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Review of a consultant microbiologist's work practice—an audit

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Little is known about the exact functions and role of the consultant microbiologist, whose post in most district general hospitals (DGH) is single handed. The work pattern is not as "visible" as surgery or medicine, and therefore remains, in the main, unnoticed by all, including management. The different functions of the consultant microbiologist are inextricably linked and although there are no defined methods of assessing the various aspects, the components can be identified as separate entities.

The job of a consultant microbiologist usually includes at least three major components: (1) management of infection, which includes the clinical interpretation of relevant laboratory results; (2) hospital infection control and maintenance of quality and standards of patient care; and (3) overall management of the laboratory budget, appropriate clinical use of the laboratory facilities, and production of clinically relevant and accurate results. Education, both formal and informal, is an important component of all the above aspects; however, in a university or teaching Hospital, it may account for a proportion.

This audit was prepared following a request from management.

Methods

The collection of data took four months and was based on information available from the medical audit department, the finance department, and internally from the microbiology department from April 1992 to March 1993; the information from the first two sources was accepted at face value. Some data required for this review had already been collected and analysed for producing an infection control budget, contracts with the purchasers, and internal accounts for microbiology.

CLINICAL NOTE PADS

The pathology computer program is a MUMPS system called "computerised information laboratory management system" (CILMS) and is produced by ACT Medisys Ltd. It has an inbuilt facility for recording a "clinical note pad" which is linked to a patient whose details have been entered, and is usually associated with a microbiology specimen. This allows staff to enter all clinically relevant information relating to a patient and it can be updated as and when necessary. The information includes clinically relevant history, laboratory results, antibiotic advice offered for the management of the patient, infection control measures (if required), follow up, and outcome. The note pad is available to all laboratory staff but is usually completed by the laboratory medical staff and acts as a clinical record. The clinical note pads provide an accurate assessment of all communications by the medical staff ($\pm 10\%$) and have been recorded since July 1990, when the computer system was installed. Where a patient does not have a specimen registered, the communications are documented elsewhere, but they are not usually so accessible unless transferred onto the system at a later date. Informal communications were not recorded on the system and made up part of the 10% not documented on clinical note pads.

LABORATORY RESULT RESPONSE TIME

The laboratory medical staff, on receiving a clinically relevant report—whether preliminary or final—communicate with the appropriate clinical staff, usually junior medical staff (or in the case of HIV, with the consultant in charge). The communication of these results depends upon the urgency, and clinical relevance, perceived by the consultant microbiologist, and is documented on the clinical note pads.

Clinically relevant specimens requiring an urgent response

The time taken between receiving the preliminary or relevant final report from the laboratory work station and communicating with the clinical staff is within 4 h but usually sooner. These are usually preliminary reports, such as Gram stain, or primary isolation of a suspected pathogen from sites such as the cerebrospinal fluid or blood culture. These criteria also apply to out-of-hours results, since these were judged as requiring urgent expert advice to ensure appropriate management of the patient.

Clinically relevant specimens requiring same day communication

These reports are communicated within the same working day and are usually final reports or specimens requiring additional clinical information to complete laboratory processing. General practice specimens are usually reported on the same day.

COMMUNICATION WITH CLINICAL STAFF

Telephone calls to and from the consultant microbiologist had been logged during August 1991 and August 1992. This period was chosen

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because the hospital was covered by a single handed consultant microbiologist and all the calls were directed to one person. It also represented a more realistic picture of what happened in many other DGHs. The intake of patients during August did not vary significantly between 1991 and 1992.

CLINICAL CONSULTANT EPISODES

Clinical consultant episodes for the other directorates were provided by the medical audit and finance departments for the period of April 1992 to March 1993. These data were used to assess clinical activity by the clinical directorate.

INFECTION CONTROL

Epidemiology records have been kept by the infection control team. These included hours spent by the consultant microbiologist (and infection control nurse) on investigation, communication control, and follow up of infection control problems. Records have been kept since 1982, but only the data for the specified period are included.

Communication with medical and ward staff on maintenance and implementation of infection control protocols such as antibiotic or patient isolation is often necessary and is complementary to the clinical management of patients, particularly for pathogens with a potential to produce outbreaks. Frequent communication with the infection control nurses was necessary to ensure agreed patient protocols were followed.

