



MINISTRY OF HEALTH

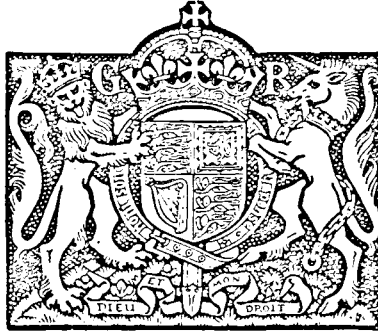
Interim Report
of
Departmental Committee
on
Maternal Mortality & Morbidity

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CONSTITUTION AND TERMS OF REFERENCE OF COMMITTEE.

I hereby appoint—

Professor F. J. Browne, M.D., F.R.C.S.
 Dame Janet M. Campbell, D.B.E., M.D., M.S.
 Mrs. Ethel Cassie, M.D.
 Leonard Colebrook, Esq., M.B.
 Professor Archibald Donald, M.D., F.R.C.P.
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 C. E. Tangye, Esq., M.D.
 O. L. V. S. de Wesselow, Esq., M.B., F.R.C.P.

to be a Departmental Committee to advise upon the application to maternal mortality and morbidity of the medical and surgical knowledge at present available, and to inquire into the needs and direction of further research work.

I further appoint Sir George Newman to be Chairman and Mrs. Margaret Hogarth, M.B., of the Ministry of Health, to be Secretary, of the Committee.

(Signed) N. CHAMBERLAIN.

4th June, 1928.

Note.—Owing to illness Dr. Margaret Hogarth was unable to undertake the duties of Secretary, which were discharged by Miss Jane H. Turnbull, C.B.E., M.D., one of the Medical Officers of the Ministry of Health.

The cost of the preparation of this Report, including the expenses of the Committee, is £1,165 7s. 9d. The cost of printing and publishing this Report is estimated by H.M. Stationery Office to be £156.

DEPARTMENTAL COMMITTEE ON MATERNAL MORTALITY AND MORBIDITY.

INTERIM REPORT.

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APPENDIX A.

ROYAL COLLEGE OF PHYSICIANS OF LONDON.

Report on Anaesthetics in Confinements.

The Royal College of Physicians has been asked by the Ministry of Health to give a pronouncement on the advisability and place in labour of sedatives, analgesics, and anaesthetics. While whole-heartedly agreeing that every effort should be made to insure relief from pain to any woman labouring with child, the College finds it necessary to point out that both the mother and child may be exposed to grave risks by the indiscriminate use of analgesics and anaesthetics. These risks and certain recommendations as to how they may be minimised are dealt with in this report.

The drugs used for the relief of pain in labour may be divided into 3 groups:—

1. *Sedatives.*
2. *Analgesics.*
3. *Anaesthetics.*

The action of each group is especially adapted for the different stages of labour—and each has its own advantages and dangers.

1. *Sedatives.*

Only three need be referred to, the Bromides, Chloral and Tincture of Opium.

The administration of these drugs in full doses is permissible in the early stages of labour. The dangers associated with their administration are not specially modified or increased by pregnancy and labour.

Precautions.—Total doses larger than 30 grains of Chloral Hydrate, 60 grains of a Bromide, or one drachm of Tincture of Opium may not be given by any midwife without medical supervision.

2. *Analgesics.*

The more important drugs in this group are Morphine, Hyoscine and Omnopon.

The administration of these drugs must be limited to the first stage of labour. *They are scheduled under the Dangerous Drugs Act.* The danger to the mother is not increased by pregnancy or labour and the precautions are therefore the same as in general medical or surgical cases. The foetus, however, is often affected, and the probabilities of a child being born in a state of profound apnoea are greatly increased if an injection of these drugs is given within 2 hours of its birth.

Precaution with regard to labour.—These drugs should never be given by a midwife or maternity nurse except on the direct personal instruction of a fully qualified practitioner, and any subsequent doses must be separately ordered by such medical practitioner.

3. *Anaesthetics.*

Anaesthetics are used for two reasons in obstetric practice.

- i. Full surgical anaesthesia for various obstetric operations, *e.g.*, The application of forceps. Version. Caesarean section.

It is obvious that full surgical anaesthesia can only be safely induced by a specially trained anaesthetist or medical practitioner. Detailed criticism on the various anaesthetics and their method of administration in labour is not within the reference from the Ministry of Health, but further information can be obtained by referring to the Proceedings of the Royal

Society of Medicine, Volume XXI (1928), Section of Anaesthetics, which contains a report of a discussion on the subject by a joint meeting of the Anaesthetic and Obstetric Sections.

ii. Solely for the relief of pain in natural labour.

Except under exceptional circumstances in multiparae, it is not permissible to give an anaesthetic solely for the relief of pain in labour, until the second stage has definitely commenced. For practical purposes in general practice chloroform is the only anaesthetic which can be used for the relief of pain in a natural labour. In hospitals and nursing homes other anaesthetics such as gas and oxygen, ether or paraldehyde per rectum, give good results, but the cumbersome apparatus necessary for the former and the site of administration of the latter render their use practically impossible in a patient's own house.

The method of administering chloroform for the relief of pain in natural labour was devised by Sir James Simpson over 80 years ago. It is called "the intermittent method." The technique is a very special one and can only be acquired by practical instruction, but the actual administration can be made by an unskilled person under the direction of someone who has had expert training. If given in this way the administration of chloroform is quite safe for a limited time during child-birth; but when that limited time has been passed a special danger immediately threatens. This danger is a uterine inertia which is due to the action of chloroform on the uterine muscle. The moment chloroform begins to produce an inert uterine muscle the risks of a delayed second and third stage of labour and of postpartum haemorrhage are increased. Both these complications are fruitful sources of maternal morbidity and mortality.

At present anaesthetics can be administered only under the direct supervision of doctors, and before departing from this practice careful consideration will have to be given to the matter. Stringent rules would have to be drawn up before allowing midwives or maternity nurses to give anaesthetics for the relief of pain in labour on their own responsibility. In order that the administration of drugs for the relief of pain may safely be offered to women who so desire it the following suggestions are submitted:—

For the Present Time.

1. In all lying-in hospitals (including the obstetric beds in poor law hospitals) special arrangements should be made for such administration.

Such arrangements would include:—

- (a) A resident and visiting staff capable of carrying out the increased amount of work.
 - (b) Special courses of instruction.
2. All medical students and midwives should receive instruction in the intermittent method of administering chloroform in normal labour.

For the Future.

3. Some responsible body such as the Central Midwives Board should be asked to draw up the necessary regulations as to the increased training for the midwives and stringent rules as to how far a midwife could give chloroform on her own responsibility. Such rules would require very careful consideration, but the first and most important one would of necessity be one which placed a very definite limit on the length of time a midwife might administer an anaesthetic without informing or sending for a doctor.

Whether administered by doctors or midwives it is clear that there are limitations to the wide and general use of sedatives, analgesics and anaesthetics for the relief of pain in natural labour. As already explained all drugs of this kind interfere in some degree with the natural forces. If however they are administered in hospital under proper medical supervision the contra-indications are negligible.

The incidence of *low* forceps deliveries would certainly be increased, but the advantages gained by the educating of doctors and medical students in the application of forceps and in the intermittent method of administering chloroform would be of service to the community.

It is possible that a time may come when the obstetric service of the country may be more in the hands of midwives than it is at present—more confinements may take place in hospitals and fewer doctors may actually be present at confinements, although their ante-natal supervision will be largely increased.

When that time comes it may be that midwives will possess such a measure of skill and experience that they may be trusted with the responsibility of administering chloroform in labour.

At present such a practice would be disastrous.

(Signed) RAYMOND CRAWFURD,
Registrar.

Jan. 30, 1930.

APPENDIX B.

BRITISH COLLEGE OF OBSTETRICIANS AND GYNÆCOLOGISTS.

Memorandum on the Use of Anaesthetics in Confinements.

The Ministry of Health has invited the College to furnish a Report on Anaesthetics and Sedative Drugs and their administration during parturition. The Council of the College therefore submits the following Memorandum.

PART I.

ANAESTHETICS AND THE METHODS OF ADMINISTRATION.

These fall under five subdivisions:

- (1) General inhalation anaesthesia.
- (2) General oral and subdermal narcotics. ...
- (3) Spinal anaesthesia.
- (4) Rectal anaesthesia.
- (5) Local anaesthesia.

(1) The commoner chemical materials used for general inhalation anaesthesia in Great Britain are:

- (a) Chloroform.
- (b) Ether.
- (c) A.C.E.
- (d) Nitrous oxide and oxygen.

(a) *Chloroform* has been very widely—almost exclusively—used by general medical practitioners. This substance has the advantage in clinical obstetrical practice that it is not unpleasant, and that the method of administration is easy for an experienced practitioner. In an ordinary uncomplicated case it is unnecessary for the doctor to place the patient deeply under its influence; in fact, the patient is rarely more than semi-conscious, in which circumstances the uterine contractions are not usually greatly diminished, yet the patient, although she may cry out with each recurring "pain," is quite oblivious of all that happens, and has no memory of the events when "all is over." Moreover, in obstetrical practice in such circumstances chloroform has proved to be singularly safe. Its safety in labour lies mainly in the fact that only the lightest state of anaesthesia—so called obstetrical anaesthesia—is required, and that the blood-pressure is raised during parturition.

Should the patient suffer from any form of toxæmia, with associated acidosis, the danger to the patient is considerably enhanced.

(b) *Ether*, especially ethyl-ether, is more unpleasant to inhale than chloroform, and the patient may be more difficult to manage; but when skilfully given by the open method it is very safe—far more safe than chloroform for deep anaesthesia.

In obstetrical practice the chief difficulty in connection with the use of ether is that a condition of light anaesthesia is more difficult to obtain and maintain than is the case with chloroform. Nevertheless, owing to the safety of the open method the patient may be fully anaesthetised at first and then be allowed to drift back to semi-consciousness, a state not then so hard to maintain if close attention be paid to her. This method necessarily, therefore, requires the undivided attention of the administrator.

It is possible to train any fully-certificated nurse in the administration of ether by this method. In other countries nurses are largely employed in the administration of "open ether."

One great disadvantage of ether is that it is highly inflammable; consequently great care is required when it is administered in a small room with an open fire.

(c) *A.C.E.*, which is a mixture of alcohol, chloroform and ether, was probably introduced to lessen the danger of chloroform, the somewhat slow effect and unpleasant taste of ether, and to combine the advantages of each. Nevertheless, the *A.C.E.* mixture is not much utilised in the present day.

Silk,* however, has shown that a mixture consisting of 3 per cent. of chloroform with ether is safe, and possesses certain advantages over the ordinary "open ether" method.

We think that further investigation of the use of Silk's mixture in labour is required before it can be definitely recommended.

(d) *Nitrous Oxide and Oxygen*. This mode of anaesthesia is particularly safe and unharmed even in the presence of toxæmia. The effects pass off almost immediately. Skilled administration and a somewhat cumbersome apparatus are required. It would be undesirable for nurses to attempt this form of administration in obstetrical work, and, indeed, it is not practicable in the absence of an expert.

(2) The chief disadvantage that appertains to all forms of *oral* and *subdermal* narcotics is that a continued state of unalterable oblivion is obtained. The "in-and-out" type of anaesthesia is not possible. Further, it is necessary to employ powerful drugs such as morphia and hyoscine, which cannot safely be used by a nurse on her own initiative. Indeed, it may be said that, apart from the production of morphine-hyoscine narcosis, these and other drugs such as chloral, are used principally in small doses to secure temporary abatement only of labour to enable the mother to obtain respite.

Morphine-hyoscine narcosis is difficult to apply in ordinary maternity work owing to the close attention necessary.

(3) *Spinal anaesthesia* has been widely used in obstetrical clinics during the performance of Caesarean section, and is of undoubted value where the operation is performed in toxæmic, "suspect" and cardiac cases.

Owing to the technical skill required for the introduction of the drug used, and the possibility of spasm of the circular muscle-fibres†, spinal anaesthesia is not at present employed in normal parturition.

(4) *Rectal anaesthesia* in labour has been practised and advocated in America, but not, we think, in this country; consequently we are unable to express an opinion about it.

(5) *Local anaesthesia* by the injection of novocaine into the lateral perineal regions to "block" the perineal nerves has been largely practised in America. This procedure has the advantage of rendering the parts insensitive during the later phases of the second stage of labour, and of abolishing rigidity of the muscles.

A similar effect has been noted in regard to the "rigid cervix" when novocaine is injected into the bases of the broad ligaments close to the cervix.

These methods cannot, of course, be practised by a nurse under the present method of training. In any case, the decision to utilise them would inevitably be dependent on the judgment of the doctor.

PART II.

