

Leading articles

Training and dealing with errors or mistakes in medical practical procedures

The complexity of treatment, procedures, interventions, and workload of modern, inpatient paediatric and neonatal care provides a setting where errors may, potentially, have serious adverse consequences for our patients. For the purpose of this article, an error is defined as clinical performance which deviates from an ideal and, as a result, could (or does) lead to an accident or an iatrogenic incident.^{1 2} Active errors are those that immediately precede an adverse event and latent errors are factors inherent to a system (for example, heavy workload, inadequate maintenance of equipment, or the prevailing professional culture) that provide the conditions in which an accident is inevitable if given the right set of circumstances. Since all physicians involved with acute or emergency care may be expected to perform practical procedures,³ we need to understand why our patients sometimes suffer as a consequence of a procedure, what mistakes occur, and how we can improve on our performance.

The scale of complications and deficiencies in practical skills

“All doctors, however experienced and conscientious make mistakes”.⁴ In the acute setting, in paediatric intensive care practice, Stambouly *et al* prospectively assessed the extent and consequence of human error.⁵ In their experience, 115 complications occurred during 83 of 1035 consecutive admissions over an 18 month period. In all, 5% to 17% (95% confidence interval (CI)) of these complications were procedure related. Human error was involved in 41 (95% CI, 27% to 45%) of these instances, 21 of which were considered to be of such consequence to the patient that life was threatened or that further therapy, specific to the intensive care unit, was deemed necessary. The extent of these problems is not only limited to the intensive care unit. In the emergency room, management skills of front line paediatricians may also be suboptimal. Among 34 paediatric trainees responsible for after hours emergency care in Adelaide, Australia, Brady and Raftos⁶ found that, when assessed by a questionnaire and mock clinical resuscitation, the average trainee was deficient in one quarter to one third of the theoretical precepts considered important for acute care. Furthermore, on average, the trainees required two minutes to establish effective bag–valve–mask ventilation in an infant manikin. The situation is probably similar in America. In 45 paediatric residents in a university based training programme, White *et al* reported that although housestaff (individuals trained in the American Heart Association “Pediatric Advanced Life Support”) were generally able to reach the endpoint of four key resuscitation skills, they less frequently achieved the specific subcomponent of each skill.⁷ For example, in the assessment of emergency defibrillation, almost 90% of the participants discharged the defibrillator when required, but the median time for successful skill completion was dangerously long, 149 seconds. In this context, the performance of UK trainees is likely to be no different to the above experience in Australia and America.⁸

Teaching practical procedures and the influence of self efficacy

One response to the previous section is to suggest that greater attention to detail during training is needed. Certainly, there is much to be improved in the way we teach practical skills during on the job training^{9 10}: how to plan ahead; how to take a long procedure, break it up into small bites, and adopt a detailed step by step approach; and how to give supportive feedback and get the trainee to have insight into the best path for improvement. However, other psychological factors may be equally important. Simon and Sullivan¹¹ examined “confidence in performance” of paediatric emergency medicine procedures in a cohort of 117 emergency department physicians who were all required to treat children. The authors rated the physicians on a four point scale of comfort (1, comfortable; 2, moderately comfortable; 3, uncomfortable but would perform in an emergency; 4, uncomfortable and would never perform) for all procedures in which the American Academy of Pediatrics recommended competence for paediatric emergency specialists. More than one quarter of the cohort were uncomfortable (grades 3 and 4) with performing certain life saving procedures, even for tasks such as tracheostomy replacement, chest tube placement, and intraosseous line placement.

Taken together with the previous section, we can conclude that, despite appropriate knowledge and training, in an emergency, resuscitation techniques and practical procedures may fail to be skilfully applied unless the operator also has an adequately strong belief in their capability. This attribute should not be confused with self confidence which is a relatively stable general personality trait and may or may not be founded in reality. Rather, such belief or “self efficacy” may vary within an individual depending on the particular task or situation. Maibach *et al* have addressed the importance of this issue to training in post-resuscitation procedures.¹² For example, for the trainee, it is important to recognise that self efficacy beliefs may influence performance: such behaviour may be apparent from particular practical choices one makes, or even specific tasks avoided. For the trainer or supervisor, it is important to ensure that the trainee experiences success and mastery with the practice and application of practical skills, even if it is vicarious and incomplete at first.

Trainee’s response to medical mistakes

One consequence of medical training is being initiated into the experience of either having done something to a patient which had a deleterious consequence or else having witnessed peers do the same. Before considering how clinicians respond to their mistakes, it is important to first acknowledge that within a blame culture there may be personal or institutional reasons why professionals in training might respond in a particular manner to a mistake, especially when there are questions of culpability and responsibility. As a result of these pressures, defensive responses are commonly seen: such responses may not be justified but we do need to recognise them if we are to make changes for the better. In this regard, almost 20 years ago,

Table 1 Varieties of unsafe acts and the human factor

Intent	Type of error	Aetiology	Potential promoting conditions
Unintended	Slips in attention	Intrusions Omissions Misordering	Hostile working environment Workload Lack of protocols and guidelines
	Lapse in memory	Losing one's place Forgetting items	Poor machine or tool to person interface Monotony and boredom
	Mistake	Rule based	Poor experience and skill mix of staff Misperception of risks
Deliberate	Mistake	Knowledge based Rule based Knowledge based	Perceived licence to break rules Conflict or poor morale which impairs "asking for help"
	Violation	Short cuts	Ambiguous or apparently meaningless rules
		Optimising for some goal unsafely One off breaches Sabotage	Belief that bad outcomes do not happen Culture that encourages risk taking Poor supervision and checking

Adapted from Reason.^{1, 15}

Mizrahi¹³ observed that, when such events occurred, junior medical staff used a variety of collectively acquired psychosocial coping mechanisms for defining and defending their various mishaps. For example, denial, which resulted in one of three responses: negation of any thought of error by emphasising that the practice of medicine was an art and so not easily subject to rigorous analysis; repression of the facts; or revision of the event by redefining mistakes as non-mistakes. Alternatively, the process of discounting was sometimes used. In this form of defence, blame was externalised to circumstances beyond the control of the individual physician concerned and directed towards other staff, or the disease process, or even the patient. Last, when a mistake could not be denied or discounted, junior clinicians resorted to distancing techniques.

These responses may, however, have more important and far reaching consequences on career development and practice. In an anonymous questionnaire study, Wu *et al* reported that 114 of 254 (95% CI, 39% to 51%) house officers in internal medicine said that they had made a serious medical mistake.¹⁴ Multivariate analysis of data from this group indicated that those who coped with their mistake by accepting responsibility were more likely to make constructive changes to their practice, but to experience more emotional distress. Whereas those who coped by escape-avoidance were more likely to report a defensive change in practice.

Mishaps and analysing the human factor

All mishaps have both a context in which they occur and a chain of events from which they appear to have arisen. By examining these ingredients of an accident and by looking at aspects of the ensuing organisational process, such as communication, stress, and supervision, it should be possible to identify an accident's key elements or potential causes.¹ Such an approach can also be applied to the assessment of the human factor in iatrogenic medical events.¹⁵ For example, the nature and anatomy of an accident can be categorised according to the scheme shown in table 1. Briefly, in this framework, the occurrence of an unsafe act can be analysed according to whether it was the result of an error or whether it was the result of some deliberate deviation from a regulated code of practice. These events can then be described as being either "unintended" or "deliberate" and represent detrimental acts committed by those at the "sharp end" or front line of practice. Latent factors are the inevitable consequence of some remote decision, made some time previously, or they

are the result of fallible organisational systems. These "in built" dormant faults may not necessarily be evident to those working at the sharp end of a particular system. Alternatively, there may be potential promoting conditions within the working environment.

When applying the above structure to the study of a particular procedure related incident, the main purpose—beyond identification and categorisation—is to enable a reasoned approach to understanding why a particular event has occurred and what can be learned from it. For example, this analysis may provide insight into whether the person at the sharp end of an event has committed a rule based mistake—that is, misapplication of a rule which may be perfectly alright in other circumstances. Alternatively, in the event of a violation, categorisation may help to signify personal and institutional features which have produced, promoted, and permitted such an event.¹⁶

Conclusion

Practical procedures are an integral part of inpatient paediatric care and physicians must know how to perform these safely and effectively. Near misses and actual mishaps, unfortunately, are inevitable. Aside from issues such as personal recrimination, peer review, patient complaint, and legal action, we must both teach and learn how to deal with iatrogenesis in a constructive manner. In this context, one successful approach has been the "critical incident technique" used, originally, in World War II as an objective method for selecting recruits with the appropriate skills to become successful pilots.¹⁷ In this method, factual accounts of incidents that were related to successful outcome or failure were collected and used to measure performance and change training. The emphasis was with the incident and not the apportioning of blame to the individual concerned. In medicine, application of this technique has been applied to the practice of anaesthesia and intensive care¹⁸: where, at best, the process results in defining the core skills needed for practice within a certain area, the development and dissemination of new, safety conscious guidelines, and the timely identification and alerting of potential system inadequacies.¹⁹ Similarly, in paediatric cardiothoracic surgery, application of a similar technique to a cluster of surgical failures led to retraining²⁰; an exemplary description of failure stimulated professional conduct. Training and maintaining practical expertise among paediatricians should be no less stringent. There is, therefore, a need to adopt approaches which will enable us to audit and investigate our own performance,²¹ not least because they will also engender good professional habits, a system of self appraisal and, if necessary, insight into when to seek retraining.

The author wishes to acknowledge the helpful comments given by Nandu Thalange, Specialist Registrar in Paediatrics, and Robert Ross Russell, Clinical Director of Paediatrics, Addenbrooke's Hospital, Cambridge.

ROBERT C TASKER

Department of Paediatrics,
University of Cambridge School of Clinical Medicine,
Addenbrooke's Hospital, Hills Road,
Cambridge CB2 2QQ, UK
email: rct31@hermes.cam.ac.uk

- Reason JT. *Human errors*. Cambridge: Cambridge University Press, 1990.
- Runciman WB, Sellen A, Webb RK, Williamson JA, Currie M, Morgan C, Russell WJ. Errors, incidents and accidents in anaesthetic practice. *Anaesth Intensive Care* 1993;21:506-19.
- The Advanced Life Support Group. *Advanced paediatric life support*. London: BMJ Publishing Group, 1997.
- Short D. Learning from our mistakes. *Br J Hosp Med* 1994;51:250-2.
- Stambouly JJ, McLaughlin LL, Mandel FS, Boxer RA. Complications of care in a paediatric intensive care unit: a prospective study. *Intensive Care Med* 1996;22:1098-104.
- Brady RM, Raftos J. Emergency management skills of South Australian paediatric trainees. *J Paediatr Child Health* 1997;33:113-16.

