and his door ajar resolved the tinnitus.

Case 5. Diagnosis in speech and language disorder.

A 4-year-old boy was referred for further advice about verbal dyspraxia by his speech and language therapist. He was seen in the combined audiological/speech and language clinic with a specialist speech and language therapist. He was dyspraxic, but the most striking finding was marked hypernasality. His palate was flat and broad with a thin median raphe and a palpable notch, suggesting a submucous cleft. Further clinical examination revealed a slight downward slant to the eyes, long philtrum, small oral aperture, neat ears with overfolded helices and a cardiac murmur.

Once his cardiac anomaly and submucous cleft palate had been repaired, he was able to continue with speech therapy for his dyspraxia. Chromosomal analysis confirmed the clinical diagnosis of 22q11 (velocardiofacial syndrome).

Balance disorders in children

2.22 There are relatively few epidemiological data on balance disorders in children, but a recent large questionnaire study in Finland (Niemensivu *et al*, 2006) reported that 8% of 1- to 15-year-olds in the general population had suffered vertigo and dizziness, and in 27% of these the vertigo was sufficiently severe to interrupt their current activity.

2.23 Vestibular symptoms occur in a variety of conditions, many of which are not associated with deafness. Comprehensive balance assessment is dependent on the age of the child, but clinical tests can be performed from infancy and, with experience, objective tests and balance platform testing from early childhood (Case 6, p11) (Wiener-Vacher, 2004).

Table 1 The purpose of balance assessment in children.

- Identify and differentiate pathology: central or peripheral
- Monitor pathological process, eg post meningitis
- Provide differential diagnosis of headache/vomiting/dizziness
- Identify correct treatment pathway
- Diagnose unexplained 'funny turns'
- Alleviate anxiety and distress/psychosocial consequences
- Recognise characteristic features of audiovestibular conditions
- Differentiate cause of delayed motor milestones/imbalance

2.24 The experienced audiovestibular paediatrician will undertake:

- the essential comprehensive physical, neurological and eye movement examinations
- age-appropriate clinical tests of balance function, using play techniques
- advice on neuro-otological testing with electronystagmography (ENG) and electro-oculography (EOG) and calorics in line with the abilities/tolerance of the child
- interpretation of the test results in the light of the overall clinical profile
- careful liaison with family and other professionals for rehabilitation
- recognition and discussion of prognosis and health and safety issues (Case 7, p11).

Adolescent care: transition from child to adult care

2.25 Young people transferring from paediatric to adult services find themselves competing for scarce resources with an elderly population in surroundings and services which do not meet their needs. Currently, the Department of Health with RCP and RCPCH is championing transition care, taking forward the issues set out in standard 4 of the National Service Framework for Children. Standards of good practice at a time of change for a young deaf person have been produced in a joint document between the Modernisation of Children's Hearing Aid Services

(MCHAS, 2005) and the National Deaf Children's Society (NDCS) (2005). The emphasis is on inter-agency joint working with health, education, social services and the voluntary sector practising in the paediatric sphere.

2.26 The audiovestibular physician will have a particular role in:

- ensuring that the young person understands the cause of their deafness or dysequilibrium and its implications for the future

Case 6. Value of auditory and vestibular investigations.

A 6-month-old boy born three months prematurely at 30 weeks (corrected age 3 months) had respiratory distress syndrome and was ventilated. He suffered a very stormy course with hypotension, jaundice, anaemia and sepsis and on postnatal day 3, he developed an intraventricular haemorrhage and hydrocephalus requiring the insertion of a transfontanelle cerebrospinal fluid (CSF) reservoir. At age 2 months he was discharged, responding to loud sounds, and an auditory brainstem-evoked response (ABR) was normal. One month later he contracted Staphylococcal meningitis, related to the CSF reservoir, and was treated with both intrathecal and intravenous vancomycin.

Subsequently no response to sounds could be elicited and one month later an ABR revealed absent responses bilaterally and he was diagnosised as suffering from a profound hearing loss and referred for consideration of cochlear implantation.

He was provided with hearing aids and when tested one month later (ie at a corrected age of 6 months) unreliable behavioural responses were obtained. As part of his assessment vestibular testing was undertaken and was unexpectedly found to be normal. There was no evidence of ossification on MRI. Regular monitoring was therefore undertaken and at 8 months aided thresholds >45 dBA (low frequencies) and >50 dBA (high frequencies) were obtained. He then fell outside the cochlear implant criteria and was discharged to routine audiological follow-up.

Case 7. Dual pathology

A 3-year-old boy was referred for a second opinion on the diagnosis of his moderate congenital hearing loss. He had been admitted to hospital on three occasions with acute instability and distress from which he had recovered within a couple of days on each occasion. He had had two MRI scans of the brain, an EEG and two lumbar punctures, but no definite diagnosis had been made. The only family history of note was migraine in his father.

Clinical examination was normal although he was a little unsteady with a wide-based gait. Assessment of his hearing showed a bilateral slightly sloping moderate to severe sensorineural hearing loss (SNHL). Subsequent comparison with local tests suggested progression of the hearing loss. Electronystagmography and calorics showed no abnormality. ECG was normal. MRI scan of the petrous bones showed bilaterally enlarged endolymphatic ducts.

As he grew older, he described two distinct types of dizziness: one of short duration accompanied by transient deterioration in hearing and tinnitus, often following air travel or minor head trauma. The other was preceded by a severe frontal to temporal headache with antecedent 'feeling funny', no change in his hearing but marked nausea and vomiting. Symptoms lasted several hours and often occurred at times of stress.

This boy has two distinct mechanisms for his dizziness: the inner ear anomaly and migraine. Careful history from the child and parents enabled clarification and appropriate management.

- ensuring that the young person has the knowledge to access genetic, ophthalmic, mobility or other services
- passing relevant clinical information on to adult medical services. This will enable both continued monitoring of identified conditions and continued opportunities for the young person to discuss subsequent symptoms so that aetiologies which only become apparent in adolescence or adult life can be sensitively and promptly addressed.

Social and emotional issues

2.27 In a general child psychiatry service, deaf children present with a similar pattern of problems to those of hearing children. In a study of 130 deaf children, 50% were marginalised and a further 25% had experienced sexual abuse with a larger number of children with autism (10%) than expected in normally hearing children (Hindley, 1994). Children who present with a *non-organic hearing loss* need an integrated MDT approach if inappropriate amplification is to be avoided and the underlying problem addressed.

2.28 While there is almost no literature on the psychological aspects of *balance disorders* in children, clinical experience suggests that avoidance behaviour, anxiety and panic attacks are not uncommon in children with persistent symptoms.

2.29 Some 60% of children with significant *speech and language disorders* have behavioural problems, often allied with poor confidence and self-esteem.

2.30 The audiovestibular physician will ensure that:

- the social and emotional needs of the child and family are considered
- additional medical conditions are identified and managed
- child protection issues are integrated into the everyday care of the child.

Adult audiovestibular medicine

2.31 Training in medical or paediatric specialities leading to MRCP(UK) or MRCPCH before entry into specialist training allows audiovestibular physicians to take a holistic medical/ paediatric approach to all aspects of a patient's condition. The importance of this lies in the plethora of general medical conditions and treatments which can be associated with auditory and vestibular disorders and initiatives to prevent hearing and balance disorders (Harrop-Griffiths, 1997).

Audiological diagnosis and rehabilitation

2.32 There are some common misconceptions which continue to surround the current management of hearing impairment (HI) in adults. These include the inevitability of HI as part of the ageing process (20% of 80-year-olds in the UK have normal hearing); the unimportance of investigating aetiology in symmetrical mild to moderate hearing loss; the view that a hearing aid is adequate and the limited consideration of possible treatment options.

2.33 Importantly, hearing loss, tinnitus, other dysacuses and vertigo/dizziness may be features of systemic disorders, including endocrine disorders, gout, autoimmunity, infections including meningitis, but may also be caused or exacerbated by medication (see Case 8, p13).

2.34 The extent to which the aetiology of the hearing impairment is investigated in many ENT/audiology departments is not clear. This is an important omission as knowledge of aetiological factors is expanding rapidly, pharmacological treatments are becoming available and an understanding of causation can have a significant impact on patients' reactions to their condition (eg Stephens and Jones, 2006).

2.35 Many departments operate a direct access policy, in which NHS audiologists can supply hearing aids to people over the age of 50 years who are referred by their GP and who have 'straightforward presbyacusis'. This policy was initiated in the 1990s to reduce the enormous ENT waiting lists. Regrettably, while the Audit Commission has data on ENT services, there are no data on audiological services from which to assess the effect of such a change in service provision. Audiologists have worked to established guidelines, known as TTSA (Technicians, Therapists and Scientists in Audiology) Guidelines (RNID, 2002a, Appendix F). Although this has been an effective method of providing rapid auditory amplification to older people (Zeitoun *et al*, 1995), this approach does not address the possible remedial and preventable causes of so-called 'presbyacusis'.

2.36 In the UK, age, male gender, current or previous employment history and family history (Davis 1995) are the four main determinants of hearing loss. However, the causes of hearing impairment range from chronic middle ear disease, which still has a significant prevalence (2% [Davis 1995] – 4% [Browning and Gatehouse, 1992] in 18- to 80-year-olds), through metabolic diseases such as diabetes mellitus, systemic inflammations such as rheumatoid arthritis and the systemic vasculitides to neoplasms, involving the middle ear and cerebello-pontine angle. If no cause can be determined after a detailed history and medical examination, vascular risk factors (serum cholesterol and blood sugar), renal function, treponemal serology, ANA, ANCA, C3, C4 and plasma viscosity should be checked (Yeoh, 1997). Patients with any unexplained unilateral symptoms or findings should be considered for an MRI scan to exclude a vestibular schwannoma or other retro-cochlear lesion. Medical history, examination and audiometric assessment can confirm these treatable conditions.

2.37 There are often very limited facilities to manage additional aural symptoms which may interfere with hearing aid fitting, such as pressure sensation, tinnitus and dysacusis. There is no serious consideration of patients with auditory symptoms, but normal audiometry, which accounts for some 5–8% of patients presenting with auditory complaints. This presentation is

Case 8. Not noise-induced hearing loss.

A 52-year-old man, who worked in a forge, presented for a medicolegal opinion as his hearing had been slowly but progressively deteriorating over six years and he was suing his company for compensation for noise-induced hearing loss. He denied any other symptoms, but in the past history, he had been a merchant seaman from 25 to 40 years of age.

Pure tone audiometry revealed a plateau hearing loss of 60–80 dB affecting all frequencies, with additional audiometric tests indicating cochlear dysfunction. Routine blood tests were taken and a positive treponema pallidum haemagglutination assay was identified. Subsequent CSF examination was normal, but a diagnosis of syphilitic labyrinthitis was made and systemic treatment with steroids and antibiotics was prescribed.

variously ascribed to obscure auditory dysfunction or auditory processing disorder (see Case 9, p15). Patients with this presentation require referral to audiovestibular physicians for audiological diagnosis and treatment.

2.38 The overall approach to audiological rehabilitation is often patchy, despite the best efforts of audiologists/hearing therapists. An MDT comprising an audiovestibular physician, a hearing therapist, audiologists with access to clinical psychologists and speech and language therapists is needed for the optimal management of patients with more complex problems. Such a team should operate within the structure of the management model shown in Fig 2 (Kiessling *et al*, 2003) (see Case 10, p15).

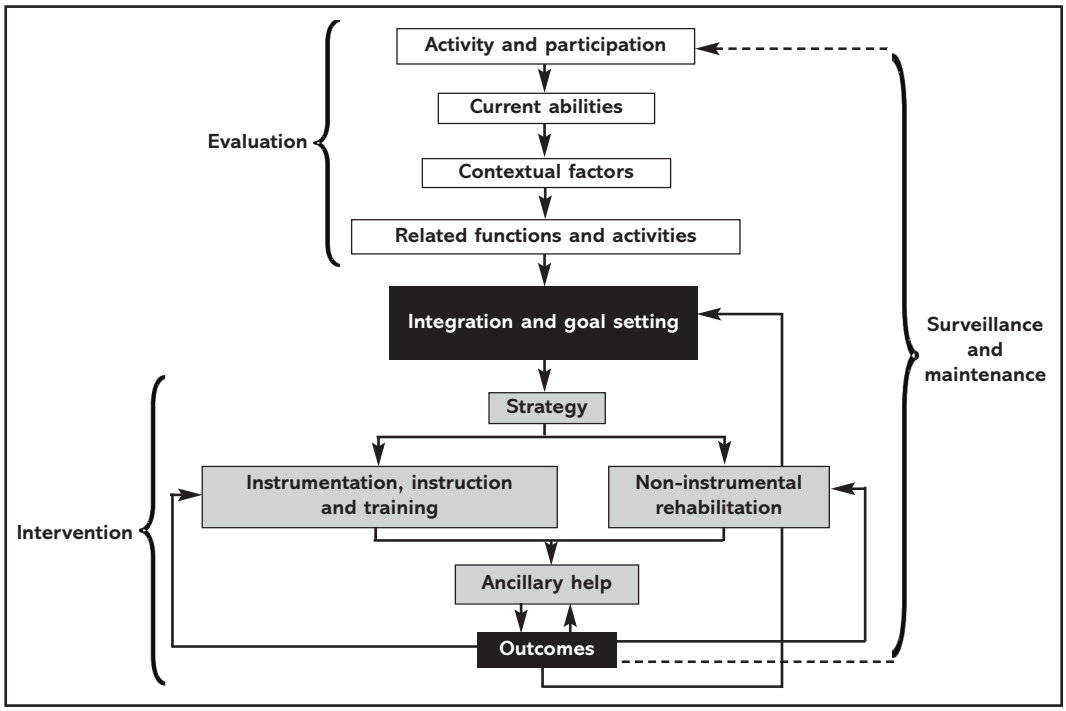

Fig 2 Management model for auditory rehabilitation (Kiessling et al, 2003, reproduced with permission of Taylor and Francis group).

2.39 The overall management of patients with tinnitus is poor, as is reflected by the popularity of Tinnitus Retraining Therapy (TRT) for which there is no evidence base (McKenna, 2004). What is needed is an effective triage system, in which it is recognised that therapeutic investigation and clinical counselling is sufficient for the many patients who are concerned only to exclude a sinister pathology for their symptom. For many others, audiological management with hearing aids, tinnitus maskers, hearing therapy, relaxation training and psychological provision of cognitive behavioural therapy will be indicated. Furthermore, while actual suicide is extremely rare in patients with tinnitus, many are severely depressed and require appropriate pharmacological and other psychiatric treatment. The audiovestibular physician is in an ideal position to make such a triage and oversee the medical aspects of the treatment.