A further aspect of the role of the infection control doctor (consultant microbiologist) is to advise and recommend compliance with the latest standards for planning or building in the hospital. These include high risk areas such as operating theatres, departments of catering, hotel services, occupational health, health and safety, sterile services, and purchase of medical and surgical supplies and dressings and other equipment for clinical use. As a member of the drugs and therapeutics committee, the infection control doctor (consultant microbiologist) ensures that protocols on antibiotic prescription and disinfectant usage and costs are regulated and advice on appropriate use is available.

COMMITTEE MEETINGS RELATING TO INFECTION CONTROL

This information was taken from the appointments diary and records of regular meetings relating to infection control, management, and administration associated with trust business. District based committees such as Family Health Services Association antibiotic working groups, Regional Advisory Committees, and national committees which the consultant microbiologists were expected to attend, have also been excluded.

Results

The North Middlesex Hospital Trust (NMHT) serves a population of 207 000 and provides approximately 60% of the health services to Haringey. There are approximately 500 beds (fluctuations because of ward closures ranged from 520 to 470 beds) which include acute general surgery and orthopaedics, general medicine, including an HIV ward, women and children, including a level 1·8 special care baby unit (eight bedded hot nursery with facilities for three babies who require supportive, but not intensive, treatment), paediatrics, obstetrics and gynaecology, ophthalmology, and a seven bedded intensive care unit and a six bedded coronary care unit. Laboratory and infection control services were also provided for care of the elderly and psychiatry (both directly managed units) and a large outpatient department including a genitourinary medicine clinic based at St Ann's Hospital. Similar services were provided for general practice (non-fundholders) and general practitioner open access through purchaser's contract.

There are two consultant microbiologists, both holding honorary senior lecturer contracts with the Royal Free Hospital, one of whom is the clinical director of pathology. There is a part time registrar. There are two infection control nurses, making up the infection control team with the two consultant microbiologists. The laboratory staff consists of 17 medical laboratory scientific officers (MLSOs) (made up of one grade 4, one grade 3, seven grade 2, and eight junior MLSOs), trainees, and medical laboratory assistants (MLAs). The number of specimens processed were 99 986 (taken as 100 000) and the number of tests carried out on these specimens was 126 591 for the period reported here.

Table 1 shows details of a consultant microbiologists's working hours per week spent on various activities, and outlines the total number of hours per week as a percentage of time on each activity (approximately 1/3). The time spent on committee meetings has been averaged over the year and divided into hours per week.[1]

MANAGEMENT OF INFECTION

Communication with clinical staff on the clinical relevance of laboratory preliminary or final reports, and advice on the management of infection is included here. The latter includes antibiotic treatment and compliance with established infection control protocols. There are daily joint intensive therapy unit (ITU) ward rounds and a weekly teaching ward round with the infection control team and junior medical staff (some of whom were visiting doctors from abroad). Further ward visits are either on an ad hoc basis, or by requested consultations, varying between 8 and 15 per week; advice is documented in the patient's notes.

A major part of the clinical workload consists of telephone communications, most of which relate to the management of infection and advice on infection control measures. Much of the time is spent locating medical staff to give urgent results, tracing patients because of incomplete information on the request forms, answering clinical queries, and consultations on antibiotic treatment and the management

Table 1 Allocation of time spent by the consultant microbiologist (CM) in hours per week

Activity	*Clinical advice*	*Infection control*	*Laboratory management*	*Total hours/week*
Telephone	to CM 5/d	to CM 6/d	variable	7·5
(approx 10 min/call)	from CM 4/d	from CM 3/d	3 h/week	7·5
	(1·5 h × 5 d)	1·5 h × 5 d)		3
	=7·5 h	**=7·5 h**	**=3 h**	**=18 h**
Ward rounds[1]				2·5
General	2·5 h	2 h		2·5
Special units	2·5 h	0·5 h		2·5
	=5 h	**=2·5 h**		**=7·5 h**
External commitments, eg, committees[2], education[3]	**2 h**	**6 h**	**5 h**	**13 h**
Signing reports			**6 h**	**6 h**
Total No of hours spent/week	**14·5**	**16**	**14**	**44·5[4]**
Percentage of time	32·5	35·9	31·4	