- 7 White JR, Shugerman R, Brownlee C, Quan L. Performance of advanced resuscitation skills by pediatric housestaff. *Arch Pediatr Adolesc Med* 1998;**152**:1232–5.
- 8 Buss PW, McCabe M, Evans RJ, Davies A, Jenkins H. A survey of basic resuscitation knowledge among resident paediatricians. *Arch Dis Child* 1993;**68**:75–8.
- 9 Hargreaves DH, Bowditch MG, Griffin DR. *On-the-job training for surgeons*. London: Royal Society of Medicine Press, 1997.
- 10 Toghiani PJ. *Essential medical procedures*. London: Arnold, 1997.
- 11 Simon HK, Sullivan F. Confidence in performance of pediatric emergency medicine procedures by community emergency practitioners. *Pediatr Emerg Care* 1996;**12**:336–9.
- 12 Maibach EW, Schieber RA, Carroll MF. Self-efficacy in pediatric resuscitation: implications for education and performance. *Pediatrics* 1996;**97**:94–9.
- 13 Mizrahi T. Managing medical mistakes: ideology, insularity and accountability among internists-in-training. *Soc Sci Med* 1984;**19**:135–46.
- 14 Wu AW, Folkman S, McPhee SJ, Lo B. How house officers cope with their mistakes. *West J Med* 1993;**159**:565–9.
- 15 Reason JT. The human factor in medical accidents. In: Vincent C, Ennis M, Audley RJ, eds. *Medical accidents*. Oxford: Oxford University Press, 1993:1–16.
- 16 Reason J. Human error: models and management. *BMJ* 2000;**320**:768–70.
- 17 Flanagan JC. The critical incident technique. *Psychol Bull* 1954;**51**:327–58.
- 18 Wright D, Mackenzie SJ, Buchan I, Cairns CS, Price LE. Critical incidents in the intensive therapy unit. *Lancet* 1991;**338**:676–8.
- 19 Vincent C. The study of errors and accidents in medicine. In: Vincent C, Ennis M, Audley RJ, eds. *Medical accidents*. Oxford: Oxford University Press, 1993:17–33.
- 20 de Leval MR, Francois K, Bull C, Brawn W, Spiegelhalter D. Analysis of a cluster of surgical failures. Application to a series of neonatal arterial switch operations. *J Thorac Cardiovasc Surg* 1994;**107**:914–23.
- 21 Vincent C, Taylor-Adams S, Chapman EJ, Hewett D, Prior S, Strange P, Tizzard A. How to investigate and analyse clinical incidents: Clinical Risk Unit and Association of Litigation and Risk Management protocol. *BMJ* 2000;**320**:777–81.

Intracytoplasmic sperm injection and other aspects of new reproductive technologies

Louise Brown was 21 in 1999. Since her birth, in vitro fertilisation (IVF) has become a widely used treatment for the subfertile couple. Currently about 1% of births in the United Kingdom follow conceptions in vitro. Certain forms of subfertility, largely those derived from male problems (affecting up to 40% of subfertile couples), cannot be treated by conventional IVF, and the development of intracytoplasmic sperm injection (ICSI) has allowed some of these couples to conceive.

What is ICSI?

ICSI was developed in humans in Belgium in 1992.¹ The procedure involves injecting a single sperm into an egg using a micropipette one fourteenth the diameter of a human hair. The spermatozoa can be obtained either after ejaculation or after aspiration (directly) from the testis or epididymis (percutaneous epididymal sperm aspiration). The spermatozoa are prepared by washing away seminal plasma and, where possible, separating the progressive (most) motile sperm from cellular debris. Poorly motile or abnormally shaped sperm are not usually selected for injection, unless no normal appearing sperm are available in the preparation. Progressive motile sperm are slowed down in polyvinylpyrrolidone, which increases viscosity of the medium and permits a better spermatozoon selection. Immobilisation is performed by crushing the tail of the spermatozoon with the injection pipette. This disturbs the membrane potential, appears to improve fertilisation, and prevents the tail of the sperm damaging the ovum cytoskeleton. If apparently normal fertilisation occurs, up to three of the resulting embryos are transferred to the uterus 48 hours after egg collection using a standard procedure in which a fine flexible catheter containing the embryos is passed through the cervix into the uterine cavity, and the embryos are expelled in a minimal quantity of medium.

Use of ICSI

ICSI is a major adjunct to conventional IVF and has been rapidly introduced world wide. More than 100 centres in the United Kingdom and more than 750 centres in the European Union are now performing ICSI (figures from the Human Fertilisation and Embryology Authority/European Society of Human Reproduction and Embryology).

On the basis of 1997 birth rates and assuming that 25% of IVF procedures involve ICSI, at present, there are some 10 000 "ICSI births" a year in the European Union. The use of ICSI is increasing so much that, in Belgium, as many as 60% of IVF cycles involve an ICSI procedure. One of the main reasons for the popularity of ICSI is that couples who are paying for treatment believe that their "take home baby rate" will be higher if ICSI is performed (for male factor problems), although this has not been confirmed by a randomised controlled trial.² Increasingly ICSI is used for "non-male factor" problems such as tubal malfunction or "unexplained infertility" where fertilisation was poor or failed with normal IVF. This is in addition to the standard indication of oligozoospermia (often with coincident asthenozoospermia (poorly motile sperm) and teratozoospermia (abnormal forms)). More recently other advances in reproductive technologies have resulted in still further potential applications for ICSI (discussed below).

Why are there concerns about the safety of ICSI?

There is no suitable animal model—that is, an infertile primate—on which to test the technique, so the safety of ICSI could not be assessed on animal models before introduction. ICSI involves bypassing sperm natural/competitive selection by the use of a single spermatozoon.

The following concerns have arisen.

- (a) The risks of using sperm that potentially carry genetic abnormalities: it is thought that oligozoospermic males carry a higher rate of genetic defects.³
- (b) The risks of using sperm with structural defects: although there is no absolute evidence that teratozoospermia (abnormal phenotype) represents an abnormal sperm genotype, these sperm would not normally be those that fertilise.
- (c) The potential for chemical and mechanical damage: chemical damage could arise from agents injected into the egg within the medium, including sperm slowing agents—for example, polyvinylpyrrolidone—or there could be mechanical damage to the ovum from the injection process.
- (d) The risk of introducing foreign material into the oocyte: some culture media may contain heavy metals known to be toxic to sperm.⁴ The description of mammalian transgenesis by ICSI⁵ has shown the most convincing evidence (so far) that inadvertent transfer of exogenous DNA into the ova by ICSI could occur. Perry and colleagues⁵ co-injected unfertilised mouse oocytes with sperm heads and exogenous DNA encoding a green fluorescent protein, with 20% of offspring expressing the integrated transgene. The risk of infection by exogenous gene expression or integration into ICSI embryos has also been inferred by the work of Chan and colleagues⁶ using rhesus monkeys. They have shown that exogenous DNA bound to sperm before insemination could be transferred to rhesus ICSI embryos, but was excluded from IVF embryos because of the sperm-egg interactions before sperm penetration.

Recent concerns

There are new as well as continuing concerns. For example, Dowsing *et al*⁷ have suggested the greater possibility of the transmission of trinucleotide repeat sequences from ICSI treated fathers to future generations. Excessive amplification of these trinucleotide repeat sequences is associated with the increased risk of neurodegenerative disease.⁸

Equally disturbing are reports by Schatten and colleagues⁹ in Oregon using ICSI in rhesus macaque monkeys. In a standard ICSI procedure, the injection pipette is polarised at 90° to the (visible) first polar body. This is to avoid damage to the (invisible) first meiotic spindle, to which it has been assumed there is a fixed relation. Schatten has dismissed this assumption. Using fluorescent markers, he has shown that the relation between the first meiotic spindle and the first polar body is not fixed. Thus the injecting micropipette may damage the first meiotic spindle (with unknown consequences). It is possible that injection into the region containing the spindle could result in chromosome damage or chromosome misalignment.

What is known about outcome?

Most early ICSI programmes started in 1994–1995, and the eldest children are now only 5–6 years old. However, there are several early outcome studies on ICSI offspring. The large series by Bonduelle and colleagues^{10–11} has provided some reassurance. However, most of Bonduelle's reports lack a control group. Her work has suggested an increase in sex chromosome abnormalities in ICSI offspring,¹¹ but this needs to be confirmed in a larger sample. Other reports^{12–13} about perinatal outcome of ICSI conceived children have been reassuring and include the recent report by Loft *et al.*,¹² which involved all Danish born ICSI children. Interim findings of a United Kingdom based population study¹⁴ have suggested that ICSI conceived toddlers are healthy in relation to a normally conceived control group. Less reassuring was the report by Bowen and colleagues¹⁵ suggesting that a single centre Sydney born cohort of children were developmentally delayed at the age of 1 in relation to a normally conceived control group. This study had a number of limitations including lack of power, multiple observers, unstandardised testing systems, and failure to allow for confounders.¹⁶

Severe idiopathic oligozoospermia (about 60% of ICSI treated patients in the United Kingdom) is now recognised in 10% of cases to be associated with specific gene deletions on the Y chromosome. Such deletions occur in the AZFc (azoospermia factor) region of the Y chromosome¹⁷ and other related genes. ICSI conceived boys from these fathers will inherit these Y chromosome microdeletions and will need ICSI themselves to become fertile unless there are further advances (as will their male offspring).

Future studies

A European collaborative group involving Belgium, Denmark, Greece, Sweden, and the United Kingdom is performing a developmental study examining child and family welfare at school entry.

The best way to deal with the issue of congenital abnormalities is through a birth registry of ICSI children. In the United Kingdom, a birth registry is planned, and agreement in principal has been obtained from 98% of United Kingdom ICSI centres to collaborate.¹⁸

More recent developments in new reproductive technology

ICSI appears to be useful for other recent developments in fertility treatment where there may be a shortage of gametes.

EXTENDED EMBRYO CULTURE

In standard IVF, embryo transfer normally takes place at 48 hours, but embryo implantation rates may improve if the in vitro culture period is extended to five days—that is, with transfer taking place at the blastocyst stage.¹⁹

IN VITRO MATURATION OF OOCYTES/TOWARDS SINGLE EMBRYO REPLACEMENT

In another development, immature oocytes²⁰ are being harvested and matured in vitro and then fertilised. This in vitro maturation may produce eggs of more certain quality than by the present practice of hormonally stimulated polyovulation producing ova of uncertain maturity. Better oocyte quality results in better embryo quality.²¹ At present, after hormonally stimulated polyovulation, these variable quality/maturity oocytes are harvested. These are then fertilised and typically two apparently normal embryos are replaced. In vitro maturation may obviate the need to replace two such embryos with the replacement instead of one better quality embryo.