It is, no doubt, undesirable that any woman should suffer the pangs of childbirth when the pain can advantageously, safely and surely, be alleviated by scientific methods.

Nevertheless, the fact must be borne in mind that if anaesthesia is to be administered solely on the demand of the patient or her relations (and all doctors know how insistent may be such demands), much harm may be done to the mother and her child.

* Brit. Med. Journ., 1919, i. 635.

† Brit. Med. Journ., 1923, ii, 406.

We need not be concerned with the production of deep surgical anaesthesia, for in securing this the method and drug employed must always depend on the judgment of the surgeon and anaesthetist, and in certain cases (as illustrated in the use of spinal anaesthesia in heart disease) on that of the physician.

All anaesthetics administered during labour, except those like novocaine, which are injected locally, interfere to some extent with the uterine contractions, either by inhibition of all the muscular contractions, or by inhibiting some and thus allowing others to act excessively. Drugs such as infundibulin can counteract this effect, but great experience and judgment are required in their use.

We are called upon, we imagine, to advise chiefly as to the manner and material which, while effective, is safest and most readily applicable to the ordinary patient in uncomplicated or very slightly complicated labour conducted in her own home by the doctor in attendance or by the maternity nurse, and to state whether the nurse should administer the anaesthetic in the presence of a doctor or in his absence.

While we believe that whenever a deep degree of anaesthesia is required, as for internal version, a doctor who can devote himself to the administration of the anaesthetic should be present, we recognise that light anaesthesia is capable of being maintained by a properly instructed nurse if she be *fully certificated*, provided a doctor is present to decide that anaesthesia is desirable.

It would be a simple matter for a fully certificated nurse to receive instruction in the administration of light anaesthesia during her six months' training in an Obstetrical Hospital or Department.

We do not think it right or proper for a midwife possessing only the C.M.B. certificate to undertake such a duty, for she has neither the knowledge nor the everyday experience of anaesthesia and its results in a variety of circumstances such as falls to the lot of a fully certificated nurse.

If the scheme for the eventual employment of fully certificated nurses which the College of Obstetricians and Gynaecologists is drafting for the consideration of the Minister of Health be adopted, this question would to some extent be solved.

We would, therefore, recommend :

- (1) *Deep* inhalation anaesthesia should be induced only by a qualified medical practitioner.
- (2) *Light* inhalation anaesthesia (Obstetrical anaesthesia) can safely be induced by a fully certificated nurse provided a doctor is present throughout the whole period of administration.
- (3) All other methods of anaesthesia should be administered by a qualified practitioner only.
- (4) Narcotics should not be given by a nurse, except on the instructions of a doctor, unless there be urgent necessity.

Signed on behalf of the Council of the
British College of Obstetricians and
Gynaecologists,

W. BLAIR BELL,
President.

February, 1930.

APPENDIX C.

BRITISH MEDICAL ASSOCIATION.

Report of Special Committee upon the Place of Anaesthetics and Analgesics in Midwifery.

I.—PRELIMINARY.

1. As a preliminary to making a pronouncement upon the place of anaesthetics and analgesics in midwifery, the British Medical Association wishes to place on record its whole-hearted belief that every effort to ensure relief from pain and suffering to women in childbirth should be made, provided the mother and child are not thereby exposed to undue risks. Any limitation in the use of anaesthetics or analgesics is only warranted by disadvantages or dangers in their use.

II.—THE USE OF ANAESTHETICS IN LABOUR.

2. In difficult labour, where full anaesthesia is necessary, the anaesthetic should be administered wherever possible by a second doctor; it is always advisable that the anaesthetic be administered by a second practitioner, both for the greater safety of the patient under the anaesthetic and the less risk of sepsis when the doctor delivering does not need to handle the anaesthetic.

3. The question remains how far in normal labour anaesthetics can be given purely for relief of pain without increasing the danger to mother or child. Unfortunately, none of the anaesthetics and analgesics to-day available for midwifery are without danger, and consequently the British Medical Association finds itself unable to recommend that it is wise to provide for anaesthetics in all cases of labour even if the question of cost were entirely removed.

Chloroform.

4. The common form of anaesthetic used in midwifery in this country is chloroform or a mixture containing chloroform. Chloroform given during labour diminishes the strength and frequency of the uterine contractions and the semi-voluntary bearing down efforts of the mother; it therefore prolongs labour and increases the frequency of the use of forceps with the risks that this entails.

5. If this anaesthetic is given in the first, or even in the second, stage it will, in most cases, have to be continued. Prolonged chloroform inhalation causes changes in the liver, which lead to delayed poisoning within the next few days, sometimes with fatal results. This is much more pronounced if acidosis is present. It is probable that some deaths ascribed to obstetric shock or toxæmia are in reality due to delayed chloroform poisoning.

6. With a patient under chloroform the natural separation of the placenta takes longer, and a tendency to relaxation of the uterus is present; therefore, the risk of hæmorrhage and the necessity for manual extraction of the placenta are increased. This danger is, however, diminished by skilled use of pituitary extract.

7. Chloroform may be used to produce a light anaesthesia in which the patient is able to assist the second stage by muscular effort, but is not conscious afterwards of any experience of pain. This is not possible in all cases. In some the patient in the semi-conscious condition is so difficult to control that she must either be allowed to come round or deeper anaesthesia must be produced and labour completed with forceps. But in those very numerous cases in which it can be carried out it is a very humane and a safe proceeding. A patient can be kept in this state by the administration of very small quantities of chloroform. The delay and the very definitely increased risk of postpartum hæmorrhage have both been largely removed since the introduction of pituitary extract.

8. The administration of an anaesthetic requires skilled judgment and medical knowledge. This applies as much to light as to full anaesthesia.

9. In addition to their use in relieving pain anaesthetics are of value in preventing shock.

Aether.

10. In cases where chloroform cannot be administered with safety, aether may be given and the dangers mentioned in paragraph 5 would be thereby diminished; aether is, however, unsuitable for administration by the intermittent method, and its inflammable nature leads to further risks in domiciliary practice.

Gas and Oxygen.

11. Although gas and oxygen is recognised as a very safe means of producing anaesthesia in midwifery, it needs cumbersome apparatus and special knowledge, and its use is therefore confined to institutional practice and to cases in which the services of a specialist anaesthetist are available.

Anaesthesia by Rectal Administration.

12. Various methods of producing anaesthesia by rectal administration have been recently introduced, but their safe use and exact value have not yet been ascertained.

III.—THE USE OF ANALGESICS IN LABOUR.

Combined Use of Morphine and Hyoscine.

13. The use of morphine and hyoscine to produce what is known as " twilight sleep " is of value, but its administration requires special experience, and reports as to its safety vary.

Opium and its Derivatives.

14. For the relief of the pains of a slow and ineffective first stage (especially in a primipara) the use of opium or one of its derivatives is most valuable. It regularises the pains and soothes the mother and so hastens delivery by some hours.

15. Where the uterus is in a condition of secondary inertia opium rests the uterus and sends the mother to sleep, during which time the os slowly dilates without pain, and labour quickly finishes when the mother awakes. Obviously the drug should not be used until any possible cause of obstruction has been diagnosed.

16. Another danger is that opium administered to the mother in effective cases within a short time of delivery adds to the difficulties of exciting the respiratory centre in the new-born babe, and may result in a still-born child.

17. Many cases of somewhat difficult breech delivery can be better treated if the woman is not anaesthetised, as the bearing down efforts of the mother help the fundal pressure of the midwife or her assistant. As these cases are frequently tedious, the use of analgesics would diminish the risk of premature interference. If this practice were followed, the probability is that the high foetal mortality in such cases would be much reduced.

Chloral Hydrate.

18. Chloral hydrate is often used with advantage where the first stage is prolonged.

IV.—THE USE BY MIDWIVES OF ANAESTHETICS, ANALGESICS AND SEDATIVES.

19. The British Medical Association is of opinion that the midwife should not administer anaesthetics, opium or its derivatives, pituitary extract, or

other dangerous drugs, except in so far as she may be acting under, or carrying out the instructions of a medical practitioner. It is of this opinion:—

- (i) with regard to *anaesthetics*, on account of the well-known dangers attendant upon their administration;
- (ii) with regard to *opium and its derivatives*, on account of the danger of unrecognised obstruction and the risk to the life of the child; and
- (iii) with regard to *pituitary extract*, on account of the risk of ruptured uterus and the danger to the unborn child.

(Sgd.) CHRISTINE M. MURRELL,
*Chairman of the Committee on
Anaesthetics and Analgesics in
Midwifery.*

(Sgd.) ALFRED COX,
Medical Secretary.

Medical Department,
British Medical Association,
British Medical Association House,
Tavistock Square,
London, W.C. 1.

27th March, 1930.

APPENDIX D.

Memorandum on the Sterilisation of the Hands. By Leonard Colebrook, M.B., B.S.

Introductory.

A search for published evidence as to the relative efficacy of treatment by lysol or perchloride of mercury for the sterilisation of the hands has failed of its purpose; but it has enabled me to make a general survey of the experimental work done in this field. Most of it was published in German journals between 1890 and 1910.

The experiments reported have differed chiefly in two respects, viz. :—

(a) As to whether the hands were artificially infected or not before treatment with antiseptics. When they were so infected it was usually with a microbe easily detectable in cultures, such as *B coli* or *B prodigiosus*. Although much of the work was done with a view to the prevention of puerperal infection, recognition of *Streptococcus pyogenes* as the most important cause of these infections was not general at that time and attention was not, therefore, directed particularly to the elimination of that microbe from the hands.

(b) As to the procedures employed for determining the number of viable microbes left on the hands after treatment by antiseptics. Some investigators have been content with simply rubbing the finger points on the surface of solid nutrient medium; others have dipped the finger points in melted medium which was afterwards allowed to set; others again have swabbed or scraped the fingers in order to liberate any microbes in the depths of the skin, subsequently making cultures in fluid medium or on the surface of solid medium from the swabbings or scrapings.

These differences of procedure are of considerable importance in judging of the results obtained by different investigators.

Hands which appear to be sterile if tested merely by rubbing the pulps of the finger tips on solid medium will often yield a great number of colonies if a more stringent test is applied, for example, swabbing the whole of the finger skin, including the nail bed and sulcus.

Experiments with Alcohol and Alcoholic Solutions.

Since about 1895 many of the German workers have followed the lead of the late Prof. Ahlfeld (an obstetrician) (1) in advocating alcohol in preference to perchloride of mercury and lysol which, they assert, had proved unsatisfactory. Schumburg's work (2) in particular should be consulted in this connexion. He showed that treatment of the hands with alcohol (70-95%) does reduce very considerably the number of microbes which can be grown from them, but seldom, if ever, makes them completely sterile. Further that the removal of microbes was the more effective if the hands had not been previously washed in hot water.

Ahlfeld contested this latter statement but did not bring forward satisfactory evidence against it.

Schumburg also showed that little if any advantage was gained by soaking the hands, after they had been treated by alcohol, in stronger antiseptics such as perchloride of mercury (Furbringer's method (3)), or lysol.

There has been much discussion as to how the partial sterilising effect of alcohol is achieved. Some have held that it is a direct bactericidal process

(Ahlfeld), others that the microbes become fixed to the skin in consequence of the fat-solvent and dehydrating action of the alcohol (Stahlschmidt (4)).

Leedham Green (5) and other writers have pointed out that alcohol, when frequently applied to the hands, defeats its own purpose because it makes the skin rough and cracked, and in this condition the difficulty of making the surface sterile is very much increased.

Experiments with Iodine.

A useful account of these is given by Seedorff (1920 (6)). He was concerned more with the sterilisation of skin before surgical operations than with the skin of the hands. Although he quotes, and apparently confirms, the observation of Claudius (7) that iodine is more effective in watery solution of potassium iodide than in alcoholic solutions, Seedorff advises the latter, particularly solutions in propyl alcohol. He does not, however, claim that absolute sterility of the skin can be obtained by this or any other agent with regularity. To get the best results he advises preliminary mechanical cleansing with soap and water, as this removes the major part of the bacteria fortuitously planted upon the hands, including the spores.

By the study of frozen sections of skin removed at operation he was able to show that one hour after a second painting with 5% iodine (whatever the solvent) penetration had occurred only half-way through the stratum corneum: ten minutes after a second painting with a 10% solution it had reached to the boundary between the stratum corneum and the stratum germinativum (Malpighian layer).

But in view of the irritant effect of solutions of this strength on certain skins their use for routine obstetric work would seem to be out of the question.

Experiments with Hypochlorites and Chloramine T (Para toluene sodium sulpho-chloramide).

Inasmuch as the hypochlorites probably act (Dakin) by virtue of the formation of chloramines when in contact with protein substances, or protein degradation products, these two agents may be considered together.

The chief papers met with are those of Conover and Laird (8) who advocate the use of Eupad (boric acid and chlorinated lime, 0.15% of each in water); of Monziols (9), who used a mixture of boric acid with calcium chloride and sodium carbonate, made into a paste with a few drops of water; and of Bergin (10), who recommends "Chloramine-Heyden" (0.25 to 0.5%). All these authors claim that the hands can frequently be rendered sterile by the procedure they employed, but the bacteriological data are scanty. In order to get rid of the objectionable smell remaining on the hands they recommend the use of sodium thiosulphate.

Experiments with Formalin.

A. A. Babsky (11) carried out an extensive series of observation—on 227 subjects—with formalin solutions of different strength in glycerine. Details of his procedures are not very full, but he states that the hands were swabbed for the sterility test, and the swabs afterwards soaked in water in order to avoid any transfer of formalin to his culture medium. He obtained complete sterility in 50-70% of his tests after treatment of hands (duration not stated) with 3% formalin. Four per cent. and upwards was found to be irritant to the skin.

Experiments with Permanganate of Potash.

The only paper met with is that of Grimsdale (12), of Liverpool, who adopted the method of Schatz. He claimed to have completely sterilised the hands by washing (7 minutes) followed by saturated permanganate of potash till the skin was stained brown, then a solution of oxalic acid to decolorise, and finally lime water to neutralise the acid.

Summary of Impressions Gained by a Survey of the Literature.

1. Notwithstanding the claims of some authors it is probably impossible to sterilise completely the skin of the hands by any chemical treatment which does not injure the skin if frequently employed. The nail bed, nail sulcus and the backs of the fingers seem to be the most difficult parts to free from microbes.

2. Mechanical cleansing with soap and water removes a large part of the bacteria, including spores, which are fortuitously implanted upon the hands from time to time; but the residual flora (staphylococci, sarcinae and diphtheroid bacilli) is often not reduced in numbers—indeed it may be increased—by washing in hot water.

3. Although the number of viable microbes on the hands can be considerably reduced by treatment with alcohol, frequent repetition of that treatment is undesirable because it tends to make the skin rough and cracked.

4. There is not very much evidence as to the efficacy, or otherwise, of treatment by perchloride of mercury or of lysol as commonly employed in this country.

My Own Experiments.

The result of my survey of the literature seemed to show that there was need for further data before conclusions could be formulated with reference to obstetric practice. The problem of puerperal fever has been narrowed down to a large extent in recent years to a question of infection by streptococcus pyogenes, and the elimination of that microbe from the hands of those in attendance upon midwifery cases should therefore be kept prominently in view. The bacteriological investigations which are here described deal with:

(1) the occurrence of streptococcus pyogenes on the hands of maternity and surgical nurses and of medical men,

(2) the spontaneous disappearance of streptococcus pyogenes—and of other microbes—from the hands of normal individuals artificially infected,

(3) the effect of washing alone upon the microbic flora of hands so infected,

(4) the effect of treating the hands with perchloride of mercury and with lysol upon streptococci and upon the normal flora of the hands,

(5) the effect of other procedures which have been advocated for sterilisation of the hands,

(6) the chemical sterilisation of rubber gloves on the hands.

The Occurrence of Streptococcus Pyogenes on the Hands of Nurses, Medical Men and Others.

The fingers of 26 nurses employed in maternity and surgical work, and of 19 medical men and others employed in laboratory work, were swabbed with sterile broth and cultivations made in poured blood-agar, and on the surface of blood-agar plates.

In no instance was streptococcus pyogenes isolated. Staphylococcus albus was the most common organism, those associated with it being sarcina, yellow staphylococci, diphtheroid bacilli and diverse air-borne bacillary and mycelial types.

Although streptococcus pyogenes was not found in this series and has never, so far as I am aware, been isolated from normal hands, the possibility ought to be kept in mind that on hands which are chapped or slightly affected with chilblains or eczema this microbe might become temporarily a constituent of the habitual flora.

No opportunity to investigate this has occurred.

*The Spontaneous Disappearance of Streptococcus Pyogenes—and of Other
Microbes—from the Hands.**

In the course of experiments with hands artificially infected with bacterial cultures it was sometimes observed that the number of these bacteria recovered from swabbings was surprisingly small—so small as to suggest that they were being rapidly killed on the skin.

To put this to the test several fingers of a normal hand were infected with broth cultures of various microbes. As soon as the hands had dried—and at intervals later—one finger was thoroughly swabbed with sterile broth. (A finger provided a convenient unit in all these experiments.) Bacterial enumerations of the several samples of broth were made by appropriate dilution and replanting in melted agar or on the surface of a solid nutrient medium. By simple calculation from the number of colonies resulting we arrived at the total number of microbes washed off each finger.

Typical results of such experiments were as follows:—

Streptococcus pyogenes.

Exp. 1. One finger (R.H.)	3 minutes	after infection	gave	30,000,000 colonies	
					S. pyogenes.
2nd "	1 hour	" "	" "	1,722,000	" "
3rd "	2 hours	" "	" "	7,000	" "
Exp. 2. One finger (L.C.)	5 minutes	after infection	gave	2,200,000 colonies	
					S. pyogenes.
2nd "	30 "	" "	" "	520,000	" "
3rd "	1 hour	" "	" "	280,000	" "
4th "	2 hours	" "	" "	7,000	" "
Exp. 3. One finger (C.E.D.)	15 minutes	after infection	gave	1,900,000 colonies	
					S. pyogenes.
" "	1 hour	" "	" "	1,300,000	" "
" "	2 hours	" "	" "	200,000	" "
" "	3 hours	" "	" "	8,000	" "

On several occasions the hands thus infected with *S. pyogenes* were swabbed on the day following the experiment—but in no instance was this microbe cultivated. (The hands had, of course, been washed several times in the interval.)

Bacillus proteus.

Exp. 4. One finger (L.C.)	2 minutes	after infection	gave	525,000 colonies	
					B proteus.
2nd "	15 "	" "	" "	7,000	" "

Friedlander's bacillus.

Exp. 5. One finger (L.C.)	2 minutes	after infection	gave	24,000,000 colonies	
					Friedlander's bacillus.
2nd "	10 "	" "	" "	2,700,000	" "
3rd "	60 "	" "	" "	84,000	" "

Bacillus coli.

Exp. 6. One finger (L.C.)	10 minutes	after infection	gave	630,000 colonies.	
" "	35 "	" "	" "	98,000	" "
" "	70 "	" "	" "	7,000	" "
" "	150 "	" "	" "	700	" "

* After these experiments were finished and incorporated in this Report my attention was called to similar observations published by Charlotte Singer and Lloyd Arnold in the Proceedings Soc. Exp. Biol. and Med., Vol. 27, page 364. My own experiments had been first described (verbally) to the Pathological Section of the Royal Society of Medicine at a meeting held at St. Mary's Hospital, London, on Nov. 5, 1929.

These results show that several different microbic species are rapidly killed on the skin of the hands. The chances of transfer of pathogenic organisms (including haemolytic streptococci) from patient to patient on the hands of medical men and nurses must be greatly reduced by the operation of this bactericidal mechanism, quite apart from washing and antiseptic procedures.

It is not proposed to deal at any length here with the explanation of this bactericidal effect exerted on the skin. Three possible hypotheses suggest themselves, viz.: (1) that it is due to desiccation, (2) that it is due to the operation of "lysozyme," and (3) that it is due to the concentration of the salts of sweat by excretion. The first of these appeared to be very unlikely in view of the rapidity of the disappearance of *B. proteus* and *B. friedlanderi*. The following simple experiments showed that desiccation can play but a small part in the phenomenon.

A broth culture of various microbes was smeared very thinly over the outside of the closed end of several test tubes, and these were set up to dry at 37° C. At intervals, as shown below, one of the tubes was swabbed with sterile broth just as the fingers had been in Experiments 1-6, and bacterial counts made.

Strep. pyogenes.

Exp. 7. Test tube No. 1, dried for 25 min., gave	924,000 colonies	<i>Strep. pyogenes.</i>
" " 2 " " 2 hours	1,190,000	" "
" " 3 " " 4 hours	945,000	" "
" " 4 " " 28 hours	718,000	" "

B. coli.

Exp. 8. Test tube No. 1, dried for 25 mins., gave	560,000 colonies.
" " 2 " " 150 "	290,000 "
" " 3 " " 22 hours	66,500 "

A similar result was obtained when cultures of *B. proteus* and *B. prodigiosus* were dried on glass.

The action of lysozyme appeared at one time to offer a more likely explanation. My colleague Prof. A. Fleming (13) had demonstrated several years ago that fragments of skin, like many other body tissues, contained this rapidly acting bactericidal principle. This hypothesis, however, also appeared rather improbable when it was found that the microbe which has proved, facile princeps, the most susceptible to lysozyme action, i.e., *M. lysodeikticus*, is not so rapidly killed on the skin as those employed in Experiments 1 to 6.

The third hypothesis, therefore, is regarded for the present as the most plausible, but direct evidence in support of it has not yet been obtained.

The Effect of Washing alone upon the Microbic Flora of the Hands.

It has often been shown that ordinary washing with soap and hot water will sometimes increase the number of viable staphylococci on the skin of the hands. My own experience confirms this.

I have not met with any evidence, however, as to the effect of washing upon the fortuitous flora of the hands, i.e., the bacteria implanted upon them by chance contact with infective material, droplet contamination from the mouth, etc.

In order to determine this 2 or more fingers* were smeared with infective material of a "sticky" character and thoroughly dried. After 15 to 20 minutes one finger was swabbed with sterile broth and bacterial counts made as in experiments 1 to 6. The hands were then washed in hot water with

* The skin of the hands employed for all experiments in this investigation was normal. The nails were kept short.

ordinary toilet soap, and a nail brush used for the nails. After drying on a sterile towel the second infected finger was swabbed and a bacterial count made.

- Exp. 9. Fingers infected with saliva, *Strep. pyogenes* and *Staphylococci*.
Dried for half an hour.
One finger, before washing, gave 462,000 colonies (*S. pyogenes* 150,000).
2nd finger, after washing, gave 263,000 colonies (*S. pyogenes* nil).
- Exp. 10. Fingers infected with pure broth culture *Strep. pyogenes* and dried 10 mins.
One finger, before washing, gave 8,500,000 cols. (*S. pyogenes* 7,000,000).
2nd finger, after washing, gave "many" staphylococcal colonies and 3,500 cols *S. pyogenes*.
- Exp. 11. Fingers infected with saliva, *Strep. pyogenes* and *Staphylococci* and dried 45 mins.
One finger, before washing, gave 840,000 cols. (*S. pyogenes* 400,000).
2nd finger, after washing, gave 157,000 cols. (*S. pyogenes* "a fair number").
- Exp. 12. Fingers infected with thick pus containing *Staphylococci* and *Strep. pyogenes*.
One finger, before washing, gave 784,000 colonies (*S. pyogenes*, 24,500).
2nd finger, after washing, gave 2,800 colonies (*S. pyogenes*, nil).
- Exp. 13. Fingers infected with broth. culture of *B. prodigiosus*.
One finger, before washing, gave 11,200 colonies *B. prodigiosus*.
2nd finger, after washing, gave 1,400 colonies *B. prodigiosus*.

These records show that mechanical cleansing by soap and water, and a brush lightly applied round the nail sulci, will suffice to remove a large proportion—sometimes all—of the haemolytic streptococci and other microbes which have previously dried upon the hands in a sticky medium such as saliva or pus. It usually reduces—but will sometimes increase—the number of staphylococci which may be cultivated from the hands. In my experience and that of most investigators it never completely removes them.

The Effect of Treatment by Perchloride of Mercury and by Lysol upon the Normal Flora of the Hands, and upon Streptococci artificially implanted upon the Hands.

Special attention has been directed to the efficacy of these two antiseptics, because they are more commonly employed than any other for obstetric work in this country. In the first experiments (14 and 15) the procedure tested is that usually taught to students and pupil midwives.

Series 1. Observations of the Effect upon the Normal Flora of the Hands.

Four nurses who soaked their hands in perchloride of mercury, after washing, and two medical men who used lysol, were investigated.

Procedure.—All the fingers of the left hand were first swabbed with sterile broth and cultures made from the swabbings after appropriate dilution to determine the number of viable microbes. Both hands were then thoroughly washed for 2 to 3 minutes in unsterilised warm water with yellow soap, a nail brush being also used. Without drying they were next soaked up to the wrists in the perchloride or lysol solution for 3 minutes, the antiseptic being worked into the nail bed and sulcus with a piece of gauze. After rinsing in a bowl of sterile water the hands were dried on a sterile towel. Finally, when dry, all the fingers of the right hand were swabbed with sterile broth and a bacterial count made as before.

Results with perchloride of mercury (0.1% solution in water).

Exp. 14.	Nurse D.	Left hand	224,000 colonies mostly staphylococci.
		Right hand (treated)	7,600 " " "
	Nurse C.	Left hand	100,800 " " "
		Right hand (treated)	5,600 " " "
	Nurse W.	Left hand	26,000 " " "
		Right hand (treated)	9,600 " " "
	Nurse O.	Left hand	86,000 " " "
		Right hand (treated)	9,600 " " "

*Results with Lysol (0.62%, i.e., 1 drachm to 1 pint).**

Exp. 15.	Dr. O.	Left hand	508,000 colonies, mostly staphylococci.
		Right hand (treated)	45,000 " " "
	Dr. H.	Left hand	203,000 " " "
		Right hand (treated)	4,000 " Staphylococci and some diphtheroids.

Series 2. Observations of the Effect upon Streptococci Artificially Implanted upon the Hands.

In these experiments the fingers were first infected and dried. The washing was also sometimes more prolonged than in Experiments 14 and 15.

Results with Perchloride of Mercury (0.1%).

- Exp. 16. Fingers infected with saliva, *Strep. pyogenes* and staphylococci. Washing 5 minutes; perchloride 3 minutes, followed by ammonium sulphide to prevent transfer of any perchloride to the culture medium.
One finger, before washing, 616,000 colonies (*Strep. pyog.* 200,000).
2nd finger, after perchloride, 63,000 colonies (*Strep. pyog.* nil).
- Exp. 17. Fingers infected as in Exp. 16. Washing 5 minutes; perchloride, etc., as in Exp. 16.
One finger, before washing, 840,000 colonies (*Strep. pyog.* about 400,000).
2nd finger, after perchloride, 287,000 colonies (*Strep. pyog.* nil).
- Exp. 18. Fingers lightly infected with pus and blood, containing *Strep. pyogenes* and *Staph. aureus*. Dried 35 minutes. Washing about 2 minutes; perchloride 3 minutes. Hand rinsed after in ammonium sulphide and sterile water.
One finger, before washing, 7 million colonies (*S. pyogenes* 2,450,000).
2nd finger, after perchloride 112,000 colonies (*S. pyogenes* 280).

Results with Lysol (0.62%).

- Exp. 19. Subject L.C.
Fingers infected as in Exp. 16. Washing 5 minutes; lysol 3 minutes, hand rinsed after in sterile water, 1 litre.
One finger, before washing, 462,000 colonies (*Strep. pyog.* 150,000).
2nd finger, after lysol, 179,000 colonies (*Strep. pyog.* nil).
- Exp. 20. Subject R.H. Fingers lightly infected with blood and pus containing staphylococci and *Strep. pyogenes*. Washing 2-3 minutes; lysol 3 minutes; hand rinsed after in two changes (1 litre each) of sterile water.
One finger, before washing, 9,100,000 colonies (*S. pyog.* 2,100,000).
2nd finger, after lysol, 4,200 colonies (*S. pyog.* 70).

* The Lysol used in all these experiments was the ordinary laboratory stock as supplied by Messrs. Evans Sons, Lescher and Webb. It is their first-grade solution, designated Evansol, and standardised to contain 50% cresol.

It is seen that very similar results were obtained with perchloride and the brand of lysol here employed. Sterilisation in the bacteriological sense was never achieved—staphylococci being always cultivated in considerable numbers after treatment. Comparatively small implantations of streptococci dried upon the hands with saliva were killed (or mechanically removed), but a few survived when the hands were heavily infected with pus.

In view of the fact that in midwifery practice (and in surgery) these antiseptics are frequently used *without previous washing* for the purpose of re-sterilising hands which may have been in contact with infective material subsequent to their original "toilet" it was thought desirable to ascertain how far they can be relied upon to kill haemolytic streptococci when so employed.

In planning the following experiments a period of three minutes for treatment of the hands was arbitrarily chosen as being the maximum likely to be devoted to re-sterilisation in routine obstetric practice.

Results with Perchloride (Without Previous Washing).

- Exp. 21. Fingers infected with saliva, *Strep. pyogenes* and staphylococci. Perchloride (0.1%) 3 minutes. Hand rinsed after in water. One finger, before perchloride, 399,000 colonies (*Strep. pyog.* "many thousands").
2nd finger, after perchloride, 29,680 colonies (*Strep. pyog.* 7,000).
- Exp. 22. Fingers infected with saliva and *Strep. pyogenes*. Dried 25 minutes. Perchloride (0.1%) 3 minutes, lightly worked in with lint swab. Hand soaked after in ammonium sulphide. One finger, before perchloride, 4,550,000 colonies (*S. pyog.* about 4 million).
2nd finger, after perchloride, 616,000 colonies (*S. pyog.* 5,250).
- Exp. 23. Fingers lightly infected with thin pus containing *Strep. pyogenes* and staphylococci. Perchloride (0.2%) 3 minutes lightly worked in with swab. Hand soaked after in ammonium sulphide. One finger, before perchloride, 8,960,000 colonies (*S. pyog.* 2,100,000).
2nd finger, after perchloride, 22,750 colonies (*S. pyog.* 2,450).

Results with Lysol (Without Previous Washing).

- Exp. 24. Fingers infected with saliva, *Strep. pyogenes* and staphylococci—dried 45 minutes. Lysol (0.62%) 5 minutes, lightly worked in with swab. Hand rinsed after in 1 litre water. One finger, before lysol, 18,200 colonies (*S. pyog.* 7,000).
2nd finger, after lysol, 35,000 colonies (*S. pyog.* nil).
- Exp. 25. Fingers infected with saliva and *Strep. pyogenes*. Dried 40 minutes. Lysol (0.62%) 3 minutes, lightly worked in with swab. Hand rinsed after in 2 changes of sterile water (1 litre each). One finger, before lysol, 6,100,000 colonies (*S. pyog.* 5,900,000).
2nd finger, after lysol, 100,800 colonies (*S. pyog.* 7,800).
- Exp. 26. Fingers infected with broth culture *Strep. pyogenes*. Dried $\frac{1}{2}$ hour. Lysol (0.3%) 3 minutes, lightly worked in with swab. Hand rinsed after in 2 changes sterile water (1 litre each). One finger, before lysol, 2,700,000 colonies (*S. pyog.* 1,750,000).
2nd finger, after lysol, 268,000 colonies (*S. pyog.* "many thousands").

These results show that neither perchloride (0.1 or 0.2%) nor lysol (0.625%) can be relied upon to kill haemolytic streptococci on the *unwashed* hands within three minutes. Lysol was, however, successful when the hands were soaked in it for 5 minutes.

In the next section a similar test was applied to several other antiseptics.

The Effect of Various Disinfection Procedures, other than Treatment by Perchloride and Lysol, which have been Advocated for the Sterilisation of the Hands.

The experiments reported in this section had a twofold purpose, viz. (1) to determine whether haemolytic streptococci dried upon the hands as in previous tests could be killed within three minutes *without previous washing* (Series A).

(Alcohol was not included among the agents tested because it has proved unsuitable for frequent application to the hands on account of the roughness which it causes. Probably some of the agents which were tested would be found equally unsuitable, but definite information on this point was not available.)

(2) To determine whether hands can be *completely sterilised* by any of the procedures for which this has been claimed (Series B).

Series A.

- Exp. 27.** Subject L.C. Fingers infected lightly with pus containing *Staph. aureus* and *Strep. pyogenes*. Dried 25 minutes.
Iodine (1% in 1% *potassium iodide*). 3 minutes; followed by sodium thiosulphate and sterile water.
 One finger, before iodine, 10,800,000 colonies (*S. pyog.* 4,900,000).
 2nd finger, after iodine, 189,000 colonies (*S. pyog.* nil).
- Exp. 28.** Subject C.E.D. Fingers lightly infected with pus containing *Staph. aureus* and *Strep. pyogenes*. Dried $\frac{1}{2}$ hour.
Chloramine T (1%). 3 minutes; hand rinsed after in two changes of water (1 litre each).
 One finger, before Chloramine T, 8,500,000 colonies (*S. pyog.* 1,750,000).
 2nd finger, after Chloramine T, 4,410 colonies (*S. pyog.* nil).
- Exp. 29.** Subject L.C. Fingers lightly infected with pus containing *Strep. pyogenes* and *staphylococci*.
Formalin (3% in 5% *glycerin*). 3 minutes; hand rinsed after in two changes (1 litre each) of sterile water.
 One finger, before formalin, 4,400,000 colonies (*S. pyog.* 2,100,000).
 2nd finger, after formalin, 200,000 colonies (*S. pyog.* 19,600).
- Exp. 30.** Subject C.E.D. Fingers lightly infected with pus as above.
Monsol (0.2%), 3 minutes; hand rinsed after in two changes (1 litre each) of sterile water.
 One finger, before Monsol, 8,000,000 colonies (*S. pyog.* 1,610,000).
 2nd finger, after Monsol, 84,000 colonies (*S. pyog.* 39,200).
- Exp. 31.** Subject C.E.D. Fingers lightly infected with blood and pus containing *Strep. pyogenes* and *Staph. aureus*. Dried $\frac{1}{2}$ hour.
Monsol (0.5%), 3 minutes; hand rinsed after in sterile water, two changes.
 One finger, before Monsol, 11,900,000 colonies (*S. pyog.* 1,400,000).
 2nd finger, after Monsol, 39,500 colonies (*S. pyog.* 5,600).
- Exp. 32.** Subject L.C. Fingers infected with saliva and *Strep. pyogenes*.
Eupad (*Chlorinated lime and boric acid*, 0.15% of each), 3 minutes; hand rinsed after in two changes of sterile water.
 One finger, before Eupad, 7,200,000 colonies (*S. pyog.* 7,000,000).
 2nd finger, after Eupad, 84,000 colonies (*S. pyog.* 1,610).

As it was represented to me that Izal would be likely to give better results than most of the antiseptics I had tested, the following experiments were carried out—on unwashed hands, just as in Exps. 27 to 32.

- Exp. 33.** Subject L.C. Fingers lightly infected with pus containing *Strep. pyogenes*. Dried 30 minutes.
Izal (0.25%, i.e., as recommended by the makers for the

- sterilisation of hands), 3 minutes; hands rinsed after in two changes of sterile water.
 One finger, before Izal, 1,220,000 colonies (S. pyog. 980,000).
 2nd finger, after Izal, 1,470,000 colonies (S. pyog. 140,000).
- Exp. 34. Subject L.C. Fingers infected as before. Dried $\frac{1}{2}$ hour.
 Izal (0.5%), 3 minutes; hand rinsed after in two changes of sterile water.
 One finger, before Izal, 1,400,000 colonies (S. pyog. 511,000).
 2nd finger, after Izal, 378,000 colonies (S. pyog. 700).
- Exp. 35. Subject L.C. Fingers infected as before. Dried 25 minutes.
 Izal (1.0%), 3 minutes; hand rinsed after in two changes of sterile water.
 One finger, before Izal, 1,400,000 colonies (S. pyog. 1,260,000).
 2nd finger, after Izal, 230,000 colonies (S. pyog. 2,100).

It is seen that haemolytic streptococci were cultivated from the fingers after treatment for 3 minutes by each of these antiseptics—except 1 per cent. iodine and 1 per cent. chloramine T.

Series B.

In some of these experiments the number of streptococci surviving was not separately determined.

- Exp. 36. *Chlorinated lime and boric acid (Eupad)* (0.15% of each). Fingers infected with saliva, strep. pyogenes and staphylococci. Eupad solution... 3 minutes after washing; hands rinsed after in water.
 Two fingers before washing gave "many thousands" of colonies.
 Two fingers after Eupad gave "about 10,000" colonies.
- Exp. 37. *Schumburg's solution (absolute alcohol, ether and nitric acid)*. Fingers not artificially infected. Solution applied 3 minutes, without washing; hand rinsed after in water.
 Two fingers, before treatment, 26,000 colonies.
 Two fingers, after treatment, 2,000 colonies.
- Exp. 38. *Ether soap followed by "surgical spirit"* (i.e. industrial spirit, 64 over proof, with 2½% castor oil). Fingers not artificially infected.
 Ether soap with few drops of water and brush for nails, 2 minutes; surgical spirit 2 to 3 minutes.
 Three fingers, before treatment, 266,000 colonies.
 Three fingers, after treatment, 189,000 colonies.
 The experiment was repeated with same result.
- Exp. 39. *Iodine (0.5% in 1% potassium iodide)*. Fingers lightly infected with pus and blood containing staphylococci and Strep. pyogenes.
 Washing 2-3 minutes, iodine 3 minutes; hand rinsed after in sodium thiosulphate and sterile water.
 One finger, before washing, 9,000,000 colonies (S. pyog. 2,100,000).
 2nd finger, after iodine, 105,000 colonies (S. pyog. 70).
- Exp. 40. *Chloramine T (1%)*. Fingers lightly infected with pus and blood as in Experiment 36. Washing 2-3 minutes; Chloramine T 3 minutes; hand rinsed after in sodium thiosulphate and sterile water.
 One finger, before washing, 5,000,000 colonies (S. pyog. 1,750,000).
 2nd finger, after chloramine, 140,000 colonies (S. pyog. nil).

The combination of mechanical cleansing with antiseptic action (Experiments 36, 38, 39, 40) did not suffice to get rid of staphylococci from the fingers in any instance. A mixture of absolute alcohol with ether and nitric acid, which Schumburg had found most effective without previous washing of the hands, was also unsuccessful. Streptococci dried on the hands in a mixture of pus and blood were completely eliminated by washing combined with Chloramine T; and almost completely by a $\frac{1}{2}$ % solution of iodine.

*The Chemical Sterilisation of Rubber Gloves on the Hands.**

Although it is widely recognised that rubber gloves can be sterilised by antiseptics I have been unable to find precise data bearing upon the subject except the statement of Theobald and Bigger (14) that treatment for 1 minute in a 0.1% solution of biniodide of mercury, after washing, is sufficient for the purpose. That statement is a little misleading because it suggests that the antiseptic plays the more important part. The following experiment shows that washing alone removes the great majority of the organisms.

Exp. 41. *Washing alone.* Glove infected with pus containing Strep. pyogenes and staphylococcus. Dried.

One finger, before washing, 784,000 colonies (S. pyog. 24,500).
2nd finger, after washing, 2,800 colonies (S. pyog. nil).

The experiments which follow were carried out precisely as the earlier ones with naked hands. The first one (No. 42) shows that treatment for one minute by a 0.1% solution of biniodide *without previous washing* was not very successful.

Exp. 42. *Biniodide of mercury (0.1%) watery solution, without previous washing.* Glove infected with pus and blood containing Strep. pyogenes and staphylococci. Dried 30 minutes. Biniodide applied with lint swab, 1 minute 5 seconds; hand rinsed after in ammonium sulphide and sterile water.

One finger, before biniodide, 10,000,000 colonies (S. pyog. 7,000,000).
2nd finger, after biniodide, 2,100 colonies (S. pyog. 1,260).

Exp. 43. *Biniodide of mercury (0.4%) in 50% spirit, without previous washing.* Gloves heavily infected with pus and blood containing Strep. pyogenes and staphylococci. Dried $\frac{1}{2}$ hour. Biniodide applied with lint swab 2 minutes; hand rinsed after in ammonium sulphide and sterile water.

One finger, before biniodide, 5,250,000 colonies (S. pyog. 3,570,000).
2nd finger, after biniodide, 0 colonies.

Exp. 44. *Lysol (2%), without previous washing.* Gloves heavily infected with blood and pus containing Strep. pyogenes and staphylococci. Dried 35 minutes. Lysol applied with lint swab $1\frac{1}{2}$ minutes; hand rinsed after in two changes sterile water, 1 litre each.

One finger, before lysol, 13 million colonies (Strep. pyog. $10\frac{1}{2}$ millions).
2nd finger, after lysol, 42 colonies (Strep. pyog. nil).

Exp. 45. *Perchloride of mercury (0.5%), without previous washing.* Gloves heavily infected with pus containing Strep. pyogenes and staphylococci. Dried one hour. Perchloride applied with lint swab $1\frac{1}{2}$ minutes; hand rinsed after in ammonium sulphide, followed by sterile water.

One finger, before perchloride, 4,000,000 colonies (S. pyog. 1,085,000).
2nd finger, after perchloride, 56 colonies (S. pyog. nil).

Exp. 46. *Chloramine T (1%), without previous washing.* Glove infected with saliva and cultures of Strep. pyogenes and staphylococcus. Chloramine T applied with lint swab 2 minutes; hand rinsed after in sterile water.

One finger, before chloramine T, 11,200,000 colonies (S. pyog. $8\frac{1}{2}$ millions).
2nd finger, after chloramine T, nil.

Exp. 47. *Chloramine T (2%), without previous washing.* Gloves infected with pus containing Strep. pyogenes and staphylococci. Dried 25 minutes. Chloramine T applied with lint swab, $1\frac{1}{2}$ minutes; hand rinsed after in sterile water.

* The gloves employed in these experiments were of smooth, thin, red rubber, of German manufacture, and sold for domestic purposes by Messrs. Woolworth. I am advised that they are sufficiently thin (they vary a little) for routine obstetric purposes, though possibly not for the "operations" of midwifery.

One finger, before chloramine T, 15,100,000 colonies (*S. pyog.* 10,500,000).

2nd finger, after chloramine T, 70 colonies (*S. pyog.* nil).

Exp. 48. *Carbolic acid* (1%), *without previous washing*. Glove infected with pure broth cultures, *Strep. pyogenes* and *staphylococcus*. Carbolic applied with lint swab, 2 minutes; hand rinsed after in sterile water.

One finger, before carbolic, 950,000 colonies (*S. pyog.* 650,000).

2nd finger, after carbolic, 14 colonies (*S. pyog.* nil).

These results show that large numbers of haemolytic streptococci dried upon the gloved hand along with staphylococci and saliva or pus were completely killed by contact for $1\frac{1}{2}$ or 2 minutes (without previous washing) with biniodide of mercury in spirit, lysol, perchloride, chloramine T or carbolic acid. The very small number of colonies—of staphylococci and air-borne bacteria—which were cultivated from the gloves in some of the experiments after disinfection, may justifiably be disregarded. Some of them, no doubt, were attributable to contamination from the air in the process of swabbing the fingers, etc. Bacteriologists will appreciate that it is difficult to conduct experiments of this kind in an ordinary laboratory where several people are working without getting a few such contaminations.

SUMMARY OF RESULTS.

1. Cultures made from the hands of 45 normal individuals—nurses, medical men, and laboratory attendants—taken at random while at work, yielded no colonies of haemolytic streptococci. It is highly probable that *Streptococcus pyogenes*, unlike the *Staphylococcus*, is unable to establish itself in the various fissures, sweat glands, etc., of the normal skin.

2. *Streptococcus pyogenes*, *B. coli*, *B. proteus* and the bacillus of Friedlander, when implanted upon the hands, were rapidly destroyed. The nature of this bactericidal process is not yet clear. Whatever the explanation there can be little doubt that the operation of this protective mechanism must diminish the chances of transfer of pathogenic bacteria on the hands of those attending midwifery or surgical cases.

3. Washing with soap and warm water gets rid of many—sometimes all—of the haemolytic streptococci previously implanted and allowed to dry upon the hands. Staphylococci always persist after washing, but usually in reduced numbers. Occasionally the number appears to be increased.

4. When preliminary washing was omitted treatment of the infected hands for 3 minutes by perchloride of mercury (0.1%) or by lysol (0.62%) did not suffice to get rid of haemolytic streptococci. The combination of mechanical cleansing by soap and water with treatment by perchloride or lysol was effective for hands infected with a comparatively small number of haemolytic streptococci and saliva; but the streptococci were not completely killed when they were present in comparatively large numbers along with traces of dried pus and blood. Under these last conditions complete elimination of streptococci was obtained only by treatment with Chloramine T (1%) after washing. (One experiment.)

5. Treatment for 3 minutes by formalin (3%), Monsol (0.5%) and Eupad (0.3%) failed to kill haemolytic streptococci on the unwashed hands. The same streptococci did not survive a similar exposure to 1% solutions of iodine and chloramine T.

6. Treatment of the normal hands, with or without previous washing, did not kill the microbes (chiefly staphylococci) which are habitually established on the skin. One thousand colonies, or more, have grown in every instance from the washings of a single finger.

7. Smooth rubber gloves on which infected blood and pus had been dried were completely freed from haemolytic streptococci by simple washing in soap and water. A small number of staphylococci could still be recovered from them.

Complete, or almost complete, sterility of gloves so infected was obtained by soaking, without previous washing, in—

- perchloride of mercury (0.5%) for 1½ minutes.
- lysol ("Evansol") 2% for 1½ minutes.
- chloramine T 2% for 1½ minutes.
- carbolic acid 1% for 2 minutes.
- biniodide of mercury, 0.4% in 50% alcohol for 2 minutes.

CONCLUSIONS.

Sterilisation of the hands aims at preventing the transfer of pathogenic bacteria to the genital passages of the mother (a) by an initial thorough antiseptic toilet and (b) by further treatment from time to time during the course of labour in case the hands have become contaminated by contact with infective material. It is not, perhaps, generally recognised that this contact with infective material may be only a sub-perceptible contact. The hands may be reinfected with streptococci by salivary spray ejected by coughing, sneezing, and even in the course of conversation.

Haemolytic streptococci, indistinguishable from those which cause puerperal infections, are known to be present from time to time in the fauces of a certain number of people. It sometimes happens that the parturient woman herself, or one of her attendants, is one of these people. In that event streptococci, potentially dangerous, are being unconsciously sprayed into the air around the patient during the period of labour. Some of them will reach the hands of the attendant and so, indirectly, may be transferred to the vulva or vagina.

The experiments here reported show that the initial antiseptic toilet as commonly advocated in this country, viz., thorough washing, followed by treatment of the hands for 3 minutes with perchloride of mercury (0.1%) or lysol (0.62%) of good quality will usually succeed, if it is conscientiously carried out, in getting rid of any haemolytic streptococci with which the hands have become contaminated. Washing alone removes the greater number of such streptococci. It must be emphasised, however, that these procedures do not sterilise the hands in the bacteriological sense. Staphylococci, and sometimes diphtheroid bacilli, can still be cultivated from them. Moreover, as a means to the elimination of streptococci, this antiseptic toilet offers only a small margin of safety. If the washing is perfunctory, or the strength of the antiseptic solutions is reduced, or, again, if the streptococcal contamination of the hands is a heavy one and combined with serous discharges, killing is likely to be incomplete.

There would seem to be little to choose between perchloride of mercury and a lysol of good quality, such as the one employed in my experiments, for the initial antiseptic toilet of the hands. In view, however, of the fact that lysol is somewhat more prone to irritate the skin (and in consequence is often used in very dilute solution), and the further fact that the several brands of lysol now on the market have different characters and bactericidal potency, there is much to be said for discontinuing the use of these products in midwifery until such time as their manufacture is so regulated as to ensure uniformity of bactericidal power combined with low toxicity for skin tissues.

Iodine (0.5–1%) or chloramine T (1%) are more efficient for killing haemolytic streptococci on the hands than either perchloride or lysol and should be tried. Their use is open to some objections (smell, staining, etc.), and it is not unlikely that they would be found too irritant for frequent use.

* * * * *

The problem of re-sterilisation of the hands at intervals is more difficult. The midwife needs for this an antiseptic solution which can be relied upon to kill streptococci on the hands quickly, i.e., within 2 or 3 minutes at most—and without previous washing. Only iodine and chloramine T. have been found to fulfil this condition. Perchloride (even 0.2%) and lysol (0.62%) do not.

* * * * *

The situation may be summed up as follows: for the ordinary run of clean midwifery practice the measures usually employed to prevent the transfer of pathogenic streptococci on the hands to the parturient woman will usually suffice.

They do not, however, offer a sufficient safeguard when circumstances favour the epidemic spread of puerperal infection, i.e., when those attending the labour, or the patient herself, are carriers of pathogenic strains.

Since the occurrence of these circumstances cannot be foreseen, it is desirable, in the interests of safer childbirth, *that rubber gloves should be much more widely employed in all midwifery work.* Smooth, thin gloves can now be bought very cheaply, and, if not heated, wear well. Their sterilisation on the hands is very readily effected, with or without washing, e.g. by perchloride of mercury (0.5%) or biniodide in spirit (0.4%) or carbolic acid (1%).

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APPENDIX E.

The Need for Bacteriological Services in the Control of Puerperal Infections.

By LEONARD COLEBROOK, M.B., B.S., and F. GRIFFITH, M.B., Ch.B.

Bacteriology should be called upon to contribute in a much larger measure than heretofore to the prevention and the treatment of puerperal fever. The contribution it can make is of several kinds.

Firstly, it enables us to recognise *at an early stage* the case infected by haemolytic streptococci. Too often in the past the gravity of a patient's illness and the need for energetic treatment have only been suspected after 3 or 4 days of fever which does not subside. Then—too late—she is removed to hospital and treatment started, at a time when there is little hope of overtaking the infection. It cannot be too strongly emphasised that clinical signs and symptoms often do not enable us to distinguish with any certainty in the early stages of puerperal fever between the infections by haemolytic streptococci and the more common, but less serious, infections by other organisms. The failure to make that differentiation is responsible for many of the deaths from puerperal fever. By the simple precaution of taking a swab from the patient at the first sharp rise of temperature, say about 101° F., the case infected by haemolytic streptococci would be detected within 24 hours. If no haemolytic streptococci are found the bacteriological report is still of value. The doctor is reassured as to the immediate prognosis and is guided in his decision as to the necessity for moving his patient to hospital. Further, he will not, as so frequently in the past, adopt a line of treatment, such as the injection of anti-streptococcal serum, which is quite inappropriate to the case, may do harm and may cause much misery. A sterile culture, or one nearly sterile, tells him that the infection is probably not a uterine one, and that he should look elsewhere for the explanation of the fever. An abundant culture of *B. coli* or of anaerobic streptococci indicates the true nature of the uterine infection and the need for treatment, either local, e.g. by glycerine, or general, by the appropriate vaccine.

Secondly, bacteriological investigation enables us to devise intelligent measures to prevent the spread of infections by haemolytic streptococci. When a case occurs in a Maternity Institution previously free from infection, a bacteriologist's report will, within 24 hours of the onset of fever, not only show the need for the immediate isolation of the patient, and for redoubled antiseptic precautions, but also may make it possible to trace the source of the infection, e.g. to a throat carrier of *Streptococcus pyogenes* among the staff or the patients. If such enquiry is delayed for several days it may happen that the carrier condition has already extended to other members of the staff, rendering it more difficult to detect the original source of the infection and prevent further spread. In these circumstances further cases of puerperal infection are apt to develop and it becomes necessary to close down the Institution for the time being.

Thirdly, bacteriological investigation enables us to be forewarned of danger from carriers of haemolytic streptococci. There is reason to believe—although it is not yet fully established by evidence—that the carrier of haemolytic streptococci in a throat quite free from inflammation is much less dangerous than the carrier who has a mild tonsillitis or laryngitis caused by these streptococci. Pending further evidence on the matter it would seem to be very desirable that in Maternity Institutions and District Midwifery Associations all such instances of mild throat infection should be reported and examined bacteriologically.

Fourthly, bacteriological methods must play an increasingly large part in the future in the development and testing of therapeutic remedies for puerperal fever.

BACTERIOLOGICAL PROCEDURES APPLICABLE TO THE INVESTIGATION OF A CASE OF PUERPERAL FEVER.

The following procedures may be recommended.

1. For the Examination of Material from the Genital Tract.

The sample is collected on a cotton wool swab (preferably mounted on pewter wire which is easily bent to an angle of about 20° at its end) from the upper vagina or (better) from the cervix uteri. In cases of several perineal or vaginal lacerations a swab from the lower vagina should suffice.

On arrival at the laboratory the swab is rubbed on two blood-agar plates. (*vide infra* for the method of making these), using a small sector of each plate, and the explanted material is subsequently distributed thinly over the rest of the plates by a platinum wire, or a glass rod bent at right angles. One plate is incubated aerobically, the other anaerobically in a McIntosh and Fildes jar. If the case from which the swab was taken is one of severe haemolytic streptococcus infection the aerobic plate will show an abundant, almost pure, culture of these organisms, easily recognisable within 20 hours by the decolorised zones around the colonies. There will seldom be any doubt as to the nature of the infection when such cultures are obtained. If the aerobic plate shows no typical haemolytic streptococcal colonies, or very few of them, the anaerobic plate should be left in the incubator for a further 24 hours to give time for the development of anaerobic streptococci.

2. For the Cultivation of Organisms from the Patient's Blood.

(When the swab from the cervix has given an abundant culture of haemolytic streptococci examination of the patient's blood is not necessary unless we wish to determine whether the infection has become generalised. On the other hand, when the culture made from the genital tract shows no haemolytic streptococci but mixed colonies of several microbic types, blood culture will often reveal the true nature of the patient's infection. In such cases strictly anaerobic, as well as aerobic methods should be employed, since there is evidence that cases of this kind often have a generalised infection by anaerobic streptococci, which may easily be missed unless specially sought for.)

Four c.cms of the patient's blood, taken from a vein with due aseptic precautions, is distributed as follows:—

(a) 1 c.cm into a large ampoule containing 1 c.cm of 5% solution of sodium chloride. The mouth of the ampoule is then closed with sealing wax and the contents thoroughly mixed. On returning to the laboratory the contents are transferred to a Petri dish, mixed with several c.cms of sterile broth, and finally with 15-20 c.cms of melted agar at a temperature of about 47° C.

This plate culture, when the agar has set, is incubated aerobically. It serves, in a case of septicaemia due to haemolytic streptococci, to tell us approximately the number of streptococci free in the patient's blood stream—information which is often of some value for prognosis.

(b) 1 c.cm into a tube of glucose broth (10 c.cm) to which about 0.3 c.cm of sterile trypsin (Fairchild's Injectio Trypsini Co.) has been added—and thoroughly mixed—with a pipette. (The trypsin is added in order to prevent clotting and at the same time antagonize the antibacterial elements of the blood. *Vide* Douglas and Colebrook, "Lancet," 1916, ii. 180.)

(c) 1 c.cm into a tube of the same medium as in (b) supra but prepared in a slightly different manner with a view to favouring the growth of anaerobic bacteria; the glucose broth is thoroughly boiled and is then quickly cooled; the trypsin is added and mixed, and the whole covered with a layer of melted vaseline. When required for the blood culture the tube is warmed round the layer of vaseline and then sloped. This serves to break the vaseline seal and permits the introduction of the blood into the broth. When that is accomplished the seal is easily re-established by again warming the tube at the top of the fluid and setting it upright.

(d) 1 c.cm into a tube of meat-broth medium prepared as described by Lepper and Martin (Brit. Jour. Exp. Path., 1929, x, 327) and covered with a layer of liquid paraffin.

Growth of haemolytic streptococci or of other aerobic species will usually be evident, even to the naked eye, after 24 hours' incubation in the tube (b). The growth of anaerobic streptococci is always much less evident—it should be sought for in tubes (c) and (d) after two and four days' incubation by film examination and subculture on blood agar.

3. For the Examination of the Patient's Urine.

The centrifuged deposit of a catheter specimen is examined by stained films and by cultivation on plates of blood agar, and McConkey's or other selective medium.

Epidemiological Investigation in Puerperal Fever of Haemolytic Streptococcal Origin.

In cases of puerperal sepsis caused by haemolytic streptococci it should be the aim to discover the source of infection, and an attempt should be made whenever circumstances permit. With this object in view throat swabs should be taken from any person in contact with the patient as well as from the patient herself. Other possible sources of infection, such as children in the house with ear discharges or tonsillitis, should be examined.

Since haemolytic streptococci are widely distributed and are of not uncommon occurrence in apparently normal throats, their discovery in any of the above situations indicates merely a potential source of infection; to establish their aetiological connection with the puerperal disease it is necessary to identify the puerperal strain with that from the suspected contact.

It is essential, therefore, to obtain all strains in pure culture and to subject them to comparative tests. These may include the appearances of the colonies in spread and poured plates, and the fermentation reactions with different sugars. The character of the surface colonies and the haemolytic activity of two or more strains are best compared by planting them thinly on different sectors of the same blood plate. While the above tests are of value in differentiating one strain from another it is necessary, in order to establish their identity, to have recourse to serological methods.

Haemolytic streptococci from puerperal sepsis are not homogeneous; they comprise, on the contrary, a group of strains as diverse in their serological characters as those from other forms of sepsis, from tonsillitis and from scarlet fever. This extreme diversity of antigenic types in the group of haemolytic streptococci makes the identification of two strains a difficult and laborious procedure, since a very large number of different type sera are required. On the other hand, there is this advantage in the infrequent occurrence of a particular type that the presumptive evidence of infection is the stronger when the puerperal strain and that from the suspected contact are found to be of the same type.

The recommendation that tests should be carried out to establish the serological identity of strains of streptococci derived from puerperal cases with those of carriers who have been in contact with them is recognised to be at the present time a counsel of perfection. Much work on the classification of streptococci is still required and progress would be advanced by the appointment of one or more workers in a central laboratory who would prepare a large number of type sera and be available for carrying out the identification tests on strains submitted to them.

Characters of Puerperal Haemolytic Streptococci.

The haemolytic streptococci responsible for the production of puerperal fever belong to the streptococcus pyogenes group, in which are included the scarlatinal, septicaemic, tonsillitis and erysipelas streptococci. The distinguishing characteristic of streptococcus pyogenes—i.e., the destruction of the red corpuscles and the decolorisation of the haemoglobin ("beta haemolysis" of Brown, 1919), within a radius of 2-4 mm.—around the colonies on fresh blood agar plates, makes its presence easily recognisable. As it is important

that the results of different observers should be strictly comparable it is desirable that the blood added to the culture medium should be from one and the same species of animal; the red cells of the horse are recognised to be particularly suitable for the exhibition of haemolysis. In making the plates a layer of ordinary agar should first be allowed to set in the Petri dish, and this should be just covered by a second layer of agar containing 5 per cent. horse blood.*

While the recognition of colonies of *S. pyogenes* in throat cultures on the blood agar plate made as described above rarely presents difficulty it must be acknowledged that exceptions occur. Streptococci will sometimes be found which produce definite beta haemolysis, but in regard to their other characters appear to differ from the typical *S. pyogenes* of puerperal infections, scarlet fever, etc. The classification, and the best means of recognising these aberrant haemolytic strains, are subjects which require further investigation.

Finally, it may be recommended that in dealing with cultures from throat swabs the abundance or sparseness of the growth of haemolytic streptococcal colonies should be taken into account. There may be difficulty in deciding whether any administrative action ought to be taken on finding that a swab from a particular nurse or medical man has given one or two colonies of haemolytic streptococci, but there is little room for doubt when such a swab has given an abundant, almost pure culture.

SEROLOGICAL IDENTIFICATION.

Agglutination Tests. The chief difficulty in serological work with haemolytic streptococci is the obtaining of suspensions sufficiently uniform for agglutination tests. One way of obviating this difficulty to a considerable extent is to use the following slide method instead of the more customary water-bath method of carrying out the test. The strain is grown in serum broth, preferably from a plate colony which generally grows at the bottom of the tube; occasionally centrifuging will be necessary, but should be avoided when possible. Without disturbing the deposit the supernatant broth is pipetted off with the exception of about 0.5 c.c., in which the deposit is resuspended. Drops of this fairly thick suspension are placed on a slide and mixed with each of the available agglutinating sera, the result being watched under a low power microscope. When a strain gives immediate coarse flocculation with a particular serum it is possible that it may be of the same type as that from which the serum was prepared. But since cross-agglutination between strains and sera of different types is not uncommon agglutin-absorption tests must be made before the type can be identified with certainty.

Agglutinin-absorption Method. The following is a quick method of determining whether a culture will exhaust a serum of its homologous agglutinin. The centrifuged deposit of 100 c.cm. of glucose broth culture, contained in a bulk of 1.25 c.cm., is added to 0.05 c.cm. of the serum to be tested. The culture and serum are well mixed and centrifuged immediately. The supernatant serum-dilution is tested by the slide method for the presence of agglutinin. A control absorption test with the homologous strain is, of course, essential.

Preparation of agglutinating sera in rabbits. With certain strains of haemolytic streptococci agglutinating sera can be prepared with comparative ease, while other strains may fail even after a long series of injections to produce a type specific serum. A method of immunising rabbits, which has given fairly successful results is the following. The culture is grown in glucose broth for 6-8 hours; after heating to 60° C. for one hour it is centrifuged, the deposit collected and resuspended in 10 c.c. of salt solution. The rabbit is injected on two or three consecutive occasions in each week with gradually increasing doses, beginning with one c.c. of the suspension until the whole ten c.c. are injected in one week. A serum of sufficiently high titre for use with the slide method may be obtained after a course of treatment of 6 weeks to 3 months. The titre should be at least 1 in 80.

* Sterile horse blood for culture media may be obtained from Burroughs, Wellcome and Company.

APPENDIX F.

Ante-Natal Clinics: Their Conduct and Scope.*I. Introductory Considerations.*

It is acknowledged that, speaking generally, the present standard of ante-natal care remains below what is required for safeguarding the mother, even within the limits of our present knowledge. Some pregnant women receive no ante-natal supervision at all, and there is reason to believe that in other cases the supervision is so insufficient that harm may be done by giving a false sense of security.

It is important to obtain for every pregnant woman a high standard of examination and treatment, and it appears certain that a definite standard for such work would be helpful to those responsible for organising and administering ante-natal clinics, as a further step in the reduction of the present high mortality rate. The adequacy of such clinics necessarily affects the whole of the work done for the pregnant woman, not only at the present time, but in the future, since a proportion at least of these clinics are attended by medical students and pupil midwives, and the educational effects are thus far reaching.

II. Principles of Ante-Natal Care.

1. Every pregnant woman should receive sufficient ante-natal care to ensure that a difficult labour will be foreseen as far as this can be done by efficient examination. Such examination should include not only the pelvic and abdominal organs, but the general physical condition: the home conditions of the patient should be investigated as well.

2. Every woman should receive sufficient ante-natal supervision to ensure the early detection and treatment of toxæmia within the limits of our present knowledge.

3. Ante-natal care should include measures directed against infection (e.g., dental care, the treatment of infection of the cervix), and measures increasing the resistance to infection, as well as directions as to preparations for labour and the puerperium.

4. Measures should be taken to include within the scope of ante-natal care the diagnosis and treatment of venereal diseases.

5. The closest co-operation should be maintained between the clinic and all persons in whose charge the pregnant woman may be during pregnancy, labour and the puerperium.

6. In order that the high standard of ante-natal care which is necessary may be maintained by midwife and doctor, the educational effect of a well-organised clinic must be always kept in mind.

III. Application of Principles.

Details of the application of these principles are given below, and it must be realised that any restriction in the extent of the ante-natal care here described will diminish that degree of safety to the woman in childbirth which is possible in the present state of our knowledge. It is obvious that such intensive care can only be given when the patient actively co-operates with the clinic or doctor. Such co-operation can be facilitated by educational propaganda, and by the following up of cases to ensure regular attendance. A proportion of the necessary observations might well be made in the patient's home by the midwife, in co-operation with the clinic or practitioner.

IV. The Ante-Natal Clinic.

Ante-natal clinics may belong to two categories—namely (a) The Consulting Clinic, (b) the Clinic for routine Examination. The Consulting Clinic may serve both purposes, but there is always likely to be a large number of municipal clinics whose function will not be consultative. It is possible that under a reformed maternity service much of the work of such routine

examination clinics may be transferred to the family practitioner and the trained efficient midwife, but at present they are essential for securing ante-natal care where it would not otherwise be available.

The Consulting Clinic will necessarily be staffed by obstetricians of standing, since it could not otherwise adequately perform its functions, and it may therefore be assumed that the organisation, equipment, etc., will be sufficient for its purpose.

The Examination Clinic.—This is the type of clinic under consideration, and will be referred to subsequently simply as the “Ante-Natal Clinic.”

V. The Organisation of an Ante-Natal Clinic.

1. Premises and Equipment.

The success of a clinic will depend to a considerable extent on suitable premises being secured either in an existing institution or elsewhere; the essentials of warmth, cleanliness and privacy, are, however, comparatively easily obtained. The lack of a special building should not discourage organisers. An important consideration is the question of accessibility. The essential furniture and equipment are simple and inexpensive.

2. The “Personnel.”

(a) *The Medical Officer*.—The Medical Officer, whether whole or part time, should be trained and experienced both in obstetrics and ante-natal work, and should preferably have held a resident appointment in a maternity hospital, with experience at its ante-natal clinic. Failing this at least three months’ post-graduate instruction at a recognised school should be required if the Medical Officer has had no recent obstetrical experience. Obstetrical experience in general practice is extremely valuable, but should be supplemented by post-graduate training or experience in ante-natal work.

(b) *The Nurse*.—The Medical Officer will require the assistance of a midwife with post-certificate experience in obstetrics and ante-natal work. A second assistant will be required in large clinics for clerical and educational work.

3. The Patients.

The patients will include:—

- (1) Those sent by medical practitioners.
- (2) Midwives’ cases.
- (3) Those coming independently.
- (4) Those sent by health visitors.

(a) A patient coming under categories (3) and (4) should be asked what arrangements she has made for her confinement, and if she has not already made any should be advised to do so without delay. Under a following-up scheme it would be possible to ascertain that she does so. If she engages a midwife her ante-natal care would be secured as suggested under the next heading.

(b) *Midwives’ Cases*.—Midwives are obliged under the Central Midwives Board rules to undertake the ante-natal care of their cases, and to keep records, but many of them are unable to do so efficiently, and in assisting and educating them to do so the clinic will find great scope for useful work. If the clinic examinations are made independently of the midwife a double series of examinations is entailed, which is not only worrying to the patient, but leads to the confusion of a double responsibility. Midwives should therefore be encouraged to bring their patients to the clinic and to do their ante-natal work there under supervision, until their knowledge of what is required and their skill in detecting abnormalities are sufficient to enable them to do the routine work in ordinary cases by themselves.

Recently trained midwives may be found able to do this work in all their cases, but even they should be urged to send their cases to a doctor or a clinic for ante-natal examination at least twice during pregnancy.

On booking a case the midwife should ascertain the name of the doctor the patient would wish to employ in case of need during labour, and should inform him of this possibility, and of the ante-natal condition. Forms might suitably be supplied for the purpose by the Local Authority. After the labour

the midwife should be advised to supply the clinic with a report as to the character of the labour, and the Local Authority might pay a small fee for such reports.

(c) *Doctors' Cases.*—If a patient attends a clinic, having already booked a doctor for the confinement, no examination should be made until the doctor has been informed of the patient's wish to attend, and his consent has been obtained. Subsequently reports should be sent to him in every abnormal case, and he in return should be asked to describe the character of the labour.

Any doctor wishing to transfer the whole or part of the ante-natal care of a patient to a clinic should be able to do so. Reports would be sent as before.

4. *Records.*

It is of the greatest importance that records of all ante-natal work should be kept and should be available to any of the trained persons who may from time to time be in charge of an expectant mother. With the patient's consent a written report should be given or sent by the Medical Officer to the doctor or midwife concerned after the preliminary examination has been made, after the special visits, and in all cases of abnormality, whether these are sent by the midwife or doctor or occur in patients already under the care of the clinic. A report of the childbirth should in return be sent to the clinic not only for use in future pregnancies, but also in order that the Medical Officer may check his findings with the actual result.

5. *Co-operation with Hospitals.*

It is hoped that hospitals, both large and small, will be prepared to reserve beds for maternity cases referred to them by clinics or doctors, and that all clinics will work in direct association with one or more hospitals.

As hospitals may find difficulty in providing the ante-natal care for patients living at a distance, it should be possible for them to make arrangements for such patients to attend the nearest clinic during the whole or part of pregnancy as circumstances suggest. In such cases mutual reports would be exchanged.

In all cases presenting difficulty in diagnosis ante-natal consultations with an obstetrician should be possible, either through a clinic or through the patient's own doctor.

6. *Appointments and following up.*

At the first visit to the clinic the woman should be given an appointment card and the date of her next visit booked. If she does not come on that date a note should be sent making another appointment, and if this also fails the health visitor should make a visit to the house. If attendance is not then secured the midwife should be informed of the fact and of her responsibility as to ante-natal care.

7. *Subsidiary Activities.*

The supply of sterilised maternity outfits for labour at cheap rates might properly be undertaken, also the supply at wholesale prices of suitable antiseptics to midwives, etc.

In necessitous cases the provision of food and milk may be desirable.

VI. *Minimum Scope of Ante-natal Examinations.*

A patient should attend first at the 16th week of pregnancy, unless owing to trouble at a previous confinement she has been asked to attend earlier. At this visit a full medical and obstetrical history should be taken, and, if she is prepared, a physical examination should be made. This should include examination of the urine, and an estimation of the blood pressure as a standard for future reference. Dental treatment, if found necessary on examination, should be arranged for. The pelvic measurements should be taken. The question of vaginal examination should be left to the discretion of the Medical Officer, but would always be desirable where there is a discharge or a history of difficult or septic labours. Wasserman reaction should be ascertained where necessary. The breasts should be examined in all cases.

After the examination by the Medical Officer is completed the nurse should enquire into home conditions, give the patient an "Advice Leaflet," and advise her on hygienic matters. Where necessary the home should be visited. The date and hour of the next visit to the clinic should be arranged.

From this time routine examinations should take place either at the clinic or the patient's home as follows:—At the 24th and 28th weeks, from then every fortnight until the 36th week, and thence weekly until she is confined. The uterine height and girth should be taken, the foetal heart listened for, the urine tested, and general enquiries should be made, with special regard to the action of the excretory organs. The midwife should be able to do this examination in most cases at the patient's home, but *any abnormality*, however slight, *must* be brought to the notice of the Medical Officer of the clinic.

In place of, or supplementing, the routine examinations, special examination should be made by the Medical Officer at the 32nd and 36th weeks. These will be directed mainly to ascertaining the presentation of the foetus, and the relation of head to pelvis.

It is advisable that, where possible, the blood pressure should be examined weekly during the last month, as a rise of pressure may be the first sign of a commencing toxæmia.

It is important that the expected date of confinement should be ascertained early in pregnancy, and be confirmed from time to time, and any patient going beyond the 40th week should be referred to the Medical Officer.

If a patient should at any time develop abnormalities rendering her case unsuitable for attendance by a midwife alone, the latter should be informed.

Generally speaking, treatment of abnormal conditions is not the work of an ante-natal clinic. Any cases requiring treatment beyond simple measures should be referred, whenever possible, to the family doctor, or to a consulting clinic, or a hospital.

Finally, the importance of co-operation between the clinic and the professional attendant, as well as the accurate keeping of records, cannot be over-estimated.

Suggestions for Equipment of an Ante-Natal Clinic.

Furniture.

Doctor's Room.

Writing table; chair; patient's chair; examining couch (6 ft. by 2 ft. by 2 ft. 6 ins. high); surgical trolley (16 ins. by 16 ins. by 30 ins.) or enamelled table (for instruments, bowls of disinfectant, etc.); wash hand basin on enamelled stand (where fixture is not available); *cupboard (metal frame, glass front and sides) (instruments); * wall thermometer; fireguard.

Nurses' Room.

Writing table (small); chair; patient's chair; cupboard; wash hand basin on stand (if no fixture); small side table (for sterilizing, urine testing, etc.); * weighing machine; 2nd couch (in large clinics); fireguard; mirror.

Waiting Room.

Chairs; screens (to arrange undressing cubicles); demonstration table (for showing clothing, confinement sets, etc.); blackboard (for health talks); filing cabinet; writing table (small); chair; fireguard; mirror.

Linen, etc.

Nurses' overalls and doctor's gowns (3 of each); dressing gowns (cotton), 12; hand towels, 12; blankets, 2; mackintosh; sheets, 3; pillows, 1; dusters, etc.

Instruments, etc.

Blood pressure apparatus; urine testing apparatus, with litmus and filter papers; pelvimeter; speculum; other instruments (dressing forceps, scissors, etc., tongue depressor and torch, etc.).

Other Equipment.

Chambers; urine glasses, test tubes and stand, etc.; pail, etc.; swab jar, 4 ins. by 4 ins.; kidney trays; bowls; gloves, steriliser; nailbrushes and soap; thermometers; lysol, vaseline, etc.; catheters; inspection light.

* Non-essentials.

APPENDIX G.

Copy of the Death Enquiry Form with Explanatory Note.

Strictly Confidential, for medical use only.**Ministry of Health.—Maternal Mortality Committee.****MATERNAL MORTALITY DUE TO PREGNANCY OR CHILDBIRTH.**

District **Name (initials or number)** **Age** **M.S.W.**
Date of Death **Cause of death as stated on certificate**
Condition of child (alive, still-born, macerated)

Previous Pregnancies (if obtainable)

No.	Year	Term Prem. or Abort.	Complications during			Child	
			Pregnancy	Labour	Puerperium	Living ?	Healthy ?

Last Pregnancy Duration (in weeks)

Occupation, with dates

Housing

No. of children at home

Standard of living (well-to-do, poor, destitute)

Previous illnesses (*e.g.*, Scarlet Fever, erysipelas, tonsilitis)Has patient recently suffered from, or been in contact with infective illness
(*e.g.*, throat, nose, ear, skin, foci of suppuration in pelvis or elsewhere)

General health during pregnancy (including fatigue or overwork)

Ante-natal care from	(1) A.N. Clinic	(2) Doctor	(3) Midwife
No. of consultations			
Examination of Urine and result			

Brief Summary of the Case	Date	Hour	Remarks
At Home Doctor arrived (if engaged) Midwife arrived Doctor arrived (if called) Handywoman In Hospital Time of admission When first seen by Doctor			
Pains began Membranes ruptured { Spontaneous Artificial Os fully dilated Baby born Placenta delivered			

Was there difficulty as to admission to Hospital ?
 (e.g., ambulance, bed not available, distance, etc.)

Abortion

Probable cause

Duration of Pregnancy

Date of first symptoms

Treatment

Cause of death

P.M. findings

Toxaemias of Pregnancy

Probable date of conception

Past history of renal disease

Toxaemic symptoms, if any, in earlier pregnancies

Date of appearance and nature of symptoms in pregnancy under inquiry

Date of first and last examination of urine	Date of appearance
Result	of albuminuria

Treatment, if any, for albuminuria—at home

in hospital

Blood pressure

If raised, when first detected

Fits—ante, intra. or post partum

Number of Date of

Operative interference

Nature and date

Other treatment

P.M. findings

Haemorrhage

Ante-partum (Placenta praevia, accidental) Was doctor immediately

Had patient been told to report bleeding or faintness? (available ?