[1] Usually combined clinical and infection control ward rounds; arbitrary allocation of time to Infection Control.
[2] Averaged over a year, eg, IC Committee, planning, drugs and therapeutics, audit.
[3] Tutorials, undergraduate and postgraduate lecturing, aseptic technique courses.
[4] Includes lunch time, early start and late finish meetings.
Times have been calculated over 2 years for the same period of time and averaged out. On-call commitment has not been included.

of infection. Where relevant, telephone calls are followed up by a ward visit. This service extends to a 24 h on-call service where a consultant microbiologist is available to advise on clinical and laboratory matters. Telephone communications averaged between 10 and 15 calls per day and lasted approximately 10 minutes (table 1). On call inquiries averaged 4 per week, while telephone calls at the weekend ranged between 4 and 12 calls, with a visit to the hospital where necessary.

Of 9479 specimens, 2045 (24·5%) were considered to require a response within 4 h (table 2). Abdominal pus or pus from other sites, sputum, and central venous pressure lines yielded the highest number of positive results.

Table 3 shows that of specimens requiring a same day response 1731/3047 positive results were recorded (56·8%). Intravenous cannulas and wound swabs yielded the highest returns. Only clinically relevant results were communicated by telephone and followed up in the usual manner. The total number of positive specimens recorded annually was 3776/12 526 (approximately 30%). Results from HIV, hepatitis B, and other viral serology and culture make up a further 10%. While not all positive results are dealt with directly by the consultant microbiologist, clinically relevant negative results are communicated by the consultant.

Table 2 A breakdown of positive results considered clinically relevant and requiring preliminary reporting within 4 h

Specimen type	*Total No processed*	*No of positive results*	*Percentage positive rate*
Abdominal pus	123	89	72·3
Blood culture	4477	612	13·6
Culture from bile (during operation)	18	7	38·9
Burns	8	7	87·5
CSF	407	11	2·7
CVP lines	143	67	45·6
Orthopaedics	403	100	24·8
Pus (any site)	250	122	48·8
Sputum (unspecified)	716	76	10·6
Sputum for AFB	186	76	30·6
Sputum, mucoid	186	39	21
Sputum, mucopurulent	1614	472	29·2
Sputum, purulent	640	309	48·2
Sputum, trap	31	11	35·48
Bronchial aspirate	153	20	13
Bronchial lavage	112	19	17
Chest drain	12	8	66
Total	9479	2045	24·5

Clinical involvement

Based on the data from the pathology computer system, 2397 clinical note pads were recorded for the 12 month period specified. This was equal to approximately 100 consultations per consultant microbiologist per month (2400 specimens, 12 months, 2 consultant microbiologists). Table 4 shows the average number of inpatient consultant clinical episodes per consultant by clinical directorate. The microbiology consultations for each clinical directorate is also shown, and the table includes the service provided to general practitioners and the care of the elderly directorate from the District Services Unit. A large portion of the consultations were from the medical directorate, women and children's directorate, and the surgical directorate. General practice and care of the elderly accounted for approximately 30% of clinical service allocated time. While consultant microbiologists are not directly responsible for beds, they are involved in the management of infection across the clinical directorates.

INFECTION CONTROL

Table 5 shows the involvement of the consultant microbiologist in investigating infectious episodes and outbreaks requiring expertise in infection control. The number of actual infections was very small, but the ma-

Table 3 A breakdown of clinically relevant results requiring communication with the clinical staff within one working day

Specimen type	*Total No processed*	*No of positive results*	*Percent positive*
Abscess	247	141	57
Appendix swab	14	4	28·5
Arterial line	15	7	46·6
Bone/marrow	14	1	7
Intravenous cannulas	1044	598	57·2
Cannula site	7	2	28·2
Contact lens	206	63	30·5
Conjunctival swab	67	24	35·8
Conjunctival scrape	67	24	35·8
Endotracheal tube	35	18	51·4
Gastric aspirate	20	4	20
Placenta	29	9	31
Peritoneal swab	58	19	32·7
Tissue	68	27	39·7
Wound swab	1273	840	66
Total	3047	1731	56·8

Table 4 The total consultant clinical episodes (CCE) by directorate and the percentage of the consultant microbiologist's time spent on advice for each directorate