Alternatively there are increasing advances in embryo scoring,²² which will allow the selection of a single better quality embryo after a standard procedure. These advances in turn may solve a fundamental problem of current IVF treatment, namely the birth of twins, triplets, and other higher order births.

ADVANCES IN FREEZING

Cryopreservation of oocytes is a technique developed to preserve oocytes of patients undergoing cancer treatment or for oocyte donors. Cryopreserved oocytes require ICSI for fertilisation (after thawing) because the cryopreservation process brings about changes in the zona pellucida preventing sperm penetration.² Only cryopreservation of mature oocytes has been successful. There has been a first report of successful cryopreservation of postpubertal ovarian tissue and reimplantation into the same patient²³ after previous oophorectomies.

IMMATURE GERM CELLS

This has led to speculation about the possibility of cryopreservation and subsequent reimplantation of immature, prepubertal germ cell tissue after children have been treated for cancer and also the separate possibility of the in vitro maturation of primordial germ cells. These are of unknown risk.

A mouse named Eggbert has been born after the first successful maturation from a primordial germ cell. Eggbert died young and was obese, diabetic, and had developed intestinal lymphosarcoma.²⁴ Critically these problems developed after full physical maturity was attained.²⁴

Conclusions

Although evidence to date suggests that ICSI conceived children are healthy, it is unsafe to draw any conclusions about their long term wellbeing. Caution needs to be exercised when considering the implications for potential children whose parents have conceived with help from these new reproductive technologies. Although infertility sometimes has devastating effects on a person's sense of completeness and self worth, the health of the child should be paramount in further developments of these new techniques.

I would like to thank Laura Hewitson (USA), Dagmar Gutmecht (Holland), Sue Avery (Cambridge), and Ben Lloyd who have commented on earlier drafts of the manuscript.

ALASTAIR G SUTCLIFFE

Lecturer in Child Health,
Royal Free and University College School of Medicine,
University College London, Royal Free Campus,
London NW3 2PF, UK
email: icsi@rfl.ucl.ac.uk

- Palermo G, Joris H, Devroey P, Van Steirteghem AC. Pregnancies after intracytoplasmic injection of single spermatozoon into an oocyte. *Lancet* 1992;**340**:17–18.
- Kazem R, Thompson LA, Srikantharajah A, Laing MA, Hamilton MP, Templeton A. Cryopreservation of human oocytes and fertilization by two techniques: in-vitro fertilization and intracytoplasmic sperm injection. *Hum Reprod* 1995; **10**:2650–4.
- Feichtinger W, Obruca A, Brunner M. Sex chromosomal abnormalities and intracytoplasmic sperm injection. *Lancet* 1995;**346**:1566.
- Miesel R, Drzejczak PJ, Kurpisz M. Oxidative stress during the interaction of gametes. *Biol Reprod* 1993;**49**:918–23.
- Perry AC, Wakayama T, Kishikawa H, *et al.* Mammalian transgenesis by intracytoplasmic sperm injection. *Science* 1999;**284**:1180–3.
- Chan AWS, Luetjens CM, Dominko T, *et al.* Transgenic ICSI: transgenic embryo creation by intracytoplasmic sperm injection. *Molecular Human Reproduction* 2000;**6**:26–33.
- Dowling AT, Yong EL, Clark M, *et al.* Linkage between male infertility and trinucleotide repeat expansion in the androgen-receptor gene. *Lancet* 1999; **354**:640–3.
- Vogt PH. Risk of neurodegenerative diseases in children conceived by intracytoplasmic sperm injection? *Lancet* 1999;**354**:611–12.
- Hewitson L, Dominko T, Takahashi D, *et al.* Unique checkpoints during the first cell cycle of fertilization after intracytoplasmic sperm injection in rhesus monkeys. *Nat Med* 1999;**5**:431–3.

- 10 Bonduelle M, Aytoz A, Wilikens A, *et al.* Prospective follow-up study of 1987 children born after intracytoplasmic sperm injection (ICSI). In: *Treatment of infertility: the new frontiers*. New York: Communications Media for Education, 1998:445–61.
- 11 Bonduelle M, Wilikens A, Buisse A, *et al.* Prospective follow-up study of 877 children born after intracytoplasmic sperm injection (ICSI), with ejaculated epididymal and testicular spermatozoa and after replacement of cryopreserved embryos obtained after ICSI. *Hum Reprod* 1996;11(suppl 4):131–55.
- 12 Loft A, Petersen K, Erb K, *et al.* A Danish national cohort of 730 infants born after intracytoplasmic sperm injection (ICSI) 1994–1997. *Hum Reprod* 1999;14:2143–8.
- 13 Wennerholm UB, Bergh C, Hamberger L, *et al.* Obstetric and perinatal outcome of pregnancies following intracytoplasmic sperm injection. *Hum Reprod* 1996;11:1113–19.
- 14 Sutcliffe AG, Taylor B, Li J, Grudzinskas G, Thornton S, Lieberman B. Children born after intracytoplasmic sperm injection: population control study. *BMJ* 1999;318:704–5.
- 15 Bowen JR, Gibson FL, Leslie GI, Saunders DM. Medical and developmental outcome at 1 year for children conceived by intracytoplasmic sperm injection. *Lancet* 1998;351:1529–34.
- 16 Sutcliffe AG, Taylor B, Grudzinskas G, Thornton S, Lieberman B. Children conceived by intracytoplasmic sperm injection. *Lancet* 1998;352:578–9.
- 17 Vogt PH. Human chromosome deletions in Yq11, AZF candidate genes and male infertility: history and update. *Molecular Human Reproduction* 1998;4: 739–44.
- 18 Hawkins M, Barratt C, Sutcliffe A, Cooke I. National epidemiological follow-up of offspring conceived by ICSI. *Lancet* 1999;354:1906–7.
- 19 Gardner DK, Schoolcraft WB, Wagley L, Schlenker T, Stevens J, Hesla J. A prospective randomized trial of blastocyst culture and transfer in in-vitro fertilization. *Hum Reprod* 1998;13:3434–40.
- 20 Chian R-C, Gulekli B, Buckett WM, Tan S-L. Priming with human chorionic gonadotropin before retrieval of immature oocytes in women with infertility due to the polycystic ovary syndrome. *N Engl J Med* 1999;341:1624–6.
- 21 Cha K-Y, Chian R-C. Maturation in vitro of immature human oocytes for clinical use. *Hum Reprod Update* 1998;4:103–20.
- 22 Vilska S, Tiitinen A, Hyden-Granskog C, Hovatta O. Elective transfer of one embryo results in an acceptable pregnancy rate and eliminates the risk of multiple birth. *Hum Reprod* 1999;14:2392–5.
- 23 Oktay K, Karlikaya G, Gosden R, Schwarz RS. Ovarian function after autologous transplantation of frozen-banked human ovarian tissue [abstract]. *Fertil Steril* 1999;72(suppl 1):S21.
- 24 Eppig JJ, O'Brien MJ. Comparison of preimplantation developmental competence after mouse oocyte growth and development in vitro and in vivo. *Theriogenology* 1998;49:415–22.

Public health

Is the ethos of medical practice in community paediatrics compatible with that in public health?

Public health and community paediatrics go back a long way together. At times, in their history, the two have been so closely linked as to be indistinguishable. Two early “public health” initiatives in the UK—the establishment of the school health services, and of maternal and child welfare clinics—bear witness to early awareness that measures to improve children’s health may be important for the health of adults. Infant mortality rates have long been regarded as a key indicator of the overall health of a nation in international comparisons, and in the UK doctors working in community child health services were first based in departments of public health. At other times the two specialties have seemed very separate. The 1974 NHS reorganisation and the concomitant development of two separate medical specialties—community child health (as community paediatrics was then called) and community medicine (as public health medicine was then called) pulled them apart. Several different forces are encouraging the two back together again: the political glasnost on social inequalities in health, and recognition at professional level that these inequalities have their most noxious impact on children^{1, 2}; the need to join forces, in the face of powerful financial interests, to advocate for a healthier environment for children (against the tobacco industry, the motor industry, and baby milk manufacturers); the need to maintain high levels of immunisation and the need to modernise the child health surveillance programme³; the rediscovery of the “life course approach to health”^{4, 5} and of “cycles of disadvantage”⁶; and the publication of research which shows that it is possible to have an impact on intractable adult public health problems by intervention in early childhood.^{7, 8} Some have proposed that the development of a new specialty—child public health—is the best way to have an impact on some of these problems. This article looks at some of the similarities and differences between medical practice in public health and community paediatrics. It also looks at some of the aspects of medical practice that make improving health a challenge for both specialties.

Principles of public health practice

An enduring definition of public health is that of Acheson in 1988: “The science and art of preventing disease, prolonging life, and promoting health, through the organised efforts of society”. This definition springs from an essential premise of public health practice, that health is determined by social and environmental factors, and that health improvement depends primarily on interventions made outside clinical practice. Public health doctors have, in the past, had greater resources at their disposal than they do now, but they have never been in a position to “organise society”. What they have achieved in this respect has been achieved through persuasion. They have gathered evidence, made speeches, written reports, identified collaborators, established coalitions. By the time that their proposals are implemented, their initial involvement may be forgotten. The main benefits of public health interventions are often felt when they have become an accepted and invisible part of the social fabric. Public health is therefore a specialty in which people need to be able to derive job

satisfaction from playing a small part. Heroism and personal acclaim are rarely on offer.

Principles of community paediatric practice

Community paediatrics is primarily a clinical specialty, revolving around the suffering of individual children and their parents. The essential premise of clinical practice is that doctors can help sick people get better, and disabled people have a better quality of life. When clinicians’ interventions work, their patients’ lives are made easier in a way that is often clearly attributable to the intervention of the individual clinician. The relationship, when it works well, is a very personal one of appropriate and timely support, and appropriate and rewarding gratitude. Community paediatrics has some similarity with public health in that the interventions are not necessarily “clinical” and delivery is often the responsibility of a group of people. The doctor may have acted as an advocate for the provision of services, which are not under their control—housing, or environmental modification of a school—but the intervention is still made on behalf of, and felt by a single individual or family, and is attributable to the team leader, who is most often the doctor.

These are stereotypes, and reality is rarely so clear cut. There are plenty of examples of public health doctors needing and seeking personal acclaim for their achievements, and there are an equal number of examples of unsung heroism in community paediatrics. When the previous government was in power, public health doctors spent most of their time on NHS purchasing, focusing, like their clinical colleagues, on clinical interventions. At the same time some community paediatricians have taken a lead in intersectoral initiatives to develop, for example, accident prevention or parent support programmes. Many have worked with head teachers and schools to develop policies on medication, which mean that all children with asthma can have access to their inhalers when needed. So it is more helpful to view the two specialties as covering a spectrum of approaches, where the means differ, but the confidence intervals overlap.

The promotion of health in clinical practice

Public health and community paediatrics therefore share many goals. Tensions between the two specialties, in so far as they exist, arise from the clinical practice component of community paediatrics and they do so because clinical practice has very different goals from public health. Public health has the goal of preventing disease and enabling health improvement, clinical practice of enabling recovery from ill health, and mitigating the impact of disability. These goals need to be met in different ways. Problems arise because medical education is tailored primarily to enable doctors to treat sick people and, at undergraduate level, provides little in the way of support to developing doctors whose practice will in future include the promotion of health (public health, community paediatrics, and general practice).

In clinical practice doctors are required to take decisions, often under pressure, on behalf of sick patients,

and in doing so may shoulder a huge burden of responsibility. All doctors are therefore schooled in the ability to take charge in difficult situations. Effective treatments may be unpleasant or painful, and particularly when treating children or mentally ill people, doctors sometimes have to resort to coercion to aid recovery. Patients afford their doctors a high level of trust in believing that short term harm may be necessary for long term benefit. An essential characteristic of medical practice is therefore the ability to assume responsibility and to act on behalf of people who are vulnerable. Doctors are respected for this ability, and are valued for this by their patients. Their respect and gratitude makes them prepared to listen to what we have to say, and gives the medical profession a powerful voice in community affairs and in the political arena.

This skill, which is so essential a part of clinical practice, is however, a disability in the practice of health promotion. Health promotion usually requires adults to change their beliefs or their behaviour, and as those involved in the process of helping people give up smoking have found, these changes can be very difficult to achieve. Doctors who have tried to change their own behaviour will understand this at an experiential level, but the development and testing of theoretical models in health promotion research also provides insights into the essential prerequisites for behaviour change (see Tones and Tilford for a more detailed discussion⁹).

In order to achieve behaviour change people need to believe that the change will benefit them. For this they need to have acquired knowledge, either from their own experience or from pedagogic teaching (health education). For the latter to have the desired effect, the source of new information needs to be credible and trustworthy. For people to change entrenched attitudes and beliefs, the new information may need to be heard from multiple credible sources. While doctors have been shown to be particularly effective in this respect they are only one source and may not be sufficient on their own. Doctors who are “economical with the truth” about treatment effectiveness and side effects or prognosis may forfeit some of their credibility. Secondly, to achieve behaviour change, people need to believe in the possibility of personal change or development. Those who have entered the adult world with a belief that their efforts at self improvement are rarely successful, and that taking the initiative usually lands them in trouble, are not likely to believe this easily. Such change may depend on them finding someone who believes that, in spite of their previous experiences, they are capable of personal development.

This sort of support is different from the sort of support people require when they are sick. Sick people want others to take charge of their lives and make them better. People with poor self belief, and little sense of self worth, need people to help them discover that they can help themselves. This may require patience, understanding, and compassion. Enabling people to believe in their capacity to take control of their own lives is the process of empowerment, a key component of the practice of health promotion.¹⁰ Such processes focus on the development of mental and social wellbeing, rather than of physical wellbeing, but as the new century dawns, mental and social wellbeing are beginning to assume some primacy as determinants of health.^{11–13}

Ideally doctors would be trained in both approaches, using, in their clinical practice, whichever benefits their patient best. But deciding which to use, and when, is not a simple matter, particularly for community paediatricians, when caring for families of children with chronic illness and disability. Action orientated medical training encourages doctors to err on the side of doing things for their

patients, which may reinforce their own sense of achievement, at the expense of their patients’.

Promoting health in communities and societies

Doctors working in public health concern themselves with improving health through social and environmental change, rather than through contact with individuals. They need to be skilled in working with groups of people from widely differing professional backgrounds. These skills are different from those required for one to one work in clinical practice. In this work, however, they face a dilemma parallel to that of clinicians; their choice is between disease prevention and health promotion. Disease prevention—immunisation, screening, road safety measures, legislation against tobacco advertising—is a way of protecting other people’s health with minimal active involvement on their behalf. Public health professionals decide that a new programme of immunisation is worthwhile, persuade the government to fund it, and then persuade people to take one small step to achieve a lifetime’s protection. Disease prevention can be achieved by coercion or by manipulation. Drink-drive legislation is an example of a coercive approach; exclusion from society of people with contagious diseases is another. Screening campaign literature, which plays down information about harmful side effects and plays up the potential benefits, encouraging people to take part in programmes under false pretences, is manipulative. The distinction between coercion, manipulation, persuasion, and support is not nearly as clear cut as it might seem. Most people knew that front seat belts were a good idea when legislation was introduced and welcomed the encouragement to wear them that the new law provided; as a result compliance is very high. The balance between too much and too little information in health education materials is difficult to get right.