2.40 Patients who fall outside direct referral guidelines are referred to ENT departments, in the absence of departments of audiovestibular medicine. Many of the conditions requiring further specialist investigation or treatment, eg dysacusis, auditory processing disorders,

Case 9. Opportunistic assessment.

A 21-year-old medical student asked to have her hearing checked while on an ENT attachment. On pure tone audiometry, she was considered to have normal hearing, but was advised to ask her GP to refer her to the audiovestibular physician as a case of *obscure auditory dysfunction* or auditory processing dysfunction.

On detailed questioning a dominant family history of hearing problems affecting her brother and father emerged. Békésy audiometry showed a marked low- to mid-frequency sensorineural hearing loss (Fig 3), with distortion product otoacoustic emission testing confirming outer hair cell dysfunction. Subsequent testing of her father and her brother with Békésy audiometry revealed identical patterns of hearing loss with little apparent progression even in the father.

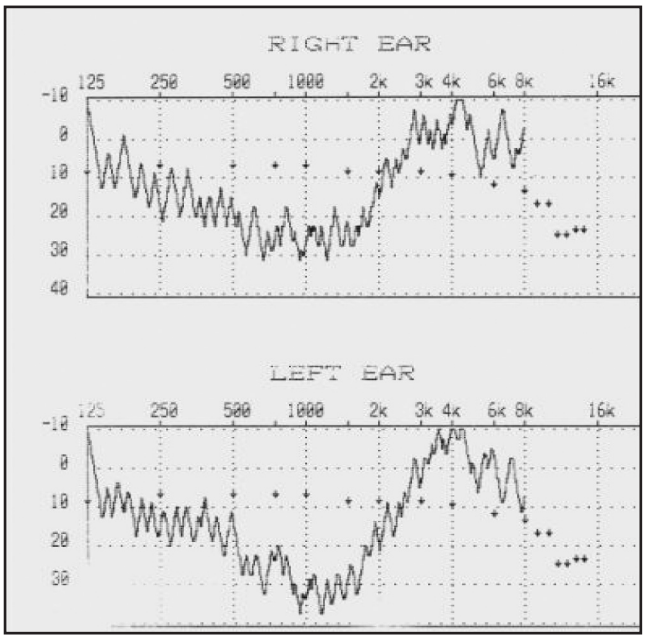

Fig 3 Békésy audiogram of the student described in Case 9.

The student's main problem was hearing with a stethoscope, and an electronic stethoscope was organised for her. The prognosis in terms of her hearing impairment affecting her career was very good. Arrangements were made for her father and brother to receive rehabilitative help in the parts of the UK where they lived.

Case 10. 'Late' cochlear implantation.

A 21-year-old woman, deaf from birth and formerly well integrated into the deaf community, was referred with increasing visual problems. Examination of her records revealed that she had been tested some 15 years earlier, as part of the investigation of her brother, who was found to have Usher (Type 1) syndrome. She and her family had been counselled at the time about the prognosis of the condition, but declined audiological help and opted to live in the deaf community.

After being educated in signing schools, she became concerned that her vision was deteriorating. She felt that she would be unable to communicate at all and would be very vulnerable in society. Although she had marginally audible hearing, she sought advice as to whether she would receive benefit from a cochlear implant. Initially, she was advised that people with profound, prelingual hearing impairment were likely to receive only limited benefit from a cochlear implant. She then sought a second opinion and consulted an audiovestibular physician in Europe. Subsequently she was included in the Cochlear Implant programme and obtained good auditory perceptions on electrical stimulation. This enabled alternative communication as her vision continued to deteriorate.

profound hearing impairment and tinnitus, which is 'troublesome' in 5% of the population, or imbalance/vertigo, could be managed both more cost effectively and appropriately by audio-vestibular physicians, as more than 95% of disorders causing these symptoms do not require surgical management.

Diagnosis and management of balance disorders

2.41 Patients with disequilibrium comprise 25% of adults in the community (Nazareth *et al*, 1999) and may have problems confined to the inner ear, such as benign paroxysmal positional vertigo; but 25–50% of patients, depending upon age, have conditions affecting other systems (see Case 11, p17).

2.42 Balance is a complex multisystem mechanism, dependent upon three sensory systems (vision, vestibular function and proprioception), from which inputs are integrated and modulated by central nervous system activity and provide a means of perception of orientation and motor control of eye movements, stance and gait. Thus, multiple pathologies affecting a variety of organs, and drugs acting upon these systems, may produce dizziness/imbalance. Therefore, the clinician responsible for the provision of a balance service requires a broad knowledge of internal medicine or paediatrics, otology, neurology and therapeutics to diagnose and instigate cost-effective management, as well as refer appropriately for more specialist advice, eg autonomic function tests, cardiac assessments and interventional radiology when required.

2.43 The most common causes of vertigo are peripheral labyrinthine pathologies and, despite this, the majority of patients referred to specialist balance clinics have undergone MRI studies, prior to referral, to exclude rare, but life-threatening pathology (see Case 12, p17). However, a knowledgeable neuro-otological history and examination, with detailed oculomotor assessment of saccades, smooth pursuit, optokinetic responses, and vestibulo-ocular reflex will frequently enable an appropriate diagnosis to be made without the use of expensive resources (Halmagyi, 2005).

2.44 There are a number of different strategies for treating peripheral vestibular disorders: pharmacological, physiotherapy interventions and psychological support all aimed at promoting cerebral compensation to render the patient asymptomatic (Bamiou and Luxon, in press). Initially, however, an accurate diagnosis with treatment of any underlying medical disorder or abnormality which may impede compensation is essential. Lack of expertise in vestibular diagnosis and management has led to the widely held medical view that 'dizziness' is a difficult symptom to diagnose and treat (Luxon, 1984).

Case 11. Non-vestibular dizziness.

A male factory worker was referred to a neuro-otology clinic with a request that 'vestibular rehab' be arranged. The patient complained of dizziness following an alleged whiplash injury one to two years previously. The accident had occurred at work (a plastics factory) when he was carrying a large polystyrene block on his head and had slipped and hit the back of his head. Since then, he had had troublesome symptoms of dizziness and unsteadiness. He had been investigated shortly after the alleged injury by a neurosurgical unit where angiography and a CT scan had been undertaken, but no abnormality had been demonstrated.

He reported that his condition appeared to be deteriorating and he was examined by the audiovestibular registrar. A visual field defect was defined and a repeat scan was requested. This showed a space-occupying lesion in the left occipital lobe. Neurosurgery confirmed the tumour and neuropathology reported appearances consistent with a metastatic adenocarcinoma. The primary was never found.

Case 12. The importance of clinical findings.

A 58-year-old man presented with a two-week history of acute vertigo, accompanied by vomiting. He was unable to walk and any movement caused a marked exacerbation of his instability. Neuro-otological examination revealed atypical benign paroxysmal positional nystagmus on performing the Hallpike manoeuvre (absence of a latent period) and profuse vomiting. An urgent MRI scan the same day was reported as normal, despite the clinical picture suggestive of posterior fossa pathology. Full neuro-otological investigation including brainstem-evoked potentials, caloric testing and electro-oculographic recording of all eye movements and rotational vestibule-ocular reflex responses were normal.

Review two weeks later showed some symptomatic improvement with resolution of the positional nystagmus, but increasing cervical and occipital pain. Despite intensive vestibular rehabilitation, the instability persisted and the occipital pain increased. There were no new neuro-otological or neurological signs. Eight weeks later, in view of persistent symptoms, a repeat MRI scan was ordered and showed a midline cerebellar metastasis.

3 Service provision

Current provision

3.1 To date the service for patients with hearing and balance disorders has been developed in an *ad hoc* manner solely dependent on local interest and poorly geographically distributed resources. The range of services which are available nationally are disparate, and lack a cohesive evidence-based standard.

Paediatric services

3.2 The recognition of the difficulties encountered by children with audiovestibular disorders remains limited (see Case 13, p19). Much of the medical work with these children has been undertaken by community paediatricians with variable training and skills in audiovestibular medicine or by otolaryngologists, whose primary focus is surgery rather than the diagnosis and management of paediatric medical conditions. The impending retirement of many community doctors challenges the provision of care for these children, while the numbers of audiovestibular physicians/paediatricians with training and competency in paediatrics remain low.

3.3 The future shape of paediatric audiology services remains under consideration. Newborn screening is changing the pattern of identification and intervention for deaf babies, but the need for later surveillance to detect the children who either 'miss' screening or subsequently develop hearing loss remains crucial. The aetiology of deafness is most effectively established by a specialist in audiovestibular medicine with paediatric competencies. There is evidence to suggest that medical involvement is of value for newborn hearing screening programmes (Davis *et al*, 1997). The children's workforce group within the NSF has noted concerns about the audiology workforce and in the light of the changing pattern of work force in the community, Professor David Hall, former President of the Royal College of Paediatrics and Child Health, convened a multidisciplinary meeting to consider the future provision of children's audiology services (2004). A number of recommendations were made:

- Audiological services need to be multidisciplinary.
- A managed network of care was proposed.
- The role of graduate audiologists needs to be expanded.
- Community paediatricians require some knowledge of the aetiology and medical aspects of hearing disorders in children.
- Audiovestibular physicians play an important role in specialised paediatric audiology.
- Educational audiologists and ENT surgeons also have a vital role.
- Improvements were proposed for training in audiology and communication disorders in the discipline of paediatrics.

3.4 This report provided invaluable background data on paediatric audiology services and needs and possible models of provision of service for the future, although the provision of vestibular services and mechanisms for training consultant audiovestibular paediatricians were not specifically considered.

Balance services

3.5 Balance services in the UK have been particularly neglected due to limited training, resources and manpower. Moreover, the time needed for assessment for dizziness and imbalance limits their availability in busy ENT and neurology clinics. While the national charities have been strong advocates for the hearing impaired, no one has provided a voice for those with imbalance, although recent initiatives by the DH, voluntary bodies and professional groups have raised awareness of the poor provision in this area.

Availability of services

3.6 Generically, consultant physicians and paediatricians provide the NHS service for non-surgically treated medical conditions and rehabilitation programmes. Thus, within the field of adult hearing and balance disorders, consultant audiovestibular physicians have a major role to play in prevention, aetiological diagnosis, interpretation of investigations and medical management/ rehabilitation of hearing and balance disorders. This is particularly important with respect to the translation of basic research advances to the clinical domain, for example in the fields of genetics, biotechnology/bioengineering, neuroscience, pharmacology (Seidman and Vivek, 2004) and neurophysiology.

3.7 Although secondary care ENT services are available throughout the country, specialist paediatric otolaryngology, neuro-otology, and otology are largely confined to tertiary centres

Case 13. Not epilepsy.

A seven-year-old boy with severe to profound congenital sensorineural hearing loss had a number of episodes when he would fall suddenly to the ground and often shake or twitch. After a few minutes, he recovered. A diagnosis of epilepsy was made by the local paediatrician and anticonvulsants started. At about the same time, his 12-year-old sister, also severely deaf, developed some similar episodes. Although she was thought to be imitating her brother, she too was started on anticonvulsants. Controlling the boy's seizures proved difficult, although his sister did not have any further episodes.

On referral to the audiovestibular medicine unit for continuing management of the hearing loss, an episode was witnessed in outpatients, accompanied by severe pallor, blue lips and a very reduced pulse. An ECG showed prolongation of the QT interval, confirming the correct diagnosis of Jervell Lange-Neilsson syndrome in both children.

and directed at surgically remediable conditions. In many centres there may not be the expertise required for optimal care of non-surgical hearing and balance disorders. Moreover, waiting times for ENT continue to be a challenge (Fig 4).

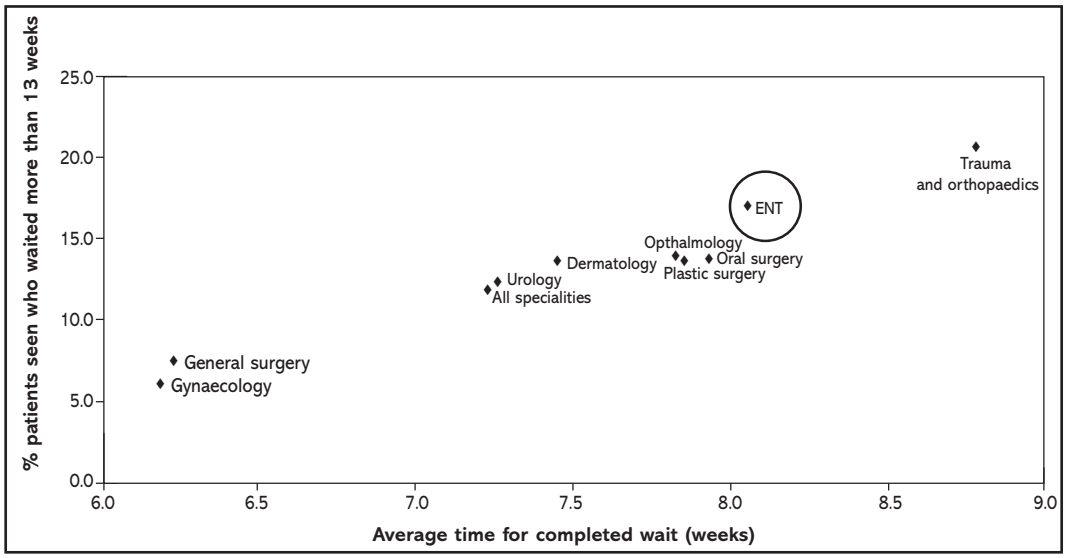

Fig 4 Outpatient waiting time for ENT appointment: average time waited from outpatient to specialty appointment vs percentage of patients seen who waited more than 13 weeks (Department of Health, 2006, reproduced with permission of the DH).

3.8 Because so many patients with hearing and balance disorders are seen by ENT specialists, a better resourced provision of audiovestibular medicine would reduce ENT waits. New initiatives such as the NHSP, and the Modernisation of Hearing Aid Services for adults and children (MHAS and MCHAS, respectively), have included the national roll-out of digital hearing aids and set national standards for these activities. This has to some extent lessened the variation in audiology services throughout the country, but in many areas has lengthened the wait for obtaining a hearing aid.

In December 2006 these waits had not improved and data across the country showed 166,740 patients awaiting averages of 10 to 45 weeks for audiology assessments with 56–79% of patients requiring this service waiting more than 13 weeks (DH, 2007).

3.9 The National Audiology Plan announced in March 2007 represents the Department of Health's initiatives to address these waits. These include use of the private sector to provide 300,000 'new patient pathways' per year and an assessment of patients through Independent Sector Testing Centres. They also include an undertaking that all complex hearing and balance cases (that is, those referred through consultant-led clinics) will be assessed and treated within 18 weeks by December 2008, while 'routine' cases will be assessed within 6 weeks by March 2008 following the national guideline for all diagnostic tests, including pure tone audiometry. However, as most audiology departments are not consultant-led, the 18-week national programme for referral to treatment does not apply. The House of Commons Health Committee audiology report (2007) noted that previous targets for audiology had not been met, such as the 13-week target for diagnostic tests by 2007, and recommended that audiology services should be included in the 18-week target at 'an early date'.

Table 2 Waiting times for audiology assessments by SHA in November 2006 (Department of Health, 2007)

	Expected average wait (weeks)	Patients waiting over 13 weeks	Total waiting	Percentage waiting over 13 weeks (%)
North east	32	9,256	13,201	70
North west	13	13,157	21,277	62
Yorkshire and the Humber	15	11,892	15,461	77
East Midlands	22	9,361	13,889	67
West Midlands	20	18,234	28,026	65
East of England	10	4,846	8,620	56
London	20	9,465	13,829	68
South east coast	45	12,742	16,101	79
South central	12	5,594	11,110	50
South west	16	18,927	28,518	66

3.10 In children, the UK has had a poor record in the identification and management of congenital hearing impairment (Davis *et al*, 1997), as highlighted by the NDCS in their *Quality Standards* Vol IV (2000). Recent research has confirmed the value of early (before 1 year of age) cochlear implantation in improving access to sound or in children with pre-lingual deafness (Kirk *et al*, 2002; Govaerts *et al*, 2002; Nicholas and Geers, 2006). Moreover, emerging findings from cochlear implant programmes indicate that a wider cohort of children with permanent hearing impairment would benefit from implantation (Balkany *et al*, 2002). This requires expansion of the current provision in addition to addressing the unacceptable delays in access for both adults and children (RNID 2002a).

3.11 To date, central auditory processing disorders, auditory neuropathy and disorders of communication have received little tertiary support in the UK . However, the MRC Institute of Hearing Research (IHR) is now spearheading research into the 'auditory brain' (www.ihr.mrc.ac.uk/research/) and the British Society of Audiology (www.thebsa.org.uk) is working in parallel with the IHR initiative to provide an evidence base for issues in clinical practice.

Proposed model for provision of an audiovestibular service

3.12 Care pathways have been established for infants detected by Newborn Hearing Screening Programme (NHSP) and for patients requiring hearing aids (MHAS and MCHAS). In addition, care pathways for patients with other hearing and balance disorders such as tinnitus are being developed through the Do Once and Share Programme (www.informatics.nhs.uk) and the 18-week Delivery Programme (www.18weeks.nhs.uk).

3.13 Thus, in the absence of a clearly defined referral route patients may be referred to a number of different disciplines and frequently 'bounce' between specialists. The US National Institutes of Health report that a patient with a peripheral vestibular pathology sees a mean of 4.5 physicians before receiving a correct diagnosis.

3.14 Modern care for hearing and balance disorders requires a 'whole system' approach, in which the 'ear' problem is not considered in isolation, but as part of the patient's overall health (see Case 14, p23). The managed network of care proposed in this report would enable different professionals in an appropriate MDT to provide an optimal integrated service at each level of care (see Fig 5). Set against this ideal, the need to deliver high quality, rapid care close to the patient's home requires a reappraisal of the current diverse and nationally inequitable service. This model satisfies a number of 'modernisation' criteria proposed by the NHS which include:

- multidisciplinary working
- expansion of the role of audiologists
- increased provision of primary/community care
- seamless provision of primary to tertiary service
- reduction in burden on hospital services
- provision of rapid, local, dedicated medical care
- ability to deliver rapid treatment following initial presentation.

and is broadly in line with the ethos of the 18-week Delivery Programme, which advocates high quality care closer to home, with rapid access to specialist services when required.

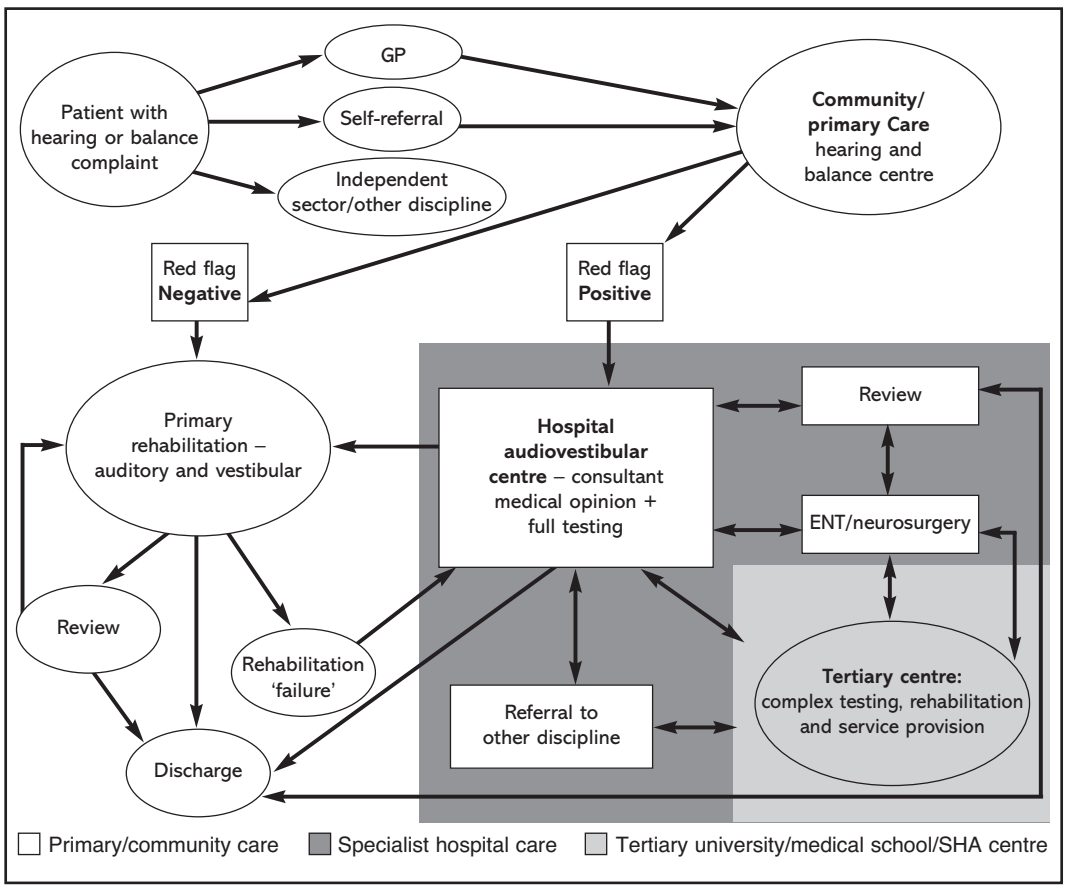

Fig 5 A model for the provision of audiological and vestibular services.

Community care

3.15 Audiovestibular medicine has received little attention in undergraduate medical schools and remains poorly addressed in pre-registration and GP vocational training schemes. A small GP direct referral clinic to an audiologist for vestibular rehabilitation, established through the Action on ENT Programme (Deparment of Health, 2003), suggested the need for education in primary care to allow the development of balance centres in the community to provide initial care for the large numbers of the population with such symptoms. Improved medical education would support general practitioners in providing this care, with audiologists running first-line hearing and balance services undertaking routine, simple auditory and vestibular tests and instituting rehabilitation. Direct access hearing aid provision, along these lines, is already in place in many centres. The proposed model integrating hearing and balance services would allow the majority of patients to be rapidly and effectively diagnosed and treated.

Hospital centre

3.16 Medical 'red flags' would be introduced across auditory (Appendix 1) and vestibular (Appendix 2) presentations, as are used in the current audiology-led hearing aid services, so that more complex cases would be identified early in the 'local' service and referred to a specialised centre with a MDT, including two consultant audiovestibular physicians, of whom one would have specific paediatric competencies (BAAP/BACDA, 2004) and experienced audiologists. More sophisticated diagnostic and rehabilitation services would be available. In the context of the team, the audiovestibular physician/paediatrician would have the appropriate skills and competencies to provide a holistic medical assessment, particularly with respect to audio-vestibular sequelae of general medical conditions and the institution of medical/paediatric therapy. Importantly, the physician would also have the appropriate competencies to evaluate the need for specialised input of other medical disciplines.

Tertiary centre

3.17 More complex cases would be further referred to tertiary centres with supraspecialty interests and skills staffed by both clinical and academic consultant physicians and audiologists as part of the MDT. These regional or university centres would have state-of-the-art facilities and take the lead in teaching and research.

Case 14. Dizziness in a normal young woman.

A 28-year-old woman presented with a six-month history of severe dizziness, which was constantly present and particularly severe on exertion. Previously she had been perfectly well and her symptoms had begun gradually and had progressively increased. She had recently married and for the past three months reported that her symptoms were preventing her from working or socialising with her husband. On systematic questioning she denied any other symptom and reported that her only medication was vitamins. She had tried an array of vestibular sedative drugs, none of which had been effective. Examination revealed a perfectly healthy young woman, with no general medical or vestibular signs and notably no evidence of postural hypotension. In the absence of any diagnosis, screening blood tests were undertaken and all were normal with the exception of a serum potassium of 2.8. Urgent review and repeat questioning elicited that she had been taking frusemide 40 mg a day (which she had obtained abroad as a 'slimming drug') for 15 months in an attempt to lose weight. This was immediately discontinued, potassium supplements were given and within a week she was well.

Changing the approach to hearing and balance service

3.18 In the future the audiovestibular physician/paediatrician is likely to focus on diagnosing and treating the causes of hearing and balance disorders in order to prevent as many of their consequences as possible. The rationale for the proposed developments in the service are:

- The audiovestibular physicians working within a multidisciplinary team would provide a responsive, one stop service across the range of hearing and balance disorders, ensuring prompt medical diagnosis and specific management/rehabilitation, with avoidance of multiple unnecessary tertiary referrals.
- Audiovestibular paediatricians have provided consultant medical care within the informal context of what has now become known as managed local networks of care: these are local networks of multidisciplinary and inter-agency working spanning primary, secondary and tertiary care across health, education and social services to provide optimal care for every child. These arrangements have been formalised in *Every child matters: change for children* (2004) and the NSF for Children is key to the implementation of these aims.
- Basic scientific and clinical research in audiovestibular medicine will lead to a better understanding of both congenital and acquired sensorineural hearing loss and balance disorders, with progress in prevention and management.
- The multidisciplinary team works most effectively if there is a full complement of professionals so that each can focus on their area of expertise and interact with other members of the team.

4 Manpower

4.1 Medical manpower requirements for audiovestibular medicine are based on:

- the clinical need
- the model for the provision of care
- the diversity of professionals able to deliver the service
- factors relating to movement and retirement of the workforce.

4.2 Three main professional groups, who in an ideal service would work in parallel, are variously responsible for care in the current diverse national clinical settings: otolaryngologists, audiologists and audiovestibular physicians. In some centres, paediatricians without specialist training are, by default, responsible for paediatric audiology services. Ideally manpower calculations for each of the three trained professional groups should be based on patient requirements for optimal care, ie the numbers of patients requiring audiological provision only, the number requiring medical audiovestibular care and the number requiring surgical care.

4.3 Based on the generic model of care outlined in section 3, the majority of care and thus manpower would be situated in the primary/community provision, with smaller numbers of patients requiring less manpower in the specialist and supraspecialist centres (Fig 6).

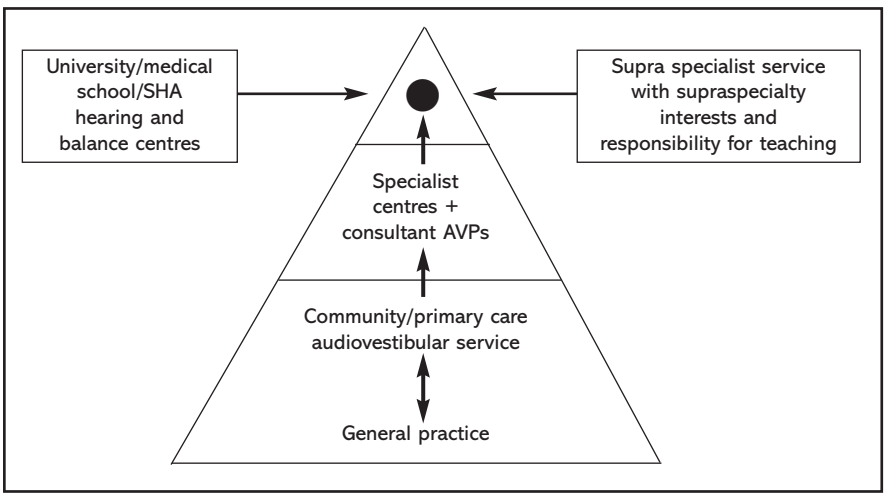

Fig 6 Model to illustrate manpower proportions for proposed national model for primary care led hearing and balance networked service.

4.4 At a meeting of the Department of Health Workforce Review Team in March 2005, data for audiologists were provided by the profession and the MRC, from the Healthcare Scientist Proforma for Audiologists in England. A total of 2,160 healthcare audiologists in England were identified, with an extra 300 required for Modernising the Hearing Aid Services (MHAS) and supporting the Newborn Hearing Screening Programme. It was emphasised that the hearing aid

services require considerable manpower, as patients are provided with aftercare for the rest of their lives. Thus, the shortage of this group of professionals was highlighted and steps have been put in place to try and resolve this discrepancy between patient need and manpower resource with the establishment of nine undergraduate audiology programmes. From 2007, about 190 students will complete the course each year.

4.5 The Royal College of Physicians defines audiovestibular physicians as specialists responsible for the medical investigation, diagnosis and treatment of patients with auditory and vestibular disorders. Otolarynygologists by training and expertise are also specialists in this area, but as in all parallel medical and surgical disciplines, their particular skills lie in surgical management.

4.6 In order to establish an aetiological diagnosis, identify systemic conditions with audiovestibular manifestations and institute medical treatment, where appropriate, before rehabilitation, an audiovestibular physician/paediatrician with specialised training should see:

- all children with permanent hearing loss (Newborn Hearing Screening Programme National Protocol)
- all children who develop progressive/sudden/fluctuating hearing loss in childhood
- all children with intractable glue ear
- all children with unexplained conductive hearing loss
- all children with dizziness/vertigo or imbalance
- all children with tinnitus
- adults who do not meet the criteria for Direct Access to the Hearing Aid Service (TTSA Guidelines – see Appendix 1)
- adults with imbalance, which falls outside medically agreed guidelines (see Appendix 2)
- adults with unilateral, pulsatile or intractable intrusive tinnitus
- adults with unexplained or undiagnosed hearing and/or balance symptoms.

Current medical staff

4.7 There are a total of 370 doctors practising in audiovestibular medicine in the UK. Only 66 consultants (of whom 47 are consultant audiovestibular physicians, while 19 are consultant community paediatricians (audiology)) and 23 specialty registrars have trained through the RCP programme, while the remainder are members of the British Association of Community Doctors in Audiology and associated with the RCPCH.

- Some 300 doctors of all grades undertake paediatric audiovestibular medicine, many of whom are part time and have received little or no formal training.
- Twelve consultants see only adults.
- The remaining 25 consultants and all 23 trainees practise in both adult and paediatric audiovestibular medicine, in the absence of a formulated paediatric training programme in this field.

4.8 Nonetheless it should be noted that there has been 100% expansion in the numbers of consultant audiological physicians between 1993 and 2002. If expansion continues at this rate, by 2020, there will be 160 consultant audiological physicians. However, these figures do not take into account the large number of consultant retirements which will take place within the next 10 years.

Audiovestibular physicians needed for a population of 500,000

4.9 There is a problem obtaining accurate statistical information for estimating workforce needs. The conclusion of the WRT was that an in-depth study in three SHAs was required. This Working Party considered two data sets (Appendix 3), which provided the best approximation to the medical need of these patients. Both suggested that 2,000 to 2,500 new referrals per 500,000 population could be expected each year for medical as opposed to surgical hearing and balance disorders. The follow-up clinic load could not be estimated but it is likely to be at least as much as the new referral load, reflecting ongoing medical/rehabilitation support.

4.10 **Thus, a conservative estimate of manpower needs would suggest that no less than one paediatric and one adult audiovestibular physician are required per 500,000 population to provide an equitable and standardised level of specialist medical care nationally to those cases that cannot be dealt with solely by a senior audiologist and do not require surgical intervention.**

4.11 **To meet this requirement, bearing in mind that approximately 50% of the current consultant population will retire within seven years (BAAP statistics) it would be necessary to:**

- **appoint 10 new consultant audiovestibular physicians over the next two years,** in hospitals without current provision of audiovestibular services. This would provide an initial spread of expertise across the country to support training.
- **appoint five new centrally funded training numbers each year for next five years.**

4.12 These posts would deliver approx 200 consultants by 2016, ie approximately 1 per 300,000 population. Specialised facilities required by a service including audiovestibular medicine for a population of 500,000 and a specimen job plan/consultant work programme are outlined in *Consultant physicians working for patients*, (RCP, 2005).

There is an urgent need to review the future manpower requirements of both audiovestibular medicine and audiology, as the provision of an high quality service to patients with hearing and balance disorders depends upon multidisciplinary working, the cornerstone of which is formed by these two disciplines, together with ENT surgeons.

5 Audiovestibular medicine in medical care

General practice

5.1 In 1989 the Royal College of General Practitioners advised that an audiometer should be available in general practices to meet such needs as the assessment of hearing loss calling for a hearing aid in older people, the monitoring of children with glue ear, the management of patients complaining of tinnitus, and the requirements of occupational medical examinations (for example for professional divers and aviators).

5.2 No funding or training were made available: a survey of 50 practices in East Dorset showed that by late 2003, 17 had an audiometer, 30 did not, and three had instead a regular service from a visiting audiology technician.

5.3 A systematic review of vertigo/dizziness in general practice (Hanley *et al*, 2001) had concluded that there was no definitive information about how these symptoms were managed. No information was available about the referral numbers to hospital for vertigo, but less than 10% of cases of dizziness were referred. More recently the effectiveness and simplicity of particle repositioning procedures such as the Epley's manœuvre for benign paroxysmal positional vertigo has led to their adoption with enthusiasm in many general practices.

5.4 Innovative developments including 'GPwSIs in ENT' (general practitioners with a special interest in ENT)', the 'PGDipENT' qualification (Postgraduate Diploma in Practical ENT (Primary Care)) and Diploma in Audivestibular Medicine could usefully be expanded to include the primary care elements of audiovestibular medicine, so that primary care could provide diagnostic and management care for an increasing proportion of cases of hearing and balance disorders, as outlined in the proposed model.

5.5 Analysis of data supplied in 2003 by 21 nationwide GPwSIs in ENT caring for 180,000 patients indicated that on average about 132 patients had hearing problems and 134 suffered balance problems each month. Of these, GPwSIs managed 63% of the former and 82% of the latter within general practice. A detailed audit is required to review the management and outcome of dizziness in general practice in order to support and develop effective primary care for patients with dizziness and balance disorders. GPs themselves have felt the need for better access to balance specialists and one-stop dizziness clinics, suggesting that this would improve the quality of care for dizzy patients and would be cost effective (Jayarajan and Rajenderkumar, 2003).

Paediatrics and child health

5.6 Paediatricians have detailed knowledge of and skill in recognising and managing health and ill health in children and how the measures of their well-being change through the different stages of growth and development. The objectives of the Royal College of Paediatrics and Child Health include raising the standards of medical care for children and educating and examining those concerned with the healthcare of children. To this end, there are a range of subspecialties

within paediatrics and child health. Children with audiovestibular disorders would be particularly likely to present to those practising in community paediatrics, neurodisability, neurology, metabolic disease, neonatology and allergy, immunology and infectious disease.

5.7 The care of children and their families is now the subject of a NSF (DH, 2004), addressing all aspects of paediatric care in hospital and the community. This framework emphasises the need for children to be assessed and treated by professionals who have been specifically trained to work with babies, children and young people (adolescents) in an environment which is designed for them and their families. Supported by a number of initiatives and green papers (eg Change for Children, Every Child Matters, Surestart, Right from the Start, Early Support Programme), the NSF highlights the importance of both interdisciplinary and inter-agency working, involving health, education, social services and the voluntary sector to ensure an accessible seamless service for children with transient, acute and long-term impairments of health or function.

5.8 Paediatricians are involved in the care of all babies and may be the coordinators of services for children with hearing impairments. Children with speech and language problems, communication or learning difficulties form a significant part of the workload in paediatrics and child health. These presentations, together with behaviour difficulties and other disabilities (eg visual impairment), may mask significant hearing loss. Even a condition as common as glue ear can interfere with the development of speech and language, behaviour and emotion. The differentiation between deafness and autism can present a particular challenge, especially in those under two years old.

5.9 The audiovestibular physician can assist the paediatrician by:

- clarifying the audiovestibular aspects of the child's condition which may have medical implications
- advising about deafness and associated conditions to determine aetiology
- advising about risk factors for late onset or progressive deafness
- ensuring that the expertise within the multidisciplinary team is accessible through clear joint clinical pathways including pathways for urgent referral for audiovestibular assessment
- providing diagnosis and treatment for children with tinnitus
- ensuring that an authoritative audiovestibular service is available, staffed by trained and experienced clinicians
- contributing to undergraduate and postgraduate teaching.

5.10 Close working with paediatricians enables the audiovestibular physician to have robust information about a child's development with identification and clarification of the natural history and treatment of other medical conditions (see Case 15, p31).

Care of the elderly

5.11 Dizziness is one of the most common problems affecting older people (30% of over 65-year-olds) and is associated with impaired balance, functional decline and falls (Colledge *et al*, 1994; Pothula *et al*, 2004). Eighty per cent of older people presenting to an A&E department with an unexplained fall have symptoms of vestibular impairment (Pothula *et al*, 2004). Dizzy older patients are under-referred to specialists, despite dizziness (especially benign paroxysmal positional vertigo (BPPV)) having a major effect on quality of life. Yet unrecognised BPPV, which has a prevalence of 9% in the older population, is eminently treatable (Oghalai *et al*, 2000).

5.12 In most older patients, vestibular disorders alone are the least common cause of dizzy symptoms, which are usually associated with angina, vascular disease (Colledge *et al*, 1994) and polypharmacy (see Case 16, p31). Thus, patients may be best seen initially by a geriatrician to exclude cardiovascular causes of dizziness and to review medications. Integrated falls services are generally provided by geriatricians and their multidisciplinary teams, but the improved assessment and diagnostic process is now identifying an increasing number of patients with dizziness and balance problems who may require specialist medical assessment by an audiovestibular physician. In a typical primary care trust catchment area of 150,000 population, 30,000 will be over the age of 65 and one-third of this older population fall each year, with half of them falling repeatedly, ie 5,000 high-risk fallers (AGS, BGS and AAOS Panel, 2001). This is a substantial workload and the audiovestibular physician would therefore be a valuable member of the falls clinic team (Case 17, p31).

5.13 The single assessment process outlined in the NSF for older people (DH, 2001) aims to identify all of an older person's needs, including hearing loss, and is largely carried out by community and practice nurses. This will inevitably result in increased referrals to departments of audiovestibular medicine.

Otorhinolaryngology

5.14 Traditionally, ENT surgeons have been the major providers of secondary care for both adult and paediatric patients with disorders of hearing and balance. At a tertiary level, ENT surgeons have been an important element of multidisciplinary services where their expertise in the surgical assessment and management of patients with auditory and vestibular deficits has been essential.

5.15 Despite increases in the number of consultant ENT staff in recent years, little impact has been made on the consultant surgeon:population ratio, which is currently 1:111,680 – making the UK one of the worst served member states in the EU. Many routine aspects of care previously delivered by consultant surgeons have been devolved to other healthcare providers in an attempt to streamline and improve healthcare delivery, eg audiology clinics in general practice and ear care nurses within the hospital setting. Moreover, surgical training is being shortened such that the general ENT surgeon of the future will have a relatively restricted practice limited to minor and intermediate surgery. Subspecialty training will be undertaken by a selected number of surgeons during an additional two years and some will choose otology. The net result is likely

Case 15. Dysequilibrium.

A 5-year-old girl was referred by her GP for a second opinion on her severe speech and language delay, felt to be greater than that expected of her generalised developmental delay. She had sat alone at 8 months and walked with hands held at 2 years. Her hearing was reported to have been 'normal' at the age of 3 years. She had been diagnosed with a 'cerebellar syndrome' by a paediatric neurologist on the basis of hypotonia, truncal ataxia and an intention tremor. She was not making progress and management was directed towards supporting her learning, motor and language acquisition.

Clinical findings included hypotonia and generalised ataxia. She was stable when sitting but had poor righting reflexes. She could walk on a broad base, provided one hand was held. She had marked vertical nystagmus with broken pursuit. Pure tone audiometry showed a bilateral symmetrical moderate to severe hearing loss. Vestibular testing confirmed the clinical findings with up-beat nystagmus on upward gaze and down-beat on positional testing.

Refsum's syndrome was considered and a further paediatric opinion was sought with some urgency. Rehabilitation was started with an integrated approach to her hearing and language development and binaural hearing aids were fitted. She was eventually diagnosed with peroxisomal leucodystrophy caused by D-bifunctional protein deficiency and is managed by diet and L-carnitine. She is making steady, albeit slow, progress.

Case 16. Multisensory dizziness syndrome.

A 65-year-old man with ischaemic heart disease presented with an 18-month history of subjective vertigo, feeling that he was constantly walking on an uneven surface. This sensation fluctuated and was worse when he was tired or ill with any viral infection. He had been seen by a neurologist who identified a visual field defect, associated with an old cerebral ischaemic event. Neuro-otological examination revealed reduced vibration sense at the ankles and poor stability with gait testing with eye closure. Neuro-otological investigation revealed a mild abnormality of smooth pursuit to the left with a left directional preponderance of optokinetic responses, but no other abnormality. An MRI scan showed diffuse small vessel disease. This gentleman was diagnosed as suffering from the multisensory dizziness syndrome with impaired visual and proprioceptive inputs for balance together with impaired integration in the CNS secondary to small vessel disease. He was treated with vestibular physiotherapy using gait retraining strategies and customised exercises. There was some improvement in his sense of balance.

Case 17. Chronic vestibular symptoms

An 84-year-old woman with hypertension and a past history of a myocardial infarct 3 years previously, presented with a 1-year history of sudden onset vertigo, diplopia and dysarthria which had largely resolved over 3 days, but she had continued to experience occasional dizziness. The present complaint was of worsening dizziness over the past 3 months and a feeling of unsteadiness when standing and walking as if she were about to fall. She had become housebound, having had several falls and having become very afraid of falling.

On examination, she was in sinus rhythm with a blood pressure of 160/90 and no postural drop. Neurologically, there was marked quadriceps weakness and wasting, with difficulty rising from a chair. There was increased tone in both legs, with increased reflexes, but flexor plantar responses. Her gait was narrow-based and short paced, with both hesitation and freezing.

The diagnoses were lower limb weakness, vascular parkinsonism, an old posterior circulation stroke and loss of confidence with fear of falling. Lower limb weakness causes a feeling of unsteadiness often described by the patient as dizziness. Freezing is a common feature of vascular parkinsonism and increases the risk of falling when turning. Muscle strengthening and balance exercise improved her mobility and confidence. Symptoms from vascular central vestibular dysfunction were helped by vestibular rehabilitation.

to be a reduction in the number of surgeons capable of the same wide range of procedures as exists today and a concentration of expertise in centres.

5.16 It will become increasingly important for ENT surgeons to work in multidisciplinary teams within their centre, even for those aspects of their work that previously were their sole responsibility. In this respect, audiovestibular physicians should become an integral part of that team. The contribution of the audiovestibular physician within that team should be to:

- help provide diagnostic services for those with sensorineural hearing loss
- liaise with audiological scientists over the medical aspects of problematic hearing rehabilitation issues, including patients with persistent conductive hearing difficulties despite active surgical intervention
- provide a diagnostic service and help coordinate therapies for patients with balance disorders and to supervise and monitor patient management
- contribute to the education of undergraduates within medical schools and of postgraduates on training schemes in otolaryngology, paediatrics, neurology, geriatrics, general practice and audiovestibular medicine
- become an integral part of the research and development output of the department in which they work.

Neurology

5.17 The Association of British Neurologists (ABN) has advocated an increase in the number of neurologists to meet the current workload (ABN, 2002) and ensure better care and outcomes, with better use of resources, than when patients with neurological disease are managed by other disciplines (Warlow *et al*, 2002). Dizziness and vertigo are common presenting symptoms to neurologists, despite the preponderance of such disorders being of labyrinthine origin. Moreover, most neurological centres do not have facilities for the investigation and management of vestibular or central auditory disorders, despite the range of neurological conditions with such related pathology (see Case 18, p33).

5.18 Audiovestibular physicians can support their neurological colleagues in providing evidence of functional derangement in the eighth nerve system and central pathways when imaging has been negative.

5.19 In general, audiological physicians support a neurological service by:

- reducing the neurological workload by providing assessment of patients with auditory and balance symptoms, with appropriate referral of neurological disorders and management of the remaining group
- providing a diagnostic and management service for patients with neurological disease who develop audiovestibular symptoms
- facilitating neurological diagnosis by appropriate site of lesion auditory and vestibular testing and diagnosis with reference to known neuro-otological abnormalities in specific neurological disorders (see Case 19, p33)
- liaising with neurologists in the diagnosis and management of central auditory processing disorders in the context of neurological disease.

5.20 The multiple interrelationships between neurology and vestibular disorders emphasise the need for training in both neurology and otology to enable appropriate and efficient provision of care to this patient group. The inclusion of an audiovestibular physician in a neurosciences team can thus allow better and more prompt diagnosis and management, while promoting efficiency of both neurological and surgical otolaryngological resources.

Psychiatry

5.21 Psychological/psychiatric disorders in the deaf and balance-disordered population are common and must be addressed to ensure successful habilitation/rehabilitation. More rarely psychological upsets are associated with non-organic hearing loss (see Case 20, below).

Case 18. Unexpected diagnosis.

A 29-year-old materials scientist presented with a marked change in personality and depression over a six-month period and a more recent, rather vague sense of disorientation. He was referred for a neurological opinion and no definite abnormality was found. He was then referred for a neuro-otological opinion and downbeat positional nystagmus on the Hallpike manoeuvre was observed. An MRI scan was obtained which showed no abnormality. His psychological state required inpatient care, with limited improvement. He began to develop cerebellar limb signs in addition to his downbeat nystagmus and a repeat MRI scan was obtained showing the characteristic pulvinar sign of new variant Creutzfeldt-Jakob disease.

Case 19. Auditory symptoms associated with stroke.

A right-handed 50-year-old woman complained of 'muffled' hearing which particularly affected speech, difficulties with recognising people's voices and she reported that 'music does not sound right'. These symptoms presented four months after a stroke.

Pure tone audiometry, tympanometry, acoustic reflexes, auditory brainstem evoked responses, otoacoustic emissions and a speech audiogram were normal, with the exception of a mild sensorineural hearing loss and reduced otoacoustic emissions above 2000 Hz.

Central auditory assessment showed a mild left ear deficit on dichotic digit testing, severely abnormal results on the frequency pattern test, but normal results on the duration pattern test. On testing speech in multi-talker babble results were normal in the right ear and abnormal in the left. An MRI showed a right temporal-parietal infarct affecting the posterior part of the transverse temporal gyrus (Heschl's gyrus) and the inferior part of the temporoparietal lobule.

These findings are typical in a patient with stroke affecting the auditory parts of the brain. Tests of the peripheral auditory system are normal, while the central auditory tests identify various processing deficits. The test results correlated well with the patient-reported auditory deficits. The patient was referred to a hearing therapist for further management.

Case 20. Missed non-organic hearing loss.

A 6-year-old girl was referred with progressive hearing loss for which no diagnosis had been established locally. Auditory amplification was not proving of benefit and the child was refusing to attend school.

In the audiovestibular medicine clinic, the striking feature was the child's apparent ability to hear normal conversational voice without any visual clues, despite virtually no hearing as judged by pure tone and speech audiometry. Otoacoustic emissions were normal bilaterally.

A diagnosis of spurious hearing loss was made. It transpired that her parents had suffered an acrimonious breakdown of their marriage. Subsequently, the absent parent had made many promises which had not been fulfilled. The child and her mother were quite unwilling to accept the findings, but never presented again to the local audiology service, and the child made steady progress in school.

Audiovestibular physicians receive basic training in psychiatry with both adults and children and work closely with their psychiatric/psychological colleagues.

Audiovestibular medicine and child and family mental health

5.22 In the context of psychological support of the deaf/hearing impaired child, the role of the audiovestibular physician practising in the paediatric setting is to:

- contribute by understanding the emotional and psychological responses of families and children to the diagnosis of deafness
- recognise and support normal adjustment of families to their child's deafness
- actively encourage similar training for colleagues in the MDT
- recognise abnormal parental responses and refer appropriately to psychological services.

5.23 Importantly, audiovestibular physicians caring for children are aware of the signs which suggest that a child may have experienced abuse (physical, emotional, sexual abuse and neglect) and understand when and how to discuss concerns with children and parents and how to refer children to child protection agencies.

Audiovestibular medicine and adult mental health

5.24 While many patients with hearing problems also have psychiatric disorders and vice versa, the main roles of psychiatry in this field concern pre-lingually deaf people, as well as some patients with tinnitus. The specialist mental health services for deaf people (in Manchester, Birmingham and London and nurse-led services in Nottingham, Newcastle and Bristol) tend to see people who are pre-lingually deaf and use British Sign Language. It is crucial that all professionals dealing with this group should understand and be sensitive to the views held by many deaf people, which may differ markedly from those held by the hearing community.

5.25 Many of the risk factors for hearing impairment, such as ethnic minority group, lower socio-economic group, those with learning disabilities and the elderly, are also risk factors for mental illness and, together, both hearing loss and mental health disorders are barriers to the access of healthcare. People with learning disability have particular difficulty in accessing audiological services and really benefit when specialist services are established for them. There is a tradition of audiovestibular physicians working closely with learning disability services.

5.26 Tinnitus is frequently anecdotally associated with suicide, although recent evidence indicates that this is a very rare occurrence, normally related to other behavioural or psychiatric pathology. Nonetheless, a psychiatrist should be an integral (albeit rarely called upon) member of any tinnitus team.

5.27 Psychological symptoms may occur consequent to vestibular pathology, with depression, anxiety, panic attacks and avoidance behaviour being the most common presentations (Jacob *et al*, 2003). Approximately one-third of patients referred to a specialist neuro-otological service will benefit from psychological support, as part of their rehabilitation package. Moreover, psychological factors are some of the most common issues mitigating against good recovery from a 'simple' labyrinthine disorder. In practice, cognitive behavioural therapy and/or psychological management are invaluable in patients with avoidance and or anxiety/panic attacks, while a formal psychiatric referral may be required in more intractable cases.

Ophthalmology

5.28 A significant number of systemic diseases manifest with ophthalmological and otological symptoms, quite apart from syndromes with dual pathology in these two systems. Moreover, a recent report from the UK identified that 40% of children with a hearing impairment have eye problems, so all hearing impaired children should have a full ophthalmological examination upon confirmation of the hearing impairment and regularly thereafter (NDCS and Sense, 2004).

5.29 Diagnostically, there are multiple causes of dual sensory impairment and the characterisation of the audiovestibular and ocular dysfunction may facilitate accurate diagnosis. In some cases, eg Cogan's syndrome and Vogt Koyanagi Harada syndrome, rapid diagnosis enables urgent intervention to protect both hearing/balance and vision. In management, monitoring of audiovestibular function in autoimmune disorders may provide a sensitive index of disease activity against which immunosuppressives may be titrated. Similarly, audiovestibular physicians may help in the monitoring of the patient with papilloedema/visual loss in patients with benign intracranial hypertension and hydrocephalus using recently developed techniques such as tympanic membrane displacement (TMD).

5.30 The audiovestibular physician also plays an important role in diagnosing eye movement disorders, which may be due to pathology of the peripheral or central vestibular pathway or brainstem/cerebellar connections. Cerebral hemisphere lesions also present with characteristic eye movement disorders

5.31 People with multiple disabilities require specialist services and in the deaf/blind child, early identification is crucial in order to initiate the appropriate intervention, eg early cochlear implantation to establish good language and communication, prior to the loss of vision. However, the largest group of deaf/blind people develop hearing and vision problems as they get older and, in some cases, this visual and/or hearing impairment is preventable, or the remaining vision and/or hearing can be maintained and enhanced with the appropriate rehabilitation.

Immunology and allergy

5.32 There has been a three-fold increase in allergy reported over the past 20 years (RCP, 2003). This is of particular relevance in serous otitis media, the most common cause of hearing loss in childhood (Brownlee *et al*, 1969) with a significant morbidity for 5% of children. In addition, autoimmune auditory and vestibular disorders, both as isolated inner ear phenomena and as part of systemic autoimmune diseases, are well recognised (Ruckenstein, 2004; Agrup and Luxon, 2006) (see Case 21, p37).

5.33 *Rhinitis* tends to involve the eustachian tube leading to dysfunction and middle ear disorders. This is most commonly seen in childhood, but can also occur in adults with severe rhinitis, and as part of the HIV spectrum. Rhinitis can be allergic, non-allergic, infectious or part of a multi-system disorder such as sarcoidosis, Wegener's granulomatosis or Churg Strauss syndrome.

5.34 *Immune deficiency*: affecting innate (eg cystic fibrosis, primary ciliary dyskinesia) or acquired (immunoglobulins, IgG subclasses) immunity can present as upper respiratory tract infections involving the ear. This middle ear dysfunction may also be associated with sensorineural hearing loss. Moreover, 50% of AIDs sufferers develop sensorineural deafness.

5.35 *Auto-immunity:* hearing loss as part of auto-immune thyroid dysfunction is well recognised (Mayot *et al*,1993). Auto-immunity may give rise to isolated sudden sensorineural hearing loss and/or vestibular impairment/failure, and as part of a multisystem auto-immunity both sudden hearing loss and vestibular dysfunction may occur. Both immune complex disposition and vasculitis have been implicated (Agrup and Luxon, 2006).

5.36 Thus, a medical examination and investigation for immunological/autoimmune pathology is required in otitis media and sudden or progressive auditory or vestibular loss. Audiovestibular medicine therefore includes training in basic immunology and allergy.

Clinical genetics

5.37 Recent advances in genetics have revolutionised the understanding of hearing impairment and some disorders of balance. The collaboration between genetics and audiovestibular medicine has enabled important scientific and clinical advances to be made and genetic counselling, in particular, has undergone radical changes as genes causing hearing impairment and vestibular dysfunction have been identified (Tassabehji *et al*,1995; Nance, 2003).

5.38 At least 50–60% of congenital hearing impairment and a significant proportion of late-onset hearing loss are believed to be of genetic origin. As a result, the ability to perform diagnostic genetic testing has had a considerable impact upon the clinical service offered to patients attending audiovestibular medicine clinics. Not only is the aetiology of a hearing loss more likely to be identified and accurate risk factors highlighted, but better prognostic information and management strategies are available (see Case 22, p37) (Prosser and Martini, 2005; Loundon *et al*, 2005).

5.39 As the field of genetics is not yet (and will not be for the foreseeable future) at the stage where deaf patients can be routinely screened for all genes needed for hearing, careful phenotypic analysis and investigation of the patient is required before referral to the genetic service. Information about severity, pattern and progression of hearing loss, presence or absence of clinical and subclinical vestibular problems, anatomy of the inner ear and presence of subtle clinical signs in other systems enables the geneticist to direct specialised and often expensive molecular analysis to a small number of genes.

5.40 Collaboration with clinical genetics has also enabled the investigation of genes which confer susceptibility to develop a hearing impairment after exposure to noise or to medication, eg aminoglycoside antibiotics (Tang *et al*, 2002). This knowledge has the potential for preventing hearing impairment with a resulting social and economic benefit for individuals as well as for the population as a whole.

Pathology

5.41 In audiovestibular medicine biopsy diagnosis is rare and histopathological examination of the ear and temporal bone is undertaken at autopsy, and as a result of stringent government edicts is now also rare. Nevertheless, the current understanding of the multifaceted nature of 'presbyacusis' (Christensen *et al*, 2001; Martini and Prosser, 2003) and the molecular biology underlying apoptosis and necrosis highlight the need for an understanding of neurochemistry and histopathology (Van De Water *et al*, 2004). Nonetheless, many pathologies affecting the labyrinth remain poorly understood and, if prevention and treatment of hearing loss and vestibular disorders are to progress, detailed histological studies are required.

5.42 Microbiology, including bacteriology, and virology, have a key role and have been instrumental in vaccination programmes which have helped to eliminate rubella, measles and mumps deafness, all of which remain major factors in deafness in the developing world (see Case 23, p39). Meningitis remains a significant risk to auditory and vestibular function, while the treatment of life-threatening infections with aminoglycosides remains a significant cause of both auditory and vestibular dysfunction, not infrequently leading to litigation. Virological examination allows early detection of CMV on Guthrie blood spot cards and the diagnosis of otological HIV infection has become a priority. Although rare, cases of Creutzfeldt-Jacob disease have presented to audiovestibular physicians with both peripheral and central auditory disorders, imbalance and oculomotor abnormalities.

5.43 Clinical chemistry and haematology enable the diagnosis of otological manifestations of systemic disorders, eg cerebrovascular disease, diabetes with both visual and proprioceptive abnormalities impacting on balance, renal function in the context of monitoring ototoxic aminoglycosides and C reactive protein, and ESR monitoring markers of inflammatory disease (see Case 24, p39).

Case 21. Sudden hearing loss.

A 13-year-old boy was referred to an audiovestibular physician with sudden, total loss of hearing and imbalance and incoordination. He was well known to his local audiology services, where he was monitored regularly for a congenital, right microtia with a moderate, conductive hearing loss. He had normal hearing in his left ear. A paediatric opinion had not identified any abnormalities.

Examination showed a withdrawn boy, who was obviously ataxic. A range of haematological, biochemical and immunological tests revealed only a mildly raised erythrocyte sedimentation rate (ESR). A CT scan was normal. Urgent vestibular assessment demonstrated bilateral, profound, vestibular hypofunction and a red left eye. This asymptomatic red eye had affected him every autumn for about six years and responded to topical antibiotics after a few days.

This combination of symptoms, together with evidence of bilateral labyrinthine fibrosis on MRI scan, and the raised ESR suggested autoimmune inner ear disease, probably Cogan's Syndrome. He was referred urgently to the local ophthalmologist, paediatrician and cochlear implant team. He was treated with systemic steroids and needed several months of psychiatric support to come to terms with his deafness, instability, unpleasant side effects of treatment and the change to his lifestyle. He is now reported to be increasing in confidence, having accepted cochlear implantation and vestibular rehabilitation.

Case 22. Inappropriate advice on aetiology.

A baby was confirmed to have a bilateral profound SNHL; both parents were congenitally profoundly deaf. Her mother attributed her own hearing loss to rubella embryopathy and reported deterioration in her hearing in early childhood. She had three normally hearing siblings and there was no history of deafness in her family. The father was one of two deaf siblings whose father had been partly deafened by meningitis. The baby was otherwise clinically normal. The family had been advised in the local audiology clinic that their baby had a dominantly inherited hearing loss and some of their children would probably be hearing.

The family sought a second opinion with a consultant audiovestibular physician. DNA testing revealed that both parents and the infant were homozygous for 35delG mutation in connexion 26. This enabled advice that all children born to this couple would have a significant hearing loss despite the aetiology of recessive deafness.

5.44 Moreover, an understanding of the biochemical pathways underlying apoptosis and necrosis enables clarification of the mechanisms resulting in both auditory and vestibular hair cell loss in ischaemia, noise trauma and ototoxicity. Further work in this field will facilitate continuing advances in possible treatment of such conditions (Waters 1999), including gene therapy, stem cell implants and pharmacological interventions (Seidman and Vivek, 2004; Atar and Avraham, 2005; Oshima and Heller, 2005).

Radiology

5.45 Radiology of the osseous labyrinth is of great importance in audiovestibular diagnosis and advances in imaging have allowed the assessment of the membranous labyrinth, internal auditory canal (IAC) and posterior fossa structures in ever greater detail.

5.46 On routine magnetic resonance imaging (MRI) it is possible to differentiate the scala tympani and vestibuli, to identify the vestibular and cochlear divisions of the eighth nerve within the internal auditory canal, to localise the root entry zones of the seventh and eighth cranial nerves (noting any vascular loops) and identify pathology at the site of the auditory and vestibular nuclei within the brainstem. MRI is therefore the radiological technique of choice for the evaluation of sensorineural hearing loss and vestibular disorders.

5.47 However, high-resolution multidetector computed tomography (CT) can demonstrate the otic capsule, ossicles and external canal (petrous temporal bony anatomy) in fine detail and it is now possible to identify subtle ossicular abnormalities; indeed the stapes superstructure and the footplate region is now usually visualised on more than one image. CT is the imaging modality of choice in patients with conductive and mixed hearing loss (see Case 25, p39).

5.48 Detailed radiological studies are crucial in the assessment of hearing loss and balance disorders in children to identify structural abnormalities, to define characteristic inner ear anomalies and in cochlear implant assessment to help to define the appropriate ear for implantation, and to identify the post-meningitic complication of labyrinthitis obliterans (Fig 7).

5.49 In inner ear disease, the use of high resolution cross-sectional imaging (MRI/CT) can differentiate pathological processes including inflammation, intralabyrinthine tumours and

Fig 7 SSR (simultaneous segmentation and registration) image – post-meningitis with occlusive changes in the cochlea and posterior semi-circular canal. (Reproduced with kind permission of Dr C Ludman.)

vascular events (MRI), trauma with fracture, erosive middle ear disease and 'new' diagnoses such as dehiscence of the superior semicircular canal (CT).

5.50 MRI is the most sensitive test to detect intracranial pathology of almost all types, and is the preferred modality to exclude acoustic neuroma and define brainstem pathology. Intravenous contrast injection unusually is not mandatory in most common situations. Optimal, cost-effective imaging requires an understanding of the pathophysiology of audiovestibular disease and a knowledge of radiological indications. Functional MRI and morphometry are allowing an understanding of structure versus function in both the auditory and vestibular pathways.

Public health

5.51 The most recent important development for public health in childhood hearing disorders in the UK has been the introduction in June 2002 of *universal neonatal hearing screening* allowing for early intervention and optimal habilitation (RNID, 2001).

Case 23. Deafness not due to infection.

A 14-year-old girl relocated from an African country where, already fluent in the local language and English, she was reported to have become deaf at the age of 8 years following typhoid. Her mother's sister, with whom she lived in UK, showed us a letter which described the use of streptomycin to treat an episode of tonsillitis when she was 6 years old, and further streptomycin when she had typhoid.

A literature search confirmed that there is no evidence that typhoid causes deafness and the possibility of aminoglycoside deafness was considered. Routine genetic testing confirmed the mitochondrial AG1555 mutation, which predisposes to aminoglycoside deafness

Case 24. Non-audiological tinnitus.

A 67-year-old woman was referred to the tinnitus clinic complaining of a disturbing pulsatile tinnitus. This had come on gradually and interfered with her sleep. On examination she had pale mucosae and audiometrically had a mild hearing impairment. Her tinnitus was increased on occlusion of her external auditory meatus, and reduced on compression of her carotids.

Thyroid function tests were normal but haematological indices indicated an iron-deficiency anaemia. A CT scan of her middle and inner ears indicated no glomus tumour and a Doppler scan of her carotid and vertebral arteries indicated only minimal narrowing.

Her anaemia was treated and she returned to the clinic some 6 months later, reporting that the tinnitus was much softer and no longer troublesome nor intrusive.

Case 25. A dizzy musician.

A 46-year-old amateur musician complained that for the past two years, if he played his flute too loudly or sang too loudly in a local choir, he would feel momentarily dizzy and would see the world move. In addition, he had reverberation of his voice in his right ear and, on walking, he could hear his footsteps in his right ear. Clinical examination revealed no abnormality. During auditory testing, an apparent air-bone gap was identified on pure tone audiometry although the air conduction thresholds were within normal limits. The patient also reported that he felt dizzy during stapedial reflex testing at 1000 Hz in the right ear. Vestibular testing revealed a right inner ear abnormality. Detailed CT scanning identified a dehiscence of the right superior semi-circular canal and vestibular evoked myogenic potentials confirmed the characteristic reduced threshold seen in the Tullio phenomenon.

5.52 Some forms of hearing loss and damage to the inner ear are preventable and therefore of particular public health interest. The selective immunisation policy for rubella and the introduction of measles, mumps and rubella (MMR) vaccine has significantly reduced the burden of hearing loss consequent upon these infections.

5.53 Moreover, Meningococcus C incidence has declined in recent years with the introduction of immunisation, but Meningococcus B incidence continues to cause serious consequences every year (www.hpa.org.uk).

5.54 In the general population, noise is an environmental hazard and the Department for Environment, Food and Rural Affairs have responded to this with a public consultation, while the Department for Transport, the Department of Trade and Industry and the Home Office also have a remit. Furthermore, noise at work causing hearing loss is subject to compensation by the Department of Social Security when the average impairment exceeds 50 dB. One-quarter of those exposed occupationally to 90 dB of noise over a working life will develop a hearing impairment. Under the 2005 Noise at Work Regulations (HSE, 2005), employers have a general duty to reduce the levels and impact of noise on workers, to provide hearing protection (Jones, 1996) and to educate employees.

5.55 Deafness and balance disorders in later life are associated with less successful ageing and reductions in health and in social roles (Crews and Campbell, 2004). Many of the 60% of those aged over 70 with sensorineural hearing loss may benefit from a hearing aid and the provision of digital hearing aids may improve quality of life for some. The problems of social isolation are increased greatly if there are combined visual and hearing impairments (Crews and Campbell, 2004).

5.56 It is now considered good corporate or organisational practice to provide hearing loop technology in locations where people with hearing impairment may be present. This is part of a wider culture of accessibility for people with disabilities within mainstream society.

Occupational health

5.57 Labour force surveys in the UK have estimated that over 100,000 people have deafness, tinnitus or other ear conditions caused by work, and over 18,000 more consider their ear condition has been made worse by work (Jones, 1996). It is well recognised that both hearing and balance disorders are more prevalent with age and therefore such disorders will impact more significantly at work in the future, as at present nearly one in five of all workers in the industrialised world are aged over 50 years. By 2030 half the UK population will be aged over 50, and one-third aged over 60.

5.58 Noise-induced hearing loss is a common occupational disorder in industrial countries, and a source of concern in developing countries as unregulated industry proliferates. Up to 4% of the UK population are exposed to harmful or potentially harmful noise levels (Hinchcliffe, 1994). Appraisal by an appropriately trained and experienced clinician remains paramount, there being neither signs nor symptoms specific to noise-induced deafness. Hearing conservation programmes are key to the prevention of noise-induced hearing loss.

5.59 In a random community adult sample, 20% had suffered from dizziness in the preceding month (Nazareth *et al*, 1999). Disorders presenting with acute vertigo can range from the briefly

limiting to severely disabling, and a full assessment linked to an understanding of the occupational requirements is required to ensure fitness for work. It is well documented that dizziness may lead to protracted absence from work.

5.60 Clear guidelines exist for public service workers with regard to fitness to work and vertigo, but in many professions the return to work is based on clinical judgement and common sense. In hearing and balance disorders, the audiovestibular physician may be able to provide insight into the prognosis and mechanisms for successful return to work, which are of value to the occupational physician.

6 Multidisciplinary team

Audiology

6.1 At a meeting of the Department of Health Workforce Review Team in March 2005, a definition of an audiologist was proposed:

> *Audiologists are… experts … in the quantitative assessment and rehabilitation of patients with problems of hearing and balance.*

6.2 Audiology refers to the clinical scientific discipline concerned with hearing and balance disorders and the description of the profession was outlined by the NHS Workforce Review Team in 2006. In an ideal healthcare system all audiovestibular centres would include both audiologists and audiovestibular physicians with adult and paediatric specialisation, working in parallel with otolaryngology in a multidisciplinary team. This model replicates the interaction of many medical and surgical disciplines in specialised services working jointly with expert support from healthcare scientists.

6.3 Audiologists provide a scientific approach to the measurement of physiological response levels, based on knowledge of the relevance of (psycho)acoustics, ear canal acoustics and the appropriate transform functions. This profession has specialist training in the acquisition and interpretation of electrophysiological data, and the scientific process of amplification selection, optimisation and verification and specialist scientific knowledge of all aspects of hearing aid fitting and environmental habilitation devices. Some subgroups of the profession are competent in speech-reading tuition and counselling skills.

6.4 Paediatric audiologists interpret the results of age-appropriate hearing tests in terms of hearing impairment and disability and make informed clinical decisions regarding appropriateness of amplification intervention taking into account the maturational status of the infant.

6.5 In balance-disordered patients, audiologists have specialist training in the scientific assessment of the audiovestibular system and training in peripheral vestibular rehabilitation, including specific treatments such as those for benign paroxysmal positional vertigo.

6.6 Audiovestibular physicians and audiologists have complementary skills. While each is able to assess hearing and balance function in patients of all ages, the strength of the audiologist lies in their scientific training and expertise in data collection, technology and hearing aid provision, while the strength of the physician lies in the holistic medical diagnosis and care of the patient. The best service is provided by the combined expertise of both professionals within a multidisciplinary team where each is able to provide expert advice to ensure optimal management strategies. At present there is inequitable distribution of audiologists and audiovestibular physicians nationally making this ideal rarely achievable. Without expert audiological support, physicians frequently lack optimal test and auditory rehabilitation facilities and without medical support, audiologists lack diagnostic expertise and holistic patient care. Multidisciplinary teams which do not reflect the appropriate mix of professionals result in practitioners of all kinds

extending their roles in an attempt to fill the gaps, but this is unsatisfactory if it is not underpinned by relevant training.

6.7 There is overlap in some aspects of the training, as well as the role, of an otologist, an audiovestibular physician and an audiologist (Fig 8).

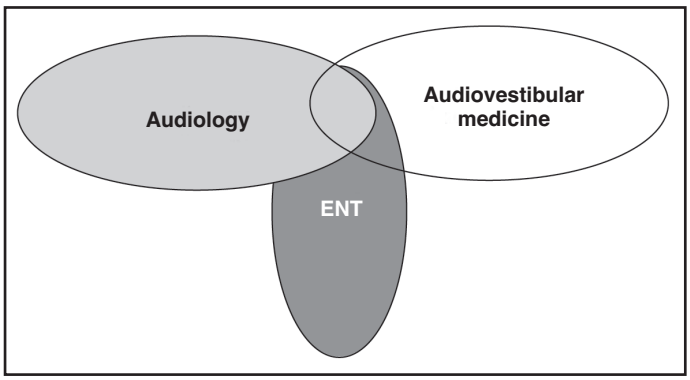

Fig 8 Overlap between audiovestibular physician, audiologist and ENT.

6.8 The higher specialty training of audiovestibular physicians as envisaged in MMC is outlined below (see section 8: Training). The Specialist Advisory Committee in Audiovestibular Medicine and the Federation of the British Association of Physicians and Paediatricians in Audiology remain in discussion with the RCPCH as to the best way to train specialists in audiovestibular medicine to serve the paediatric population. Higher surgical specialty training in otolaryngology is under the aegis of the Royal College of Surgeons, while that of audiologists is regulated by the Health Professionals Council by registration with the Royal College of Clinical Physiologists.

Speech and language therapy

6.9 Speech and language therapists specifically trained in deafness are few in number but are vital in ensuring that the often unpredictable communication needs and difficulties of deaf and deafened individuals are met. They all have additional competencies in British Sign Language.

> *Hearing impairment is not simply a deprivation of sensory input, but also a disruption of adult-child interactions and relationships.* (Wood, 1982)

6.10 In most cases, a deaf child has no fundamental impairment of either speech or language. Despite this, deafness has a significant impact on a child's ability to develop language and research suggests that even hearing losses of as little as 20 dB may have adverse implications for language development (Bench *et al*, 1979; Northern and Downs, 1991). In addition, a deaf child's language frequently ceases to develop past a concrete level. There is often a mismatch between social, literacy and cognitive needs and language skills (Gregory and Hindley, 1996), which impacts upon academic skills, emotional and behavioural development. Even children deafened relatively late in childhood may have difficulties with higher-level language skills such as inference, idiom and humour.

6.11 Communication difficulties of deafened adults and older children differ fundamentally from those of congenitally deaf people and people deafened very early in life. Deafened adults will have significant difficulties understanding others, leading to social withdrawal and reduced speech intelligibility. Strategies developed by the adult to overcome his/her difficulties often have

a negative impact on relationships. In contrast to many people who are deaf from birth, the deafened person will still be able to understand the message once it is conveyed adequately, and will have a complete speech sound system. Sudden loss of hearing in adults and children can have devastating emotional effects that impact on communication.

6.12 The audiovestibular physician may

- liaise with the speech and language therapist about medical issues which affect prognosis
- plan care pathways to include the speech and language therapist
- coordinate the audiological and medical assessment of the child with delayed or disordered speech, whether deaf or hearing.

Physiotherapy

6.13 Vestibular rehabilitation (VR) has become the standard of care for patients with dizziness and balance disorders and is best provided by physical and therapists with specialised training. This exercise approach is used to treat both primary (eg dizziness, gaze instability) and secondary (eg decreased range of movement and flexibility of neck and trunk) symptoms associated with vestibular pathology. Current work suggests that customised VR approaches directed to individual deficits provide greater improvement compared with generic exercise regimes (Black *et al*, 2000).

6.14 In addition, therapists may teach patients relaxation techniques. This may be of particular value in tinnitus, alleviating stress and tension, which exacerbate this symptom. In addition, relaxation may directly remove a cause of dizziness and imbalance if it is influenced by stress, neck tension, or hyperventilation, and may help to reduce or prevent the development of secondary autonomic symptoms which are common in patients with vestibular dysfunction (Ödkvist and Ödkvist, 1988).

Psychology

6.15 As noted in the earlier section on psychiatry (p27), psychological symptoms are common in patients with hearing and balance disorders and psychological support is crucial to the rehabilitation of many patients. The professionals involved in the provision of this service vary from unit to unit depending on resources and staffing structure and may include a psychiatrist, psychologist, psychiatric nurse and cognitive behavioural therapist.

6.16 Ideally, a clinical psychologist should be part of every multidisciplinary team providing assessment and management for child and adult patients with balance disorders and hearing impairment. In the paediatric population, access to an educational psychologist is essential to identify and advise on learning difficulties and to differentiate such problems from primary auditory problems, eg in children with auditory processing disorders which may be confused with speech and language, developmental and/or psychological disorders. In adults, the hearing impaired and deaf populations have special psychological needs, while patients with chronic vestibular disorders are particularly susceptible to anxiety, panic attacks, height and space phobias, avoidance behaviour and depression.

7 Interagency working

Education

7.1 The Department for Education and Skills has set out the following vision:

> *All children should have a good education that enables them to achieve to the full and provides a firm foundation for adult life. All children should have the opportunity to learn, play and develop alongside each other in their local community. Parents should have the confidence that their child's needs will be met. We are aiming to deliver a vision, which unlocks the potential of children who may have learning difficulties, whose life chances depend on a good education.* (*Removing barriers to achievement*, DfES, 2004)

7.2 The great majority of deaf children are educated in mainstream schools, some with the additional support of a unit or resource base. About 8% of deaf children are in special schools for the deaf – usually those deaf children who have significant additional difficulties. About 12% are educated in other types of special school. While many families choose a sign language route, either through total communication or a sign bilingual approach, the great majority of deaf children follow an oral/aural route.

7.3 Parents should be given comprehensive and unbiased information about how and where their deaf child should be educated, based on audiological diagnosis, other disabilities, prognosis and factors individual to each family. This can best be achieved through a multidisciplinary approach involving professionals in the medical and educational spheres, with an emphasis on good communication between the disciplines (MCHAS standards document). Positive teamwork which includes *all* the professionals involved within both health and education, based on mutual respect and understanding, provides the best possible opportunity for all children.

7.4 The duty of care should continue from identification of a hearing loss through to adulthood. Teachers of the Deaf support deaf babies, children and students both in the home and at school and are well placed to ensure that devices and management strategies developed with their scientific and medical colleagues work to their full potential.

7.5 The educational audiologist, trained in both teaching and audiology, can have a key role within this multiprofessional approach, ensuring a child's successful access to sound within the classroom.

7.6 The audiovestibular physician will support this by:

- ensuring the multidisciplinary team is available to the family
- sharing relevant diagnostic information with other professionals, as agreed with the family
- revising management strategies in the light of additional information from educational services.

Social services

7.7 The interrelationship of audiology departments and local social service provisions is often limited (Weaver, 2004).

7.8 In order to obtain help from social services, the person must be registered with their local social service department as being deaf or hard of hearing (Chronically Sick and Disabled Persons Act 1970; Disabled Persons Act 1981; and Carers and Disabled Children Act (2001) and subsequent amendments). Although most of those individuals who are congenitally deaf or who have a severe hearing impairment dating back to childhood are usually registered, only a tiny proportion of those whose hearing loss has developed later in adult life are registered. In recent years there has been a move away from social workers with specific remits such as Social Workers for the Deaf, to generic social workers, who have little knowledge of the particular needs of the hearing impaired. There is even less specialist knowledge about the housing and transport needs of those individuals with chronic balance disorders.

7.9 For children, the function of social work intervention, in partnership with other agencies, is to diminish barriers and give deaf children the same opportunities for development as their hearing peers (RNID, 2002b; DfES, 2004b). Although deafness is not a problem *per se*, deaf children are 'children in need' (DfES, 2000, DH 2000) and some intervention may be needed to empower deaf children and their families to make informed choices (DH, 1990). Care becomes particularly important at transition (Connexions, 2006): deaf young adults leave education earlier, start employment earlier, are more likely than their hearing peers to be out of work in their twenties and are often in low paid/unskilled jobs (DH, 1998). In practice, there is a huge variation in the availability of these services to families, who are often confused and uninformed about different agencies (DH, 1998).

7.10 Audiovestibular physicians can facilitate better interaction between social services and the hearing impaired in several ways:

- Ensure they are well informed and knowledgeable about available services and how to gain access to them.
- Develop a care plan that includes routine assessment and registration with social services, where required, to ensure that their patients' needs are defined and thus addressed by social services.
- Ensure appropriate training of specialty registrars in understanding how social services relate to health.
- Ensure appropriate education and support in primary care to enable GPs to make appropriate referrals.
- Ensure the provision of the social care needs of people with additional learning disorders.
- Promote knowledge of local services, referral and voluntary registration.
- Define the NHS contribution to strategic long-term planning for care of hearing impaired.
- Promote access needs of deaf children and adults.

Voluntary sector

7.11 The voluntary sector has a key role in promoting patient interests and concerns and in championing optimal provision of care. The British Deaf Association (BDA), Royal National Institute for the Deaf (RNID), National Deaf Children's Society (NDCS), Hearing Concern, Sense, the Menière's Society, Contact a Family and the Brain and Spine Foundation have all held high profile campaigns to raise both public and government awareness of the needs of deaf, hard of hearing and balance-disordered adults and children. This is in addition to the direct initiatives for patients and their families, including information, advice and counselling. These organisations all provide training (both to professionals, eg deaf awareness, and to patients and families), support research, lobby government and develop standards of practice (eg NDCS Quality Standards, 2000–2005).

7.12 Key roles of the audiovestibular physician include:

- recognising the complexity of needs for individual patients
- linking patients and their families with the relevant voluntary bodies at all stages of care via direct introductions, web addresses and telephone/minicom numbers
- coordinating medical management including input from small specialist providers, some of which may be in the voluntary sector, for example dual sensory impairment and Sense, adult-aquired deafness and the Link Centre.

7.13 The fact that there are so many diverse voluntary organisations and websites in this field attest to the difficulties patients have in obtaining enough knowledge or support for their condition. Feedback from the voluntary organisations supports the patients' view that where an audiovestibular physician has been actively involved, this coordination is much more likely to take place successfully and on a sufficiently broad basis.

Independent sector

7.14 The prevelance of auditory and vestibular disorders in both the paediatric and adult sectors, the long waiting lists for audiology, and the relative dearth of balance clinics have led to many patients seeking care in the private medical sector. Approximately 25% of those who need a hearing aid use the private sector. A small number of private hospitals provide a wide range of auditory investigations and auditory rehabilitation including cochlear implantation. However, the scope for sophisticated vestibular testing and care in the private sector is very limited and thus a significant proportion of vestibular testing is carried out, on a fee for service basis, in facilities within the NHS. Noise-induced hearing loss, head and whiplash injuries (with both auditory and vestibular damage) and medical negligence cases, involving birth trauma, delay or incorrect diagnosis of meningitis and inadequate monitoring of ototoxic drugs, particularly the aminoglycoside antibiotics, comprise the medico-legal workload within the specialty.

7.15 Audiovestibular physicians have not routinely been involved with the independent hearing aid sector, except in the context of giving advice to patients who wish to be provided with auditory amplification outside of the NHS. However, the independent sector began to provide NHS audiology services through the Public Private Partnership Scheme (www.18weeks.nhs.uk). It is envisaged that this activity will expand.

7.16 The HAC has been the statutory body established under the Hearing Aid Council Act (1968) to regulate anyone who dispenses hearing aids in the independent sector. To date, an audiovestibular physician may be appointed by the Secretary of State for Trade and Industry to be a member of the Hearing Aid Council (HAC) with specialist medical knowledge. The physician may be involved in the disciplinary and examination activities of the Council. Recently, a foundation degree has been developed by the Hearing Aid Council together with the British Academy of Audiology, the British Society of Hearing Aid Audiologists and the Association of Independent Heavy Health Professionals. It is intended to be the threshold entry qualification for all hearing aid audiologists working within the NHS and independent sector. The first intake of undergraduates will take place in 2007. It is envisaged that these professionals will support the additional audiology service pathways procured for the NHS and provided by the private sector as directed by Lord Warner in 2006.

8 Training

Undergraduate training

8.1 The GMC leaves details of the undergraduate medical curriculum to individual medical schools, but defines some general principles and practical procedures in which graduates must be competent (GMC, 2003). Undergraduate teaching in audiovestibular medicine is found in only one medical school in the UK. As ENT symptoms have been reported to represent one third of the work in general practice, Donnelly and co-workers (1996) reported that many GPs feel that the time allocated to training in ENT is disproportionately small. Moreover, a survey of Finnish medical graduates (Kentala *et al*, 2005) found that audiovestibular medicine was one of a number of areas which were seen as having insufficient coverage during the undergraduate course in otolaryngology.

Postgraduate training

8.2 Audiovestibular medicine in the UK evolved from neurology and this background is assuming ever greater importance as the science underpinning the pathophysiology, prevention and treatment/management of hearing and balance disorders becomes clarified.

8.3 Audiovestibular medicine has attracted candidates onto the five-year training programme from a variety of disciplines including neurology, paediatrics, rehabilitation medicine, otorhinolaryngology and general medicine. Trainees have entered higher training with a variety of postgraduate medical qualifications: MRCP, FRCS, MRCS, MRCPCH, MRCGP. It is planned that Modernising Medical Careers may lead to run-through core medical and higher specialist training but the system is new and not fully formalised and competitive entry at ST3 may remain.

8.4 As the majority of audiovestibular physicians undertake work in both paediatrics and adult medicine, there is currently a combined paediatric and adult higher specialist training programme, supported by a diploma in audiovestibular medicine. This diploma programme forms the knowledge base for the specialty and includes the theoretical aspects of the basic and clinical sciences, which underpin the practice of audiovestibular medicine, but which are not part of formal medical training, eg physics of sound, fluids and forces, acoustics and psychoacoustics, statistics, detailed microanatomy and physiology of the auditory and vestibular systems, inner ear genetics, immunology and labyrinthine pathology. Four years of clinical training ensures competency in the three core curricular subjects of audiovestibular medicine (paediatric audiological medicine, adult audiological medicine and vestibular medicine) with accompanying secondments to the relevant allied medical disciplines, eg genetics, neurology, developmental paediatrics, otorhinolaryngology, ophthalmology, psychiatry, care of the elderly.

Modernising Medical Careers

Modernising Medical Careers (MMC) aims to improve patient care by delivering modernised and focussed career structure for doctors through a major reform of postgraduate medical education. It aims to develop demonstrably competent doctors who are skilled at communicating and working as effective members of a team. (www.mmc.nhs.uk/pages/about)

8.5 The important facets of the review of training include:

- a standardised training pathway following two foundation years of general training
- demonstrable examined competencies in the clinical assessment, diagnosis, management and rehabilitation of medical conditions.

Specialty training (Appendix 4)

8.6 The path and content of specialist audiovestibular medical training is as follows:

1 After the first two foundation years, training will be undertaken either by completion of core medical or basic paediatric training before progressing into higher specialist training in audiovestibular medicine. There may be competitive entry into the specialist audiovestibular medicine programme. The specialty is seeking with the RCPCH to define a route to develop paediatric specialists in AVM as outlined in 8.7. Moreover, the specialty would wish to support entry from otolaryngology, probably into ST2 and will seek to establish a training route within the new training arrangements. (See Cases 24 and 25, p39.)

2 The specialty training in audiovestibular medicine includes basic sciences, assessment and rehabilitation of hearing and balance disorders at all ages from newborn (eg Newborn Hearing Screening Programme) to the very elderly, together with other medical conditions that impact on aetiology and management of these disorders. The clinical subject matter is unchanged from that described above.

3 Satisfactory completion of training will require a knowledge-based assessment, which is expected to be the diploma in audiovestibular medicine, and clinical competency evaluation. The diploma offers the same taught programme as the MSc in audiovestibular medicine, but does not include a research project.

8.7 The specialty recognises the overwhelming benefits for children of being treated by paediatricians in a child-friendly/family-centred environment. Currently, the training programme in audiovestibular medicine enables CCT holders to work with both adults and children. The potential advantage of specialisation in either paediatric or adult audiovestibular medicine in order to deliver highly skilled services appropriate to the needs and age of the population remains under consideration by both the Specialist Advisory Committee in audiovestibular medicine and the British Association of Audiovestibular Physicians. Such a scheme could be achieved by core training to achieve the MRCP(UK) or appropriate paediatric training defined by the RCPCH and including the MRCPCH. This primary adult or paediatric training could be followed by joint specialty training in the basic and clinical sciences allied to the practice of audiological and vestibular medicine in both children and adults. Further specialist training would be supraspecialised: paediatricians would have a predominant emphasis on paediatric audiovestibular medicine and related paediatric disciplines as agreed with RCPCH, while adult physicians would concentrate their training on the provision of adult audiovestibular medicine. The common core specialty training would ensure joint training and appropriate competencies in underdeveloped areas (eg paediatric vestibular medicine, care of the learning disabled adult) and seamless transition from paediatric to adult services. This training would be efficient of manpower and resources, while ensuring acquisition of the appropriate specialty knowledge base. It is envisaged that the

optimal future provision in an audiovestibular unit would include both a paediatrician and a physician with specialist training and a certificate of clinical training in audiovestibular medicine.

Competencies – future provision of services

8.8 The opportunity for development of enhanced multidisciplinary working and thus better provision of patient care cannot be overestimated in the context of ongoing changes in healthcare provision. Audiology and audiovestibular medicine training require certain common core knowledge and skills. Modernising Medical Careers and the establishment of a graduate audiology profession has led to a reappraisal/establishment of medical and audiology curricula and training programmes in both disciplines. Great interdisciplinary benefit and efficiency would accrue from joint training in core areas, together with common assessment of competencies. Certificates (60 credits) in subspecialties of audiovestibular medicine are being established to enable accessibility to trainees/specialists in other disciplines, for example audiology, otorhinolaryngology, paediatrics and geriatrics, who wish to expand their knowledge in a subspecialty area for their clinical practice.

8.9 A competence-based approach to training enables assessment of the capacity to integrate knowledge, values, attitudes and skills in the practice of audiovestibular medicine (BAAP/BACDA, 2004; Hager and Gonzi, 1996; Royal College of Physicians 2001).

8.10 This approach would enhance cross-discipline understanding of strengths and ensure that any professional with demonstrable competencies could perform appropriate tasks to a recognised and mutually acceptable standard. Moreover, this approach could be developed to enable senior healthcare scientists to acquire, through relevant training and competency assessment, certain 'medical' skills, which would enhance their career progression.

9 Academic audiovestibular medicine

9.1 As a relatively new specialty, established and developed during a period of continual change and economic constraints in the NHS and universities, audiovestibular medicine has a weak academic infrastructure. There is one university chair in the UK and only two junior academic posts – a clinical lecturer at University College London Hospital Trust in London and a senior lecturer in Liverpool. Two personal chairs were established in the University of Manchester and the University of Wales at Cardiff in the 1990s, but were lost in the past two years through retirement.

9.2 Over the past three years the government has recognised the need to strengthen clinical research in the UK and address the worrying decline in clinical academics. In March 2005, *Medically- and dentally-qualified academic staff: recommendations for training the researchers and educators of the future* (Modernising Medical Careers, 2005) was published. The report emphasised that special efforts should be made to support specialties with limited academic infrastructure and proposes the formation of a cohort of 'new blood' senior lecturers to promote academic development.

9.3 Audiovestibular medicine is in an ideal position to benefit from expansion of the academic training framework. Two academic clinical fellowships have been awarded in the last application round. There is a well established MSc programme at University College London and a small cohort of postgraduates undertaking research degrees, who would be keen to pursue an academic career if such options were available. An expansion of the academic base would enable training of academics, who would then be in a position to re-establish academic departments in major centres such as Manchester and Cardiff, where academic units have closed as a result of retirements.

10 Remit revisited

The information available to the Working Party allowed the following conclusions to be drawn in response to the four points of the remit.

(a) Define the role of audiovestibular medicine, as distinct from otology/ENT and audiology, and describe the unique role of the audiovestibular physician in providing optimal national audiovestibular services

Financial constraints in the NHS make cost-effective healthcare an imperative. Consultant audiovestibular physicians form an integral part of the MDT, which aims to provide prompt, accurate, resource efficient and effective care to patients with audiological and vestibular disorders. The unique role of the audiovestibular physician is two fold:

a) generically, as a consultant physician supervising the holistic care of the patient and

b) specifically, in the prevention and/or amelioration of pathology, aetiological diagnosis, interpretation of investigations in the context of medical care and medical treatment/ management/rehabilitation.

This is particularly important with respect to the translation of basic neuroscience research advances in pathological mechanisms, neurochemistry and pharmacology into the clinical domain.

(b) Understand the role of the multidisciplinary team in the light of recent developments, and define the medical input of the audiovestibular physician within the team context

The MDT is a well established, successful construct in the provision of audiological and vestibular care. Recent DH initiatives have expanded the role and numbers of healthcare scientists and highlighted overburdened medical disciplines. In addition, there is a policy shift to facilitate the provision of NHS care in the community for ease and speed of access. Within this model, the focus of the work of the audiovestibular physician is directed at supporting and integrating with the skills of all members of the MDT, but particularly otologists and audiologists, to ensure both optimal use of resources and best clinical practice. This aim is achieved by integrated training, specialist medical assessment and treatment for cases not successfully managed at the primary care level and robust multidisciplinary working across the proposed hearing and balance networks.

(c) Provide a model for audiological and vestibular services offering acute and chronic care

To meet the NHS targets of rapid, easy access to medical care, a three-tier multidisciplinary managed network of care for hearing and balance disorders is proposed. A healthcare scientist/GP-led primary care service will be developed and have access to and support from specialised centres, with audiovestibular physicians as part of the MDT. These centres, in turn, will be linked to tertiary centres with state-of-the-art facilities and medical and non-medical staff with subspecialty expertise. This will enable rapid, high quality the patient's home for the most routine

cases, with prompt and direct access to superspecialist care for complex cases, as required by current NHS directives.

(d) Clarify pathways through primary to secondary and tertiary care provided by audiovestibular physicians, for adults and children within the frameworks of the multidisciplinary teams, in audiological and vestibular services

Proposals to simplify and accelerate the patient pathway across NHS care are needed to meet current NHS reorganisation: success is achieved by identifying the correct mix of professionals, with complementary and overlapping skills and a mutual respect for each others' knowledge and efficacy in order to address the common complaints of hearing loss, tinnitus and disequilibrium. The pathways proposed in this document build on the evidence presented to the working party, taking into account the government's determination to deliver the majority of care near the patient's home. The foundation for excellence is sound medical knowledge of the principles and practice of audiovestibular medicine, whether in primary care or in more sophisticated environments, so that patients may be confident that any disease or disorder will be diagnosed and treated and the team can be confident that non-medical professional care is in the patient's best interest.

Our health, our care, our say.

Appendix 1

Criteria for direct referral to audiology services

Criteria for direct referral: Guidelines of the Liaison Group of Technicians, Therapists and Scientists in Audiology (TTSA), 1989

The following are the suggested criteria which should be satisfied before a patient referred directly to an audiology department by a GP may be fitted with a hearing aid.

1 The patient must be aged 60 or over.

2 The patient must have been seen by the GP and have both ears de-waxed as necessary.

3 Directly referred patients may be seen by any qualified audiology technician or scientist for their audiometry. The history taking, the examination of the ears and the judgement of suitability for hearing aids must be done by a technician of senior grade or by a post-probationary audiological scientist (ie following successful completion of the course leading to the BAAS's Certificate of Audiological Competence).

4 The direct referral service shall apply only to patients referred for consideration for hearing aids. No other type of ENT or hearing abnormality referral may be accepted directly from a GP.

5 The technician or scientist may not proceed with the supply of any hearing aid system without ENT (or audiological medicine) advice if any of the following conditions apply:

(a) excessive wax in either ear

(b) a perforated eardrum, an active discharge or a history of discharge from either ear

(c) otalgia affecting either ear

(d) vertigo (classically described as 'an hallucination of movement', not to be confused with the common unsteadiness often associated with age)

(e) hearing loss of sudden onset

(f) sudden deterioration of an existing hearing loss

(g) hearing loss subject to fluctuation beyond that associated with colds

(h) hearing loss where audiometry shows an average air/bone gap in excess of 30dB in either ear. The bone conduction audiometry, masked as necessary, should be tested in octaves from at least 500 Hz to 2000 Hz

(i) asymmetrical hearing losses: as an index of suspicion a difference in bone conducted thresholds of 20 dB or greater at 0.5, 1, 2 or 4 kHz may be used

(j) any other unusual presenting features at the discretion of the audiology technician or audiological scientist.

Appendix 2

Guidelines for medical referral for a specialist medical opinion on a balance disorder

The following groups should be referred for a specialist medical/paediatric audiovestibular opinion on a possible balance disorder:

- all children with persistent (ie more than one month) dizziness/vertigo or imbalance
- adults with dizziness/vertigo/imbalance and a discharging and/or painful ear
- adults with dizziness/vertigo/imbalance and unilateral cochlear symptoms
- adults with persistent, not improving dizziness/vertigo or imbalance of more than six weeks duration, whether or not they have abnormal vestibular function tests
- adults with disequilibrium of any type, associated with any eye movement abnormality other than unidirectional, recovering (over one week), horizontal nystagmus
- adults with dizziness/vertigo/imbalance with any other neurological symptom or sign
- any adult with acute vertigo who is unable to stand
- any adult with a systemic illness and auditory and/or vestibular symptoms.

Appendix 3

Manpower calculations

Data set 1: St George's Hospital, London

(Kindly provided by Drs Snashall and Raglan)

As a result of the difficulty in collecting data across specialties, hospitals and healthcare boundaries, a limited study was undertaken at St George's Hospital in south west London. St George's Hospital is the ENT base for inpatients for Wandsworth, Merton and Sutton, Croydon, Kingston and Richmond, but also draws in patients from Lambeth and Surrey. The assumption has been made that the catchment size for audiovestibular and ENT patients is 500,000.

In this hospital there are 11 ENT surgeons of whom three practise adult otology and one paediatric otology. There are 2.4 WTE audiovestibular physicians and two community paediatricians working full time in community paediatric audiology. There are 11 hospital-based qualified audiologists and three community assistant audiologists.

Expected prevalence values from national studies for the given population are shown in Table A1.

Table A1 Expected prevalence values from national studies for the given population.

	Adult	Children
Deafness more than 35 dBHL	9,000	1,000
Tinnitus (troublesome)	5,000	500
Vertigo/imbalance (persistent)	5,000	250

The number of ear operations carried out in 2004–5, excluding day cases in surrounding hospitals, is shown in Table A2.

Table A2 The number of ear operations carried out in 2004–5.

	Adults	Children
Deafness	180+*	300
Tinnitus	none**	none
Vertigo/imbalance	none*	none

* Few neurosurgery.

** Some neurosurgery.

The data on new fittings of hearing aids in 2004–5 are given in Table A3, and estimated referrals for one year are given in Table A4.

Table A3 New fittings of hearing aids in 2004–5 (MHAS and MCHAS data).

Adult Direct Access	492
Adult from ENT	120
Adult from audiovestibular medicine	120
Children all from audiovestibular medicine	29

Table A4 Referrals for one year estimated from one month's data.

Adults meeting TTSA criteria	800
Adult deaf to audiovestibular medicine	500
Adult deaf to ENT (inferred from hearing aid data)	500
Adult tinnitus audiovestibular multidisciplinary team	200
Adult tinnitus seen in ENT and referred for therapy	200
Adult vestibular seen in audiovestibular medicine	364
Adult vestibular seen in ENT could be more than	400

Comments on the data

The data for ENT referrals were difficult to obtain, as even the neuro-otology ENT clinics contained a mixture of other patients. The data were estimated on the basis that the proportion of patients with these conditions was the same across ENT and audiovestibular medicine clinics. It is known that 1 in 7 attendees at ENT outpatients at St George's Hospital require surgery.

Due to the difficulty in recruiting senior healthcare scientists in London, there are no scientists at this hospital sufficiently experienced and competent to see adults with dizziness and tinnitus, without a medical opinion. Neither can the more junior audiologists see adults not meeting the TTSA criteria for Direct Access. There were, therefore, figures for hearing aid patients seen only by audiologists, but there were no patients in this category with dizziness or tinnitus.

All those patients requiring surgery and all those seen in ENT and audiovestibular medicine clinics had quantitative audiovestibular tests undertaken by audiologists, and many patients also required rehabilitation by healthcare scientists in addition to the Hearing Aid Service.

Summary

- 3,000 hospitals referrals per year for audiovestibular conditions: 480 operations and 492 hearing aid fittings by healthcare scientists, without medical involvement.
- Approximately 2,000 patients seen either in audiovestibular medicine or ENT.

- It is likely that the proportion of patients seen between ENT and audiovestibular medicine were equal as the referrals to the hearing aid service from these two specialties were equal.

Additional comments

- St George's provides a broad, but highly expert service in AV medicine, ie there is no attachment to a falls clinic, no cochlear implant programme.
- 1,000 non-surgical patients were seen within ENT and while some overlap is inevitable greater efficiency could be achieved.
- Additional data from 108 consecutive referrals to a specialised 'dizzy' clinic show that 15% passed from ENT directly to AVP, but 64% had been seen in two or more specialist departments for 'dizziness' before referral to AVP suggesting re-duplication of referrals.

Data set 2: For a population of 500,000

The data are based purely upon published national statistics.

Adult workload

Significant hearing loss: 17% of the adult population have a significant hearing loss (Davis, 1995). Making an assumption that 75% fall within TTSA criteria then 21,250 adult (aged 18–70) hearing-impaired patients require a medical opinion: Patients/year = *409/year*.

Troublesome tinnitus: 5% of the population have troublesome tinnitus, ie 25,000 (18–70 years old, NSH): Patients/year = *480/year.*

Vertigo: one third of the population by age 60 years (Roydhouse, 1974) suffer from vertigo. One quarter require specialist medical opinion = *992/year* (Yardley *et al*, 1998).

Total adult patients = 1,881/year
No of adult operations (from St George's data) = *182/2,900 (0.06%).*
No of non-surgical cases = 1,768 new cases/year.

Paediatric workload

UK birth rate = 11 births/1,000 population, ie 5,500 annual births.
PCHI = 1.07/1,000 at birth, ie 5 new cases/year
+ *additional 5 new cases/year* in older age group (9-16) (Fortnum *et al*, 2001)
+ *additional 5/year with mild sensorineural hearing loss or unilateral loss.*

Serous otitis media: 80% of children have an episode of serous otitis media.
1–2% have serious problems. 5% have grommets.
Guestimate: 10% require a specialist medical opinion.
No of children/year born = 5,500.
Therefore number of specialist opinions required = *550/year.*

APD: US figures: 4–7% children suffer from APD.
Figure unknown for UK – guestimate 1%.
55,000 children (5–15) in population.
Hence possible 550 children for assessment, ie *50/year.*

Tinnitus: accurate figures for children are not known.
Guestimate = *50/year.*

Balance symptoms/disorders: accurate figures for children are not known.
Guestimate = *50/year.*

Paediatric new cases/year = 715 children.

Therefore, approximate new audiovestibular referral workload for population of 500,000 = 2,500 cases.

Additional work with adults and children

In the above calculations, no allowance has been made for additional sources of work that cannot be quantified, for example:

- vestibular assessment in falls clinic as per NSF for the elderly
- follow-up of patients for ongoing medical treatment/rehabilitation
- auditory and vestibular assessments as part of other disciplines' workload, eg neurology, neurosurgery (trauma), immunology/rheumatology, psychiatry
- audiovestibular input to specialised services, eg cleft palate service, cochlear implant service, joint genetic clinics, joint dual sensory impairment clinics
- work with children with speech and language disorders
- work with children/adults with multiple disabilities.

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