In Table II the results with the box mask are compared with those for other similar open methods^{1 2 3}—that is, with the patient not enclosed in a tent or using an apparatus with valves. It is obvious that even with the catheter outside the nose the box mask uses only half the amount of oxygen consumed by other methods. Of course tents can be run on 2 to 3 litres a minute and

TABLE I

Subject and Position	Rate of O ₂ flow, Litres per Min.	Alveolar Pressures % Atmosphere		Position of Catheter	Mask Used
		CO ₂	O ₂		
C. P., sitting ...	1.9 4.0 4.3	6.6 5.8 6.4	26.2 40.1 41.9	3 in. in nose	Cardboard, No. 1
" "	5.0 4.6 4.6	6.7 5.6 6.1	50.5 50.3 47.9	"	" "
" "	4.5 5.0	6.6 6.5	48.7 53.0	"	"
J. A. C., "	5.1 4.8	6.6 6.0	50.9 48.6	"	No. 2
C. P., "	5.0	6.1	53.6	"	No. 1
" "	5.7 6.0 5.7	6.1 6.1 5.9	56.7 56.6 57.5	"	Aluminium, No. 1
J. A. C., "	6.0 6.0	6.1 6.1	57.5 59.5	"	Cardboard, No. 2
" "	5.6 6.4 6.0	6.0 5.8 5.9	51.5 55.0 53.6	"	Aluminium, No. 2
" "	8.0 8.0	5.2 5.0	50.0 50.0	Outside nose	" "
C. P., "	7.0 6.5	6.9 6.6	73.1 72.0	3 in. in nose	Cardboard, No. 1
" "	5.0 6.0	6.5 6.0	48.9 43.2	Outside nose	" "
" "	6.6 8.0	6.5 6.5	47.8 52.0	"	" "
" "	8.0 8.0 8.0	6.3 6.3 6.4	54.0 60.3 54.5	"	" "
" lying down	5.5 5.9 6.0	6.7 6.3 6.2	62.7 66.8 67.4	3 in. in nose	" "
" "	6.3 6.0	6.8 7.0	44.9 44.2	Outside nose	" "

TABLE II

Method	Rate of O ₂ Flow, Litres per Min.	Alveolar O ₂ Pressure % Atmosphere
Catheter ² ...	7	34.5
Forked nasal tube ² ...	7	38-43
Double catheter ³ ...	8	39-42
" " ...	12	38-52
" " ...	16	52-63
Box mask (J. A. C.) (catheter inside nose) ...	4	40
" " " " " " ...	5	50
" " " " " " ...	6	60
" " " " " " ...	7	70
" " " outside " " ...	5-6	40-50
" " " " " " ...	7-8	50-60

maintain 60 per cent. alveolar oxygen pressure, but tents require also soda lime and special cooling mechanism and much more attention; also the patient is isolated when in the tent. The box mask thus appears to be superior to the other methods in all respects under ordinary circumstances; of course there may be cases more suitably treated in tents—for example, infants.

The carbon dioxide alveolar pressures shown in Table I are similar to those given by other methods, so that the box mask does not cause any undue accumulation of

carbon dioxide. This is to be expected with flows of oxygen at 4 or more litres per minute. There is a gentle flow of oxygen down the sides, and this has a cooling effect. With the catheter outside the nose this cooling effect is distinctly pleasant.

Similar results are obtained with the mask upside down—that is, with the open end at the top and the catheter directed downwards. This position is not so convenient.

At present observations are being made on children with a smaller box mask, and there is every reason to believe that it will be of value at least to older children.

Summary

A box mask is described which permits a great saving in consumption of oxygen and also gives less discomfort than other methods of administration. In actual practice no analysis of gas is necessary, the efficiency of the apparatus being controlled by a suitable flowmeter only. It is recommended to run the mask on 5 to 6 litres a minute, with the catheter or tube outside the nose and its end directed upwards. As with all other oxygen apparatus, no naked flames are allowed in its vicinity. Smoking is not permitted.

REFERENCES

- ¹ Campbell, Argyll, and Poulton, E. P.: *Oxygen and Carbon Dioxide Therapy*, London, 1935.
- ² Poulton, E. P.: *British Medical Journal*, March 21st, 1936, p. 567.
- ³ Marriott, H. L., and Robson, K.: *Ibid.*, January 25th, 1936, p. 154.

DECREASING MORTALITY AND ELIMINATING PHTHISIS IN MENTAL HOSPITALS

BY

A. W. B. LIVESAY, M.B., F.R.C.S.ED.

SURGEON CAPTAIN R.N.