Had there been previous bleeding during this pregnancy? How was this (treated ?

Treatment

by midwife

by doctor

Was patient removed to hospital?

If not, why?

Condition on arrival at hospital

Treatment in hospital

Post-partum (before or after expulsion of placenta). Probable cause
Treatment
 by midwife
 by doctor
Blood transfusion. Available used
P.M. findings

Difficult labour**Presentation and position**

Disproportion between foetus and pelvis?

Was difficulty anticipated? Steps taken, if any

Operative interference (at home—in hospital)**Forceps**

Indication

Time of application

Condition of cervix

Descent of head in pelvis

Version

Caesarean section—reasons

Other operative treatment, nature

Manual removal of retained placenta or membranes

Anaesthetic or narcotic By whom administered (*i.e.*, a second doctor)

Laceration of genital tract How treated (Duration)

Condition of patient at end of labour P.M. findings

Puerperal Sepsis**Date of Notification** (P.P or P.F.)**Condition of patient at onset of labour****General****Local**

Was there abnormal vaginal discharge?

Treatment before labour?

Disinfection. Precautions during and after labour—antiseptics used.

1. Patient (Preparation of perineum, vulva)

2. Attendant (doctor, midwife, nurse)

Hands gloves gown

Instruments

Were sterile surgical sheets, towels, pads, etc., used?

Sutures

Vaginal examinations Number By whom made

Precautions taken on each occasion.

Complications of Labour**Trauma**—nature and method of treatment**Placenta and membranes** spontaneous—expressed—manual removal
Complete or incomplete

Toilet of patient after labour

Nursing during puerperium including local treatment

Day of onset of fever

Signs of local or general infection,

Treat { at home
ment { in hospital

Day of death

Bacteriological findings

Suggested source of infection

P.M. findings

(1) Was there any difficulty in the conduct of the case which in the opinion of the Medical Officer or the attendant might have been prevented by medical or other assistance? (2) Has the Medical Officer or the Medical Attendant any suggestion to offer as to the prevention of the condition which caused death?

Comments by medical investigator.

(1)

(2)

Signature.....

Comments by practitioner in charge of case.

Final Remarks by M.O.H. or Investigator.

Signature.....

Date.....

INVESTIGATION OF MATERNAL DEATHS.

Explanatory Note.

1. In accordance with the directions of the Minister of Health, the Committee on Maternal Mortality have drawn up an Inquiry Form for the investigation of maternal deaths, which they suggest should be circulated to Local Authorities to be used in such inquiries by the Medical Officer of Health either in its present form, or with such modifications as may be considered desirable by individual Authorities. Obviously it will be convenient if the data relating to these deaths are collected in a generally uniform manner, and it is, therefore, hoped that similar arrangements will be made in all parts of the country. It is suggested that investigation into these cases would be facilitated if a copy of the Inquiry Form and of this Explanatory Note were sent to each private practitioner in the district, inviting collaboration in an investigation directed towards improving the maternity service of the country.

2. In order to prevent misconception, it is desirable to state in the first place that all information given on the Inquiry Form will be treated as *strictly confidential*. It will be available only to the Medical Officer of Health himself and to the Ministry of Health, for public health and scientific purposes. Should it be deemed expedient to utilise information obtained in this way for purposes of a report, all names of persons, places, institutions, etc., which might lead to identification will be omitted.

3. The Medical Officer of Health concerned, who should be the Medical Officer of Health of either the Local Supervising Authority, or the maternity and child welfare authority, and should not be engaged in private practice, (see Circular 888), will be responsible for the inquiry which, as far as medical data are concerned, should be conducted by himself either alone or with the assistance of some competent registered medical practitioner. In areas where no recognised obstetric specialist is available to assist the Medical Officer in such inquiries, it may be desirable to invite the local division of the British Medical Association to nominate one or more practitioners whose

services could be requested as and when necessary. The inquiry should always be carried out with the co-operation of the medical practitioner in attendance on the case, and it is perhaps hardly necessary to emphasise the importance of observing the rules of professional courtesy in letter and in spirit. The names of patients or their doctors need not necessarily be included in the reports as submitted to the Ministry, numbers or initials being substituted if preferred.

4. If the patient dies in a hospital or other institution, it is hoped that the authorities of the institution will be willing to furnish all necessary information, but the responsibility for obtaining the history of the case prior to admission to hospital will remain with the Medical Officer of Health.

5. Much of the information asked for on page 1 of the Form will be available already from various sources, and the remainder will usually be obtained at an interview between the general practitioner and the medical investigator. In making such further inquiries as are necessary, due care should be taken to avoid any appearance of criticism of those concerned in the professional conduct of the case. If it be remembered how disturbing to the practitioner is a maternal death in his practice, it will be realised that the attitude should be sympathetic rather than critical.

6. In order to facilitate the investigation of the most common causes of death these are grouped on pages 2 and 3, and there are various questions under each heading which are intended to suggest appropriate lines of inquiry. These groups are not mutually exclusive, and in many cases investigations will fall under more than one heading. Remarks on other conditions may be included on page 1 in connection with the general Summary of the case, or under "Comments" on page 4.

7. It is suggested that if the medical practitioner in charge of the case so desires, the findings of the medical investigator should be shown to him for his observations before the Medical Officer of Health formulates his final report for the Ministry.

GEORGE NEWMAN,
Chairman of Maternal Mortality Committee.

APPENDIX H.

List of Medical Men who Attended Sub-Committees by Invitation of the Committee.

- W. M. Ash, F.R.C.S., Medical Officer of Health, Derbyshire County Council.
- Cyril Banks, M.B., B.S., Medical Officer of Health, Nottingham County Borough.
- T. Evans, M.B., Medical Officer of Health, Swansea County Borough.
- James Fenton, M.D., Medical Officer of Health, Royal Borough of Kensington.
- W. E. Henderson, M.B., lately Medical Officer of Health, Westmorland County Council.
- Sir T. Eustace Hill, O.B.E., M.B., Medical Officer of Health, Durham County Council.
- Oscar M. Holden, M.D., Medical Officer of Health, Croydon County Borough.
- R. J. Maule Horne, M.B., Medical Officer of Health, Borough of Poole.
- D. Llewelyn Williams, M.C., F.R.C.S., Senior Medical Officer, Ministry of Health, Medical Member of the Welsh Board of Health.
- James Young, D.S.O., M.D., F.R.C.S., Gynaecologist, Royal Infirmary, Edinburgh; Physician, Royal Maternity Hospital, Edinburgh.
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APPENDIX J.

List of Bodies and Persons who Submitted Statements of Evidence to the Committee.*Royal College of Physicians of London.*

Sir John Rose Bradford, K.C.M.G., C.B., C.B.E., M.D., P.R.C.P.
J. Prescott Hedley, F.R.C.P., F.R.C.S.

Royal College of Surgeons.

Victor Bonney, M.D., F.R.C.S.
L. Carnac Rivett, M.C., F.R.C.S.

Royal Society of Medicine.

Arthur E. Giles, M.D., F.R.C.S.
J. Montagu Wyatt, F.R.C.S.

British College of Obstetricians and Gynaecologists.

Professor W. Blair Bell, M.D., F.R.C.S. (President).
Eardley L. Holland, M.D., F.R.C.S.

British Medical Association.

H. B. Brackenbury, LL.D., M.R.C.S., L.R.C.P. (Chairman of the Council of the Association).
G. C. Anderson, M.D.
J. W. Bone, M.B.
H. G. Dain, M.B., M.R.C.S.
A. L. Flemming, M.B., M.R.C.S., L.R.C.P.
Sir Ewen J. Maclean, M.D., F.R.C.P.
Christine Murrell, M.D.
Wm. Paterson, M.B.

Medical Women's Federation.

Catherine Chisholm, M.D., Ch.B. (President).
Rhoda H. B. Adamson, M.D., B.S.
Mary H. Frances Ivens-Knowles, C.B.E., M.B., M.S.

Midwives' Institute.

Miss Farrant, Superintendent and Inspector of County Associations of the Queen's Institute.
Mrs. Florence Mitchell, Hon. Secretary, Affiliated Associations Committee.
Miss Fox, practising midwife, Bradford.

Independent Witnesses.

The Right Hon. Lord Riddell.
Sir Henry J. F. Simson, K.C.V.O., M.B., C.M., F.R.C.P.
Comyns Berkeley, M.D., F.R.C.P., F.R.C.S.
Donald W. Roy, M.B., F.R.C.S.
Professor Major Greenwood, F.R.C.P., F.R.S.
H. Harvey Evers, M.S., F.R.C.S.
A. Fulton, M.B., B.Ch., Divisional Medical Officer, Ministry of Health.
W. McKendrick, M.B., B.Ch., Regional Medical Officer, Ministry of Health.
J. Orton, M.D., Regional Medical Officer, Ministry of Health.
Howard E. Collier, M.C., M.B., Ch.B., Redditch.
H. W. Pooler, M.B., B.Ch., Alfreton, Derbyshire.
J. F. Walker, M.B., Southend-on-Sea.

APPENDIX K.

List of Papers Submitted to the Committee.

- British Medical Association: Memorandum Outlining a National Maternity Service Scheme for England and Wales.
- British Medical Association: Report on Causation of Puerperal Morbidity and Mortality.
- Medical Women's Federation: A Scheme for a National Maternity Service.
- The Utilisation of Existing Institutions for a Complete Maternity Service in a County, by W. M. Ash, M.B., F.R.C.S., Medical Officer of Health, Derbyshire County Council.
- Memorandum on the Relief of Pain in Labour without the Use of General Anaesthetics, by S. A. Winstanley, M.B., Ch.B.
- Report on Puerperal Infection in Maternity Hospitals, by A. S. M. Macgregor, O.B.E., M.D., Medical Officer of Health, Glasgow.
- Throat Infections as an Etiological Factor in Puerperal Fever, by W. W. King, M.B. F.R.C.S. (Edin.), Lecturer in Gynaecology and Obstetrics, Sheffield University, Hon. Surgeon, Jessop Hospital for Women, Sheffield.
- Essay on Air-borne Infection in Puerperal Sepsis, by Richard R. Armstrong, M.D., F.R.C.P.
- Studies in Immunity to Haemolytic Streptococci. II. Variations in the ability of broth cultures to withstand the bactericidal power of normal human blood, by Ronald Hare, M.B., B.S. (Lond.).
- Latent Sepsis in Pregnancy Toxaemia, by Frances Ivens-Knowles, M.S., M.B., Ch.M.
- Puerperal Sepsis: An Investigation regarding Contagion and Throat "Carriers" of the Streptococcus Haemolyticus, by E. Farquhar Murray, M.D.
- Observations on Methods of Ante-Natal Care and Midwifery Practice, by Dr. Harold White and Dr. C. V. Pink.
- Maternal Mortality and its Relation to the Shape of the Female Pelvis, by Kathleen Vaughan, M.B.
- Report on Maternal Mortality (being the Quarterly Report to the Maternity and Child Welfare and Midwives Acts Committee of the Radnorshire County Council on January 24th, 1930). Submitted to the Committee by Dr. J. W. Miller, County Medical Officer of Health for Radnor.
- Observations on Maternal Mortality, by Dr. Andrew S. McNeil.
- Memorandum on East Riding Benefit Nursing Association, by The Lady Margaret Bickersteth.
- A Collection of Newspaper Reports on cases of Criminal Abortion, supplied by the Right Hon. Lord Riddell.
- Information as to the conduct of Ante-natal Clinics was placed at the disposal of the Committee in response to their request by the following persons:—
- Dr. W. S. H. Campbell, Medical Officer of Health, County of Lindsey.
- Dr. Dart, Medical Officer of Health, Hackney.
- Dr. H. Evers, Assistant Obstetric Physician, Princess Mary Hospital, Newcastle-on-Tyne.
- Dr. John Fairbairn, Obstetric Physician, St. Thomas's Hospital.
- Miss Alice Gregory, Hon. Secretary, British Hospital for Mothers and Babies, Woolwich.
- Dr. Mary Howie, Senior Child Welfare Officer, Durham County Council.
- Mrs. Keen, Hon. Secretary, North Islington Maternity Centre.
- Dr. E. Lewis Lilley, Obstetric Surgeon, Leicester and Leicestershire Maternity Hospital.
- Professor Louise McIlroy, Obstetrical and Gynaecological Unit, Royal Free Hospital.
- The Secretary, Paddington School for Mothers.
- The Secretary, Queen Charlotte's Hospital.
- Professor B. P. Watson, Sloane Hospital, New York.