Compulsory school based physical activity programmes may be a subtle example of coercive health promotion. These programmes are effective in getting children fit,¹⁴ but experience would suggest that they may have a negative long term impact on exercise participation. Diseases can be prevented by coercion, but it is unlikely that health, in the positive sense, can ever be improved by this method. Coercion or manipulation may achieve short term benefits. However, the process of submitting to a more powerful individual or group of individuals, against one’s personal interest or will, or allowing oneself to be fooled into believing something which is not true, are both disempowering, and likely to be destructive of social and mental wellbeing in the long term.

Health promotion encourages people to take charge of their own destinies, both individually and in groups. A health promoting approach to injury prevention would aim to inform communities about their injury risk, and support the community in coming to their own solutions for prevention. It is important that there are resources to ensure the implementation of these solutions, otherwise the collective belief of community members, that it is not worth trying, will only be reinforced. One problem with bottom up approaches such as this, is that agendas may clash. The health authority may have made accident prevention a priority in the same year as members of the community with the highest rates of injury have just decided that they really want to work on environmental improvements. In such a situation it would be respectful and empowering for the powerful health authority to agree to facilitate the less powerful community’s agenda, before embarking on its own. Like clinical practice, public health therefore requires a delicate balancing act between top down control and bottom up initiatives; the key principles for both are mutual respect, trust, and fairness.

Health improvement programmes almost always require the cooperation and collaboration of organisations, such as local authorities, health authorities, and non-government organisations. The specific organisations depend on the task. Those working in public health therefore need to be able to establish multidisciplinary, intersectoral collaboration. The skills needed to do this work have a lot in common with the skills needed to empower individuals and communities. The attributes which ensure effective intersectoral working are mutual trust and respect. These approaches do not work when one individual, group, or organisation aims to take charge without the consent of the others. They are, therefore, a challenge to those working in “clinical practice mode” who may assume that taking charge and top down control is what is expected of them. Respect and trust are the only way to ensure that all those contributing to the process feel they have an equal voice; it is the only way to achieve confidence that collective solutions will be fair. Such attributes cannot be relied on to be present in intersectoral activities, and the conflict between the need to empower and the need to control is often very evident. Doctors working in “public health mode” need to be able to model helpful ways of working. In such circumstances it can be valuable to remember that health is unlikely to be improved by coercion or deceit. The process of implementing health promotion interventions is very important in determining their success.

Conclusions

Public health and community paediatrics have some common and some different goals. The different goals arise from the clinical elements of the latter. Clinical practice requires different skills from public health practice and provides different rewards; doctors will differ in the extent to which they feel comfortable with one or other approach, but they are not incompatible and in an ideal world we would all be able to do both. Health promotion is a skill which is applicable to both clinical practice and to public

health. It demands ways of working and relating to colleagues and patients which differ from those that have, in the past, dominated medical practice in both specialties. The key attributes of health promotion practice, respect, trust, and fairness, are however now beginning to be incorporated into medical education. They are being incorporated, primarily, because they have been shown to improve patient satisfaction with clinical consultations. Perhaps in demanding something slightly different of the medical consultation, patients are showing us how doctors could be more helpful in improving health.

SARAH STEWART-BROWN

Director, Health Services Research Unit,
Department of Public Health, University of Oxford, Oxford, UK
email: Sarah.Stewart-Brown@dphpc.ox.ac.uk

- 1 Acheson D. *Independent inquiry into inequalities in health*. London: Department of Health, 1998.
- 2 British Medical Association. *Growing up in Britain: ensuring a healthy future for our children*. London: BMJ Books, 1999.
- 3 Hall DMB, ed. *Health for all children*. Oxford: Oxford University Press, 1996.
- 4 Kuh D, Ben-Shlomo YA. *A life course approach to chronic disease epidemiology*. Oxford: Oxford University Press, 1997.
- 5 Marmot ME, Wadsworth MEJ, eds. Fetal and early childhood environment and long-term health implications. *Br Med Bull* 1997;53:81–96.
- 6 Patterson GR, DeBaryshe D, Ramsay E. A developmental perspective on antisocial behaviour. *Am J Psychiatry* 1989;44:329–35.
- 7 Olds D, Henderson CR, Cole R, et al. Long-term effects of nurse home visitation on children's criminal and antisocial behaviour. *JAMA* 1998;280:1238–44.
- 8 Schweinhart L, Barnes H, Weikart D. *The High Scope Perry Preschool Study through age 27*. Michigan: High Scope Press, 1993.
- 9 Tones K, Tilford S. *Health education: effectiveness, efficiency and equity*. London: Chapman and Hall, 1994.
- 10 World Health Organisation. *Ottawa Charter for Health Promotion*. Geneva: World Health Organisation, 1986.
- 11 Murray C, Lopez LA. *The global burden of disease*. Cambridge, MA: Harvard School of Public Health (on behalf of World Bank and WHO), 1996.
- 12 Wilkinson RG. *Unhealthy societies: the afflictions of inequality*. London, New York: Routledge, 1996.
- 13 Stewart-Brown S, Layte R. Emotional health problems are the most important cause of disability in adults of working age: a study in the four counties of the old Oxford region. *J Epidemiol Community Health* 1997;51:672–5.
- 14 Keays J. *The effects of regular (moderate to vigorous) physical activity in the school setting on students' health, fitness cognition, psychological development, academic performance, and classroom behaviour*. York, Ontario: North York Community Health Promotion Research Unit, 1993.