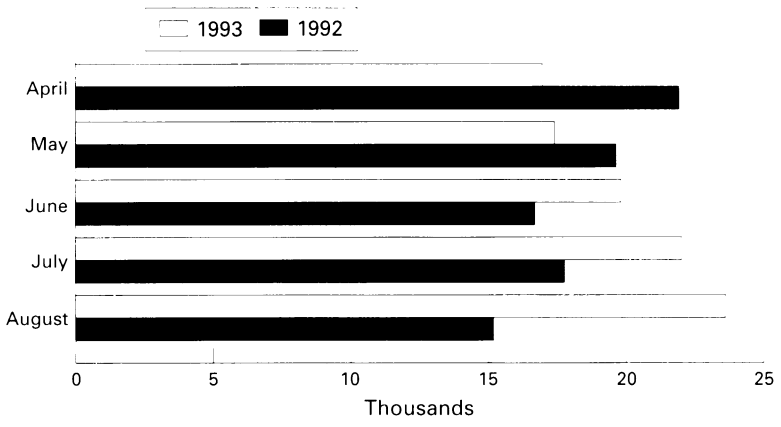
Clinical directorate	*No of consultants*	*Total CCEs for 12 months*	*Microbiological consults (CLPs)*	*Percent of CCEs*
Surgical total	12	9536	322	14·5
general	4			
urology	2			
orthopaedics	2			
eye	3			
dental	0·5			
anaesthetics	0·5			
Medical total	14	9548		41·5
general HIV	4		452	
haematology	3		148	10·3
dermatology	1·5			
infectious diseases	0·5		38	38·5
rheumatology	3		19	36·5
radiotherapy	2		69	3
accident and emergency			90	9·6
Women children	3·2 5	8727 2462		20·7
obstetrics			18	
gynaecology			129	12·7
paediatrics			172	
SCBU				
Total		30 273[1]	2314	77·4
Not in NMH Trust				
Care of elderly	3	?	214	
General practice			190	

CLP = clinical note pad.
[1] Total of all inpatient and outpatients CCEs except well babies.

Table 5 Involvement of the consultant microbiologist (infection control doctor) in investigation and management of infective episodes and outbreaks

Outbreak/infective episode	*Directorate*	*No of patients screened*	*No of staff screened*	*Time (h) spent by ICD*
MRSA (5)	Care of the elderly	131	61	15
Pen^r pneumococcus (3)	Paediatric	24	18	6
Pen^r pneumococcus (2)	Care of the elderly	10	0	4
Respiratory tract infection (viral) (5)	Care of the elderly	8	0	4
Vibrio cholerae (1)	Paediatric	19	16	2

ICD = infection control doctor; MRSA = methicillin resistant *Staphyloccus aureus*; ( ) = number of cases affected during the outbreak or infective episode; Pen^r = pencillin resistant.



Cost of antibiotics, April to August 1992 v April to August 1993.

jority of the time was spent on advising, reinforcing policies, and reassurance of the ward staff. NMHT has been relatively clear of major outbreaks and only one case of cross infection between patients has been recorded since 1987. The investigation of clinical infectious episodes in table 5 shows three and two investigations in the care of the elderly wards and the paediatric wards respectively. The reasons for investigating penicillin resistant *Streptococcus pneumoniae* in a child was that this was the first incident at the hospital and a member of staff was found to be a nasal carrier. While investigating a case of *Vibrio cholerae* four nurses developed diarrhoea; this was not found to be related but the episode required detailed investigation. The cost of investigating each of these episodes ranged between £1200 and £7500.

Effects on costs

It is difficult to assess the cost-effectiveness of implementing good infection control policies but there have been two areas of note where a change in implementation of policies affected cost. (1) The figure shows the effect on antibiotic usage over a specified period when compared over two years—direct intervention and implementation of the policy during the first year was replaced in the second year by less stringent monitoring by the consultant microbiologist; an increase of approximately £2000 per month was noted. (2) An increase in infections associated with intravenous devices (blood stream isolates associated with central venous lines increased from 12% to 45%) was documented but is not shown here.

LABORATORY MANAGEMENT

The day to day activity included authorisation of clinically relevant reports in accordance with established laboratory protocols. Where further investigation into clinically relevant specimens is required, the laboratory staff were advised accordingly. Laboratory based protocols are devised in conjunction with the clinical staff (users of the service) to provide the highest affordable quality and standards of results; the role of the consultant microbiologist here is to liaise with the clinical staff and improve general management and the use of resources. Weekly laboratory meetings include aspects on accreditation, audit, quality control results, protocol amendments, and general administration. During the period in question, considerable time had been invested in complying with COSHH (Control of Substances Hazardous to Health) regulations and other health and safety aspects of laboratory practice.

EDUCATION

As an associated teaching hospital, a considerable amount of teaching of both undergraduate and postgraduate students is undertaken for junior medical staff, medical students, nurses, physiotherapists, and other non-medical staff. Teaching of medical students at the associated medical school is also required. The outcome of formal and informal teaching programmes (table 6) shows that maximum benefit is derived from constant reinforcement of policies.

Discussion

To our knowledge, and despite extensive search of published reports, there is no information on the work practice of consultant microbiologists or any other specialty. This review is the first time an attempt has been made to

Table 6 Outcome of infection control (IC) education at the North Middlesex hospital based on feedback from attendees, questionnaires, and ward visits after 6–8 weeks and then within the year

Type of education	*Hours/year by IC team*	*Short term outcome*	*Long term outcome*
Formal lectures	200	Basic issues reinforced	Forgotten 90%
Practical training	30	One to one teaching—good	Remember issues relevant to self protection
Reinforcement of policy by phone or ward visits	6 h/week × 52	Immediate effect only	Need constant reminding

identify the components of a consultant microbiologist's workload.

Most consultant microbiologists are single handed and carry out all the functions described above without differentiating them into the respective components. It has not been customary in the NHS to log calls or record communication on clinical matters except in the patient's notes. It is important, particularly for specialties like medical microbiology, to collect data which give an approximate apportionment of time and the appropriate utilisation of resources. Therefore logging activity for a specified period of time, although time consuming, gives some idea of how the time is spent. Two thirds of a consultant microbiologist's time is spent on infection control and management of infection, while a further third is spent on laboratory business. A survey carried out by the Association of Medical Microbiologist's clinical services committee on behalf of the Department of Health showed that 89% of infection was managed by consultant microbiologists (infection control doctors), of whom 70% were single handed (unpublished data).

There has been some criticism of consultant microbiologists, who are perceived to be mainly laboratory based and to rarely visit the wards. It should be noted that often one consultant microbiologist is required to cover several (up to five) small but widely dispersed hospitals or clinical units and therefore may be physically unable to visit each one on a regular basis; telephone communications may thus exceed those documented here.

What becomes clear from this review is that there are at least three major components to a consultant microbiologist's job, and, depending on the local circumstances, any one of these may take priority over another. For example, during an outbreak, the time spent on investigation, management, and control may be far more than the one third normally expected, and by definition, takes away from the other commitments. While these roles are inextricably linked, the cost-benefit of employing a consultant grade with the capability of performing the task of three people is self evident.

Laboratory results are based on locally agreed protocols, and only clinically relevant information is reported. In comparison, in countries where microbiology is not consultant led the quality and standard of laboratory practice requires considerable attention. In the United Kingdom, antibiotic reporting is restricted to those antibiotics contained in locally agreed protocols—which in turn allows the pharmacy to stock fewer antibiotics—and guidelines are available for junior doctors. This policy is reflected in the antibiotic sensitivity patterns in hospitals. Compared with countries where antibiotic reporting is unrestricted, by and large bacterial strains in the United Kingdom show less antibiotic resistance.

Response times for clinically relevant specimens and timely clinical advice improves patient management and reduces the costs (and possibly length of stay). If one relied entirely on the routine turn around times for reports, an extra 48 to 72 hours may be added to the appropriate management of patients. The consultant microbiologist liaises between the laboratory and clinical activity of the hospital and helps to maintain the quality of reports and appropriate processing of specimens. This controls excessive investigation and waste of laboratory resources and improves clinically relevant reporting. The on-call services helps to maintain locally agreed protocols, whether they be on the use of antibiotics or on hypodermic needle injuries. All such out-of-hours inquiries receive the attention of a person consultant grade or deputy. This helps to reduce confusion among junior doctors (particularly locums) regarding infection and antibiotic advice.

The infection control expertise relating to the day to day hospital practice is important in maintaining a high standard and an overall safe environment. Appropriate advice on planning and building can save substantial sums in the long term and also helps to avoid major disasters. The remit of the consultant microbiologist is broad and this may be the reason why they are not as "visible" as their clinical colleagues.

1 Mehtar S. How to cost and fund an infection control programme. *J Hosp Infect* 1993;25:57–69.