LATE DEPUTY SUPERINTENDENT, ST. ANDREWS HOSPITAL, THORPE, NORWICH

The dual title of this paper is due to the two subjects being interdependent. In an effort to reduce the death rate phthisis was the first point of attack. It was soon found that the special measures taken to reduce phthisis had also a wider effect in lowering the general death rate.

The author of this paper, after twenty-six years' service in the medical branch of the Royal Navy, was appointed medical officer in sole care of the female side of a large mental hospital averaging 650 individuals. The Navy tends to make its medical officers statistically minded. The Blue Book *The Health of the Navy* issued to every officer is not only received but studied. The whole Service, from the director-general down to the most junior surgeon, is constantly working for the reduction, year by year, of the average daily sick list. Each medical officer of a ship strives to have the lowest sick list in his Division, announced from the flag-ship by signal on Sunday forenoon. So each Division competes to have the lowest sick list in the Fleet. A wider rivalry exists between the Fleets themselves on the various home and foreign stations.

It was strange on joining the mental service to find little evidence of such emulation. The anomaly could be seen of two mental hospitals not one hundred miles apart, and subserving similar sections of the community, in which the death rate of one was double that of the other. Apart from those under "group management," such as the London County Council, each mental hospital, good or indifferent, seemed to wear an air of isolated self-sufficiency. There is no sick list in the mental service; the tests of efficiency are the death rate and the recovery rate.

The very great advances made in recent years of treatment from the psychological side, and the limelight thrown on these methods, tend to obscure treatment purely physical. The two methods must go hand-in-hand.

Enthusiasts sometimes need reminding that psychotherapy can only be practised on the living. If there is any meaning in modern hygiene and dietetics the patients in a mental hospital should be among the healthiest in the nation. They are cloistered alike from the excesses of the rich and the privations of the poor. The medical officer of health for a district, apart from statutory regulations, can only influence the individual by exhortation and persuasion. In comparison the superintendent of a mental hospital, in all that affects the immediate well-being of his patients, is from the hygienic standpoint an autocrat.

On appointment as medical officer and in charge of the female side of St. Andrews, the Norfolk county mental hospital, in May, 1922, the writer's ambition was to have as low a death rate as any in the country. This aim was attained by the end of 1927.

Work in the Hospital

The building had few structural or other advantages, excepting that it was exposed to every wind that blows! The hospital for female patients, a quarter of a mile distant from the male side, is the original building, erected

Average for the Ten Years 1925-35 Inclusive				Phthisis Total No. Deaths in 10 years
Numbers Resident	Percentage of Deaths	Recovery Rate	Phthisis Deaths per annum	
563	10.2	38.6	11.2	112
Average for the Ten Years 1925-35 Inclusive				
671	5.0	40.6	1	

*Open Air and Im- proved Diets Started	Percentage of Deaths	Deaths from Phthisis	Recovery Rate	England and Wales	
				Percentage of Deaths	Recovery Rate
*1922	9.7	7	46.8	8.3	34.8
1923	6.2	6	40.6	6.9	34.0
1924	8.2	4	47.5	7.0	37.0
1925	6.7	3	52.7	6.9	34.0
19 6	5.9	2	51.8	6.6	34.2
1927	4.9	0	29.8	7.3	33.5
1928	4.4	1	55.2	6.5	32.9
1929	5.0	1	31.9	7.7	33.9
1930	4.4	1	39.4	6.1	35.3
1931	6.0	1	32.8	6.8	33.3
1932	6.4	1	33.8	7.4	33.0
1933	4.8	0	46.0	7.0	35.3
1934	5.3	1	56.2	6.4	33.3
1935	3.3	2	29.9		

over one hundred years ago, and added to from time to time. It occupies a site in the Yare Valley close to the river, very few feet above sea-level, and is subject to frequent fogs. The primary aim being to reduce phthisis, it was considered that the measures taken in sanatoria to effect its cure would, if applied in a mental hospital, lessen its incidence. Apart from special methods in complicated cases, the two essential factors of sanatorium treatment are open air and diet.

Dr. O. G. Connell, appointed medical superintendent in 1922, at once entirely reorganized the diets on an extremely liberal scale, based on the report of the Departmental Committee on Dietaries for Mental Hospitals set up by the Board of Control. In the same year the writer started "open air" on the female side. The figures

above in *parallel* lines give a comparison of the general death rate and phthisis mortality on the female side in St. Andrews Hospital for two periods of ten years each. For the earlier decade later figures than 1914 could not be given, since during the war the whole institution was taken over by the War Office as a base hospital. The figures in *vertical* columns show the gradual and steady improvement in the general death rate and the lessening of deaths from phthisