

more expensive and suffer from the need to train interviewers in order to reduce observer variation in applying the questions. In the absence of precise information on the sensitivity and specificity of the questions, the finding of a poor repeatability¹⁹ might suggest that these questionnaires lack adequate precision for use in screening.

For persons with chronic obstructive bronchitis, tests of ventilatory function can be used for their identification. A number of such tests are available and rely either on spirometry or on measurement of expiratory-flow rates. These techniques are simple, require no complex instruments, are acceptable, and can detect airways obstruction at an early stage. However, their repeatability is not high.¹⁹ In addition, there is no agreement as to the appropriate level of ventilatory abnormality at which individuals should be selected for further investigation. Further, these tests do not readily distinguish between interference to air-flow caused by airways obstruction and that caused by restriction of lung expansion. The costs of identifying cases using tests of ventilatory function are not accurately known but will certainly be greater than those using a questionnaire alone.

The advantages to the patient of an early diagnosis of chronic bronchitis are not clear. Those with reduction in F.E.V.₁/V.C., and who are smokers, subsequently progress most rapidly to disability from airways obstruction.²⁰ Such persons identified by a screening programme could be advised to give up smoking. However, there is no guarantee that ceasing to smoke would result in other than some lessening of sputum volume²⁰ and maybe minor delay in the progression of the disease. The general lack of success in persuading smokers to give up must make this a relatively ineffective course of action. The attempted prevention and also the treatment of acute chest illness by chemotherapy in chronic bronchitis do not alter the natural progression of the disease,²¹ so there is no clear evidence that intervention in early chronic bronchitis confers any worthwhile benefit. For this reason alone, there can be no justification for introducing screening programmes aimed at detecting chronic bronchitis in the adult population. It may be more worthwhile instead to concentrate efforts upon prevention of the disease, and this may need to be started in childhood. For example, a history of chest illness in early childhood increases the risk of chest symptoms in early adult life, especially if this is combined with smoking cigarettes.²² The lesson, for both lung cancer and chronic bronchitis, must surely be that the only serious hope of limiting their mortality and morbidity lies in prevention of these diseases, and this means by not smoking.

REFERENCES

1. Cochrane, A. L., Fletcher, C. M. Early Diagnosis; paper 6. Office of Health Economics, London, 1968.
2. Cochrane, A. L., Springett, V. in *Screening in Medical Care* (edited by T. McKeown); p. 116. London, 1968.
3. Yerushalmy, J. *Rad. Clins N. Am.* 1969, 7, 381.
4. Macgregor, I. M. *Hlth Bull.* 1962, 20, 20.
5. Cochrane, A. L. *Br. J. ind. Med.* 1962, 19, 52.
6. Styblo, K. *Bull. Un. int. Tuberc.* 1970, 43, 95.
7. Horwitz, O. *Am. J. Epidem.* 1974, 100, 20.

References continued at foot of next column

Occasional Survey

MEASUREMENT OF PAIN

E. C. HUSKISSON

Department of Rheumatology, St. Bartholomew's Hospital, London EC1A 7BE

Summary Of the various methods for measuring pain the visual analogue scale seems to be the most sensitive. For assessing response to treatment a pain-relief scale has advantages over a pain scale. Pain cannot be said to have been relieved unless pain or pain relief has been directly measured.

INTRODUCTION

IN clinical trials of drugs given for painful conditions, pain cannot be said to have been relieved unless it has been measured. The meagre potency of many analgesics compared with placebo demands that the measurement should be both accurate and sensitive.

It is only relatively recently that attempts have been made to find satisfactory methods of measuring the severity of pain in disease.¹ There have been few formal studies or comparisons of the available methods; it is therefore difficult to discover which is the most suitable for a particular purpose, and in many instances it is not even clear what each method should be called.

Measurement of pain in disease should not be confused with measurement of experimental pain. It is easier to study experimental pain because it can be measured in terms of the intensity of the stimulus. In pathological pain the nature of the stimulus is often unknown, its intensity is usually difficult to measure, and severity of disease is not clearly related to pain because pain is modified by such factors as the individual patient's pain threshold.^{2,3}

SIMPLE DESCRIPTIVE PAIN SCALE

Keele¹ described a four-point scale, grading pain as slight, moderate, severe, and agonising. Agonising pain is rare, and this grade has been dropped by most subsequent users of the scale. The term "mild" is often used instead of "slight". Hewer et al.⁴ used

DR COLLEY: REFERENCES—continued

8. Nelson, B. *Science*, 1971, 174, 1114.
9. Registrar General's Quarterly Returns for England and Wales: quarter ended Dec. 31, 1973. H.M. Stationery Office, 1974.
10. Chan, W., Chia, M., Lee, L. K., Macfadyen, D. M. *Bull. Wld Hlth Org.* 1971, 45, 551.
11. Liliensfeld, A. *Cancer Res.* 1966, 26, 2083.
12. Liliensfeld, A., Kordan, B. *ibid.* p. 2145.
13. Brett, G. Z. *Thorax*, 1968, 23, 414.
14. Dunn, J. E. *Proc. R. Soc. Med.* 1966, 59, 1198.
15. Boucot, K. R., Weiss, W. J. *Am. med. Ass.* 1973, 226, 566.
16. Randall, K. J. *Lancet*, 1974, ii (in the press).
17. Medical Research Council. *ibid.* 1965, i, 775.
18. Medical Research Council. *Br. med. J.* 1960, ii, 1665.
19. Discher, D. P., Massey, F. J., Otoupalik, E. L. *J. occup. Med.* 1970, 12, 429.
20. Fletcher, C. M., Peto, R., Speizer, F. S., Tinker, C. M. in *Bronchitis III* (edited by N. G. M. Orie and R. van der Lende); p. 103. Assen, 1970.
21. Medical Research Council. *Br. med. J.* 1966, i, 1317.
22. Colley, J. R. T., Douglas, J. W. B., Reid, D. D. *ibid.* 1973, iii, 195.

this scale to measure the effects of narcotic analgesics, and it remains a useful standard method with the advantage of simplicity. The disadvantage of the method is its lack of sensitivity.⁵ Between the limits of "agonising pain" and "no pain" there are only three points, and it is difficult to think of any other intermediate description. A patient with slight pain has only one possible grade of improvement—complete relief, which is seldom achieved by simple analgesics in chronic pain. The relative size of differences between descriptive terms is also unknown and the assumption must be made, when attaching scores to them, that the differences are equal.

VISUAL ANALOGUE SCALE AND GRAPHIC RATING METHOD

Some of the problems of the simple descriptive pain scale can be overcome by using either a visual analogue scale stretching from "no pain" to "pain as bad as it could be" or the graphic rating method (fig. 1)—approaches borrowed from psychology in which they

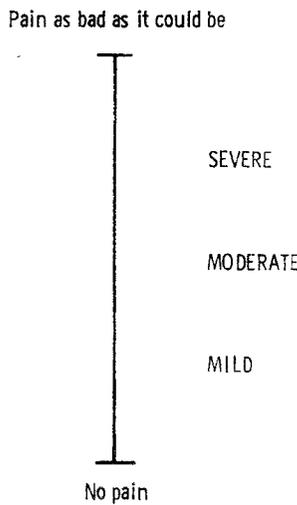


Fig. 1—Graphic rating method for measuring pain.

The visual analogue scale is the same without the descriptive terms severe, moderate, and mild.

have been applied since the early part of this century to measure such unmeasurables as personality, depression, and sleep.^{7,8} With these scales there is an infinite number of points between the extremes. With the graphic rating method the intervals between the descriptive terms must usually be assumed, though it is possible to alter them to correct the abnormal distribution of results which may arise⁷; it is also possible to use arcsin transformation to make normal the distribution of results on the visual analogue scale.⁸ Clarke and Spear⁹ used a visual analogue scale to measure well-being, and concluded that it was both reliable and sensitive, though it is difficult to establish reliability in repeated measurements of subjective states—there is no reason to expect that pain would remain constant even from one minute to the next. Good correlations have been found between pain measurements using visual analogue and simple descriptive pain scales.^{10,11} Berry and Huskisson¹¹ used both measurements in a group of patients and superimposed the descriptive terms on the visual analogue scale at the end of the experiment, finding more or less equal intervals between the descriptive terms. The distribution of 100 consecutive measurements on the

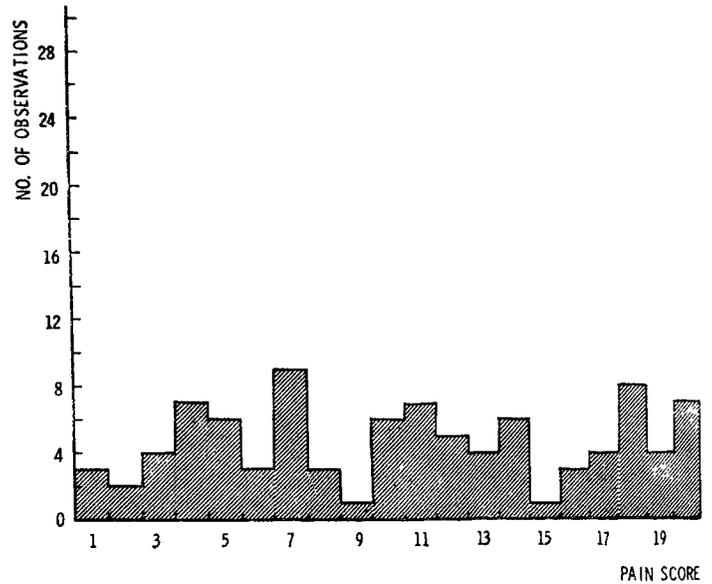


Fig. 2—Distribution of 100 consecutive measurements of pain severity on a visual analogue scale.

The distribution is uniform.

visual analogue scale is shown in fig. 2; this distribution is uniform. The distribution of 100 consecutive measurements on the graphic rating scale is shown in fig. 3 and is neither normal nor uniform. 73% of patients have used one of the points corresponding to a descriptive term, failing to take advantage of the extra sensitivity of the visual analogue scale; for these patients one might as well use a simple descriptive pain scale. Freyd⁷ noted a similar tendency in graphic rating-scales of personality traits. Patients find simple descriptive pain scales easier than visual analogue scales; in the experiments described above, all patients were able to complete a simple descriptive pain scale, 7% were unable to complete a visual analogue pain scale on the first occasion after a single adequate explanation of the method, and 3% were unable to complete a graphic rating-scale under the same conditions.

From these experiments it appears that the visual analogue scale is the most sensitive method for measur-

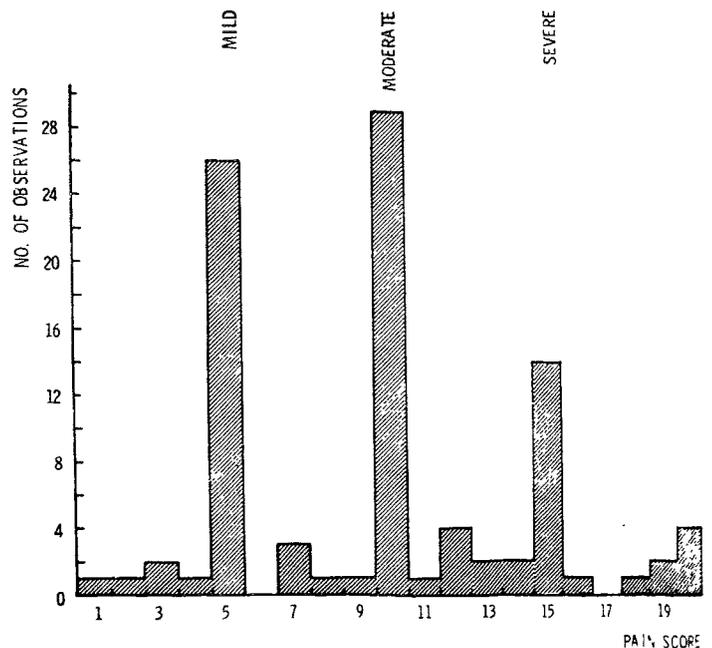


Fig. 3—Distribution of 100 consecutive measurements of pain severity using the graphic rating method.

ing pain. Patients may require painstaking explanation from a trained assistant, especially on the first few occasions. It is usual to divide the scale into 20 portions at the end of the experiment; that patients can distinguish so many grades of pain is suggested by Hardy et al.¹² who found that there were 21 just noticeable differences in experimental pain from the first perception until the sensation became intolerable.

MATCHING METHODS

Hardy et al.¹² suggested that pathological pain could be measured in dols by matching the severity of ex-

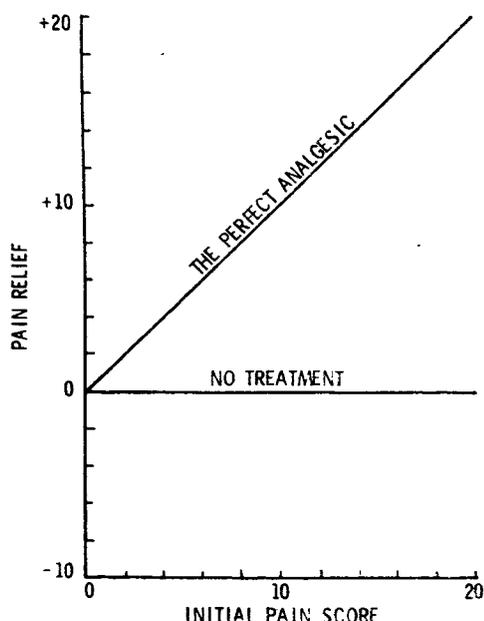


Fig. 4

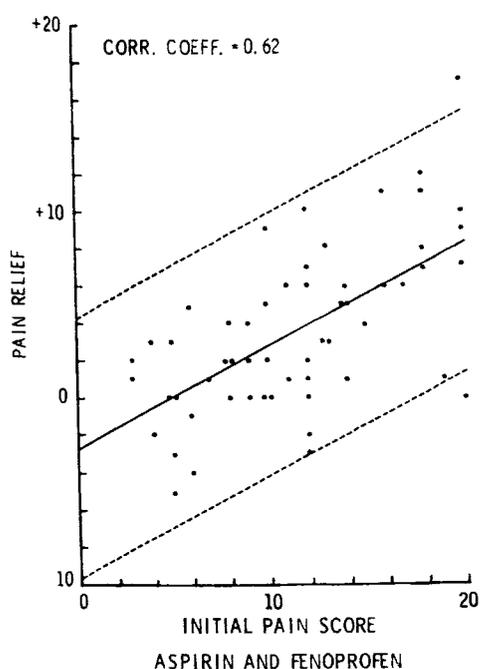


Fig. 5

Fig. 4—Theoretical relationship between pain relief and initial pain score when pain relief is measured by subtracting pain score after treatment from initial pain score.

All treatments must lie between the horizontal line representing no treatment and the slope representing the perfect analgesic.

Fig. 5—Relationship between pain relief measured by subtraction and initial pain score for two analgesic anti-inflammatory drugs in rheumatoid arthritis.

perimental pain, induced by heat, to that of pathological pain. Kast¹³ used a machine operated by the patient which applied pressure to the finger-tip. The unpopularity of these methods is perhaps explained by the difficulty of comparing different types of pain.

NON-VERBAL METHODS

It is usual to rely on a statement from the patient of the severity of his pain, and this is apparently the most reliable method. Lim and Guzman¹⁴ showed that the visible manifestations of pain were unreliable. They infused bradykinin into the peritoneal cavities of prison volunteers and took videotape pictures of the responses. 81% of the volunteers felt pain regularly, but only 52% showed facial signs such as grimacing interpretable as indicating pain, and only 31% continued to do this repeatedly with each infusion. "Vocalisation" was even less frequent. Man is able to control his behaviour to a degree which depends on conditioning, personality, training, past experience, and present circumstances. Behavioural phenomena cannot, therefore, be relied on as indicators of pain severity.

Armstrong et al.¹⁵ used a mechanical method of recording pain as an alternative to verbal statement, asking the subjects to squeeze a bag in proportion to the severity of their pain. Most people are, however, able to express their pain severity verbally, just as most can comment on ambient temperature and other sensations; and there seems little reason to search for other means of communication.

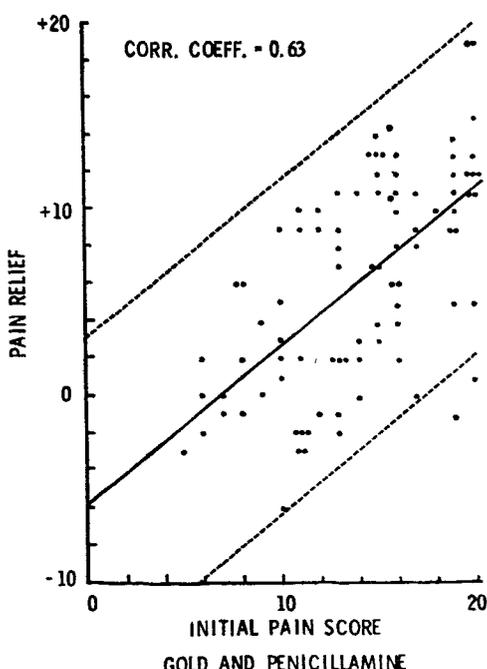


Fig. 6

Fig. 6—Relationship between pain relief measured by subtraction and initial pain score for two drugs with specific activity in rheumatoid arthritis.

The slope is significantly steeper than that of fig. 5, showing that these drugs are more effective.

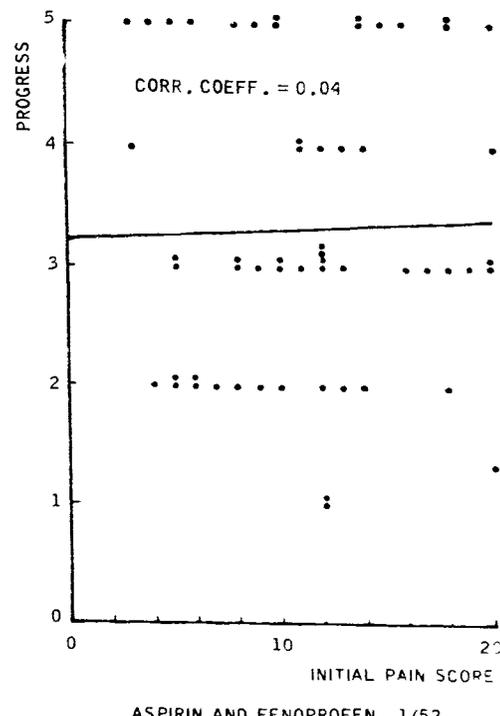


Fig. 7

Fig. 7—Lack of relationship between progress (pain relief measured directly) and initial pain score in the same experiment as shown on fig. 5.

ADVANTAGES OF MEASURING PAIN RELIEF

In experiments designed to assess the effects of treatment, pain relief can be measured instead of pain severity. This has three advantages. Firstly, the magnitude of the response does not depend on the initial pain severity, all patients starting from the same baseline. Secondly, it is not necessary to assume that differences in different parts of the scale are equal. Thirdly, it is more usual for a patient to express himself in terms of pain relief; he says "my pain is a little better" rather than "my pain is now moderate".

When pain relief is measured by subtracting the pain score after treatment from the initial pain score, a relationship will always be found between pain relief and initial pain score (see fig. 4). The effectiveness of any particular treatment is proportional to the slope of the line, but all treatments must lie between "no treatment" and the "perfect analgesic". This relationship for two types of drug treatment of rheumatoid arthritis is illustrated in figs 5 and 6. Fig. 6 shows the more effective treatments with a significantly steeper slope. This relationship is highly undesirable because even a small imbalance between initial values in two groups of patients in a trial may affect the pain relief obtained; in a trial of anti-inflammatory drugs,¹⁶ a statistically significant difference between two treatments was entirely explained by the imbalance of initial pain scores between the two groups. The relationship between pain relief (measured by subtracting pain scores) and initial pain score is eliminated by the use of a pain-relief scale (fig. 7). Though a pain-relief scale clearly has advantages in measuring response to treatment, it is wise to document the initial pain severity especially when between-patient comparisons are made. Response to both analgesics¹⁷ and placebo¹⁸ may depend on initial pain severity.

METHODS OF MEASURING PAIN RELIEF

The first method used to measure pain relief was the quantal method,^{19,20} which is based on the proportion of patients achieving a certain defined degree of pain relief. This technique was used by Beecher et al.²¹ to study aspirin. Significant pain relief was obtained after 20–40% of doses of placebo compared with 50% of 300 mg. doses of aspirin (differences not statistically significant) and with 55% of 600 mg. doses of aspirin (differences highly significant). This study is somewhat unconvincing because the lowest percentage of patients whose pain was significantly relieved by placebo occurred in the experiment with high-dose aspirin—accentuating a very small difference. The quantal method is not ideal for testing simple analgesics such as aspirin because these drugs produce only modest pain relief in a modest proportion of patients; a much more sensitive method is required to detect the small differences between such drugs and placebo.

A simple descriptive pain-relief scale provides some improvement in sensitivity over the quantal method. Dundee²² scored analgesia as excellent, good, moderate, poor, and doubtful or absent. Huskisson²³ graded pain relief as none, slight, moderate, or complete, and found this scale useful for measuring the effects of

simple analgesics in rheumatoid arthritis. A nine-point scale of change has also been used.⁵ Sensitivity can be further improved with a visual analogue pain-relief scale, but experience suggests that a simple descriptive pain-relief scale gives better results when relief is assessed without the help of a trained assistant.

A variety of numerical pain-relief scales have been used. Copeman²⁴ asked patients to assess their pain severity as a percentage of the initial level. Swerdlow et al.²⁵ defined pain relief in fractions, more than half relieved or less than half relieved. Such a scale could be extended to improve its sensitivity.

Preference for one period of treatment over another, or the rank order of different treatments, is sometimes used as a measure of pain relief, and this is quite unjustifiable. Preference is a compound measurement and reflects not only effectiveness but also tolerance.²⁶ Using single doses of analgesics, Huskisson²³ noted that in 24% of comparisons patients' expressed preferences disagreed with the order of effectiveness based on pain-relief scores. One reason for this was that some patients felt sick after one of the active drugs and therefore preferred another drug or placebo even though it gave less pain relief. Though preference cannot be equated with pain relief, it may still be a useful measurement.²⁷

INDIRECT METHODS

A number of attempts have been made to provide an indirect but objective method of measuring pain. Masson²⁸ showed that vital capacity was increased by morphine after upper-abdominal surgery, and Parkhouse and Holmes²⁹ found this measurement as sensitive as an observer's rating of pain. Though apparently objective, the measurement also reflects the amount of effort the patient is willing to expend.²⁸ Keele and Stern³⁰ showed a fall in serum beta-lipoproteins and cholesterol associated with experience of pain. Huskisson³¹ demonstrated reduced urinary catecholamine excretion in patients with rheumatoid arthritis when pain was relieved. Though a reduction in catecholamine excretion might be a useful objective confirmation of pain relief, it could never be said that, because catecholamine excretion had been reduced, pain had been relieved. This problem arises with many of the measurements made in painful conditions and may lead to incorrect interpretation of the results of treatment. Hart³² pointed to the importance of pain as a cause of disability, and it is not surprising that some tests of locomotor function in patients with painful conditions reflect the severity of pain: grip strength in rheumatoid arthritis, for example, is proportional to pain severity.³³ Tenderness is sometimes regarded as synonymous with pain, but pain may be felt without tenderness and tenderness without pain.

WHO MEASURES—SUBJECT OR OBSERVER?

There is some difference of opinion as to whether pain should be measured by the subject or by a trained observer. Lee¹⁹ tried to use questionnaires which the patients completed, but failed because the patients were either apathetic if their pain was relieved or, if it was not, "unreasonable" in exaggerating their discomfort. Pain charts completed by the patients were abandoned by Houde et al.³⁴ who found that they were not always

completed regularly, and suggested that introspection led to an undue influence of emotional factors. Parkhouse and Holmes²⁹ also favoured the use of an observer, pointing out that some patients are known to exaggerate the severity of their pain. On the other hand, Keele¹ found that patients could record their pain severity on his simple descriptive scale and in almost all cases welcomed the task. Though patients may on the first few occasions find it difficult to express their pain severity within the descriptive limits of a particular scale, preferring their own descriptions to those provided, they soon accept, learn to use, and appreciate the value of a standard pain scale. It is difficult to accept that an observer, no matter how experienced, could ever measure another person's pain. The severity of pain is known only to the sufferer. Though some patients may exaggerate pain, it would be impossible to accept measurements in which the observer had decided, for example, that a patient who claimed to have severe pain had moderate pain and was exaggerating. The observer is also liable to the error, mentioned by Merskey and Spear,³⁵ of confusing the stimulus with the experience. Would Beecher's soldiers with serious wounds have been accused of minimising their pain? Pain is a personal psychological experience, and an observer can play no legitimate part in its direct measurement.

REFERENCES

1. Keele, K. D. *Lancet*, 1948, ii, 6.
2. Keele, K. D. *Br. med. J.* 1968, i, 670.
3. Huskisson, E. C., Hart, F. D. *ibid.* iv, 193.
4. Hwer, A. J. H., Keele, K. D., Keele, C. A., Nathan, P. W. *Lancet*, 1949, i, 431.
5. Huskisson, E. C., Shenfield, G. M., Taylor, R. T., Hart, F. D. *Rheumatology phys. Med.* 1970, suppl. p. 88.
7. Freyd, M. *J. educ. Psychol.* 1923, 14, 83.
8. Aitken, R. C. B. *Proc. R. Soc. Med.* 1969, 62, 989.
9. Clarke, P. R. F., Spear, F. G. *Bull. Br. psychol. Soc.* 1964, 17, 55, 18A.
10. Woodforde, J. M., Merskey, H. *J. psychosom. Res.* 1972, 16, 173.
11. Berry, H., Huskisson, E. C. *Clin. Trials J.* 1972, 9, 13.
12. Hardy, J. D., Wolff, H. G., Goodell, H. *Pain Sensations and Reactions*. Baltimore, 1952.
13. Kast, E. C. *Med. Clin. N. Am.* 1968, 52, 23.
14. Lim, R. K. S., Guzman, F. in *Pain* (edited by A. Sonlirac, J. Cahn, and J. Charpentier). New York, 1968.
15. Armstrong, D., Dry, R. M. D., Keele, C. A., Markham, J. W. *J. Physiol. Lond.* 1953, 120, 326.
16. Huskisson, E. C., Wojtulewski, J. A., Berry, H., Scott, P. J., Hart, F. D., Balme, H. W. *Br. med. J.* 1974, i, 176.
17. Hill, R. C., Turner, P. *J. clin. Pharmac.* 1969, 9, 321.
18. Traut, E. F., Passarelli, E. W. *Ann. rheum. Dis.* 1957, 16, 18.
19. Lee, L. E. *J. Pharmac.* 1942, 75, 161.
20. Denton, J. E., Beecher, H. K. *J. Am. med. Ass.* 1940, 141, 2051.
21. Beecher, H. K., Keats, A. S., Mosteller, F., Lasagna, L. *J. Pharmac.* 1953, 109, 393.
22. Dundee, J. W. *J. Anaesth.* 1960, 32, 48.
23. Huskisson, E. C. *Br. med. J.* (in the press).
24. Copeman, W. S. C. *ibid.* 1950, ii, 849.
25. Swerdlow, M., Murray, A., Daw, R. H. *Acta anaesth. scand.* 1963, 7, 1.
26. Hart, F. D., Huskisson, E. C. *Lancet*, 1972, i, 28.
27. Dick, W. C., Neufeld, R. R., Prentice, A. G., Woodburn, A., Whaley, K., Nuki, G., Buchanan, W. W. *Ann. rheum. Dis.* 1970, 29, 135.
28. Masson, A. H. B. *Curr. Res. Anesth.* 1962, 41, 615.
29. Parkhouse, J., Holmes, C. M. *Proc. R. Soc. Med.* 1963, 56, 579.
30. Keele, K. D., Stern, P. R. S. *Roy. Coll. Physns Lond.* 1973, 7, 319.
31. Huskisson, E. C. *Br. J. clin. Pharmac.* 1974, 1, 80.
32. Hart, F. D. *Br. med. J.* 1968, iii, 635.
33. Ingpen, M. L. *Ann. phys. Med.* 1968, 9, 322.
34. Houde, R. W., Wallenstein, S. L., Rogers, A. *Clin. Pharmac. Ther.* 1960, 1, 163.
35. Merskey, H., Spear, R. G. *Pain, Psychological and Psychiatric Aspects*. London, 1967.

Hospital Practice

EFFECT OF CLOTHING ON DISPERSAL OF STAPHYLOCOCCUS AUREUS BY MALES AND FEMALES

JOYCE HILL ANTHONY HOWELL
ROBERT BLOWERS

*Clinical Research Centre and Northwick Park Hospital,
Harrow HA1 3U7*

Summary Dispersal of *Staphylococcus aureus* into the air is fairly common and is sometimes profuse among men, but is rare and very slight among young women. Shedding from the skin is increased by friction from clothes. The main site of shedding is the skin of the perineal area. Dispersal can be reduced by bacteria-proof underpants.

INTRODUCTION

SYMPTOMLESS carriers of *Staphylococcus aureus* harbour the organism in their nose and throat, on the skin, and in the hair. Most of these carriers disperse very few staphylococci into the air around them, but a few, recognised by Hare and Thomas¹ as "dispersers", shed them, attached to skin scales,² in very large numbers. Members of a surgical team who are profuse dispersers of *Staph. aureus* are potentially dangerous, but their relative infrequency perhaps explains why evidence of airborne infection with this organism is found only rarely.

In operation rooms, organisms shed by slight or moderate dispersers are probably removed fast enough by conventional systems of pressure ventilation with filtered air. But when a very profuse disperser is present, contaminated air may reach the wound or exposed sterile materials, especially if the disperser works very close to the patient. This hazard can be reduced by special methods of ventilation, and by the more fundamental method of reducing the dispersal. Taking a shower before an operating-session does not reduce dispersal and sometimes increases it^{3,4}; nor do operating-suits made of conventional cotton fabrics reduce dispersal.⁴⁻⁷ Operating-suits made of closely-woven 'Ventile L19' material are effective^{6,7} but are too uncomfortable for long operations, and experience at Middlesbrough General Hospital (unpublished) suggests that suits made of Ventile L34 are not much better; Charnley⁸ has overcome this problem by exhaust ventilation of the space between the suit and the body via tubing connected to a suction pump. This method, though suitable in special circumstances, seems unlikely to gain acceptance in general surgical units and is unsuitable for staff who have to move about the operating-room.

Simpler types of clothing could perhaps be designed if more were known about the sites from which contaminated skin scales are shed. Hare and Ridley⁹ observed that profuse dispersal of *Staph. aureus* was particularly associated with carriage of the organism in the skin of the perineal area. It therefore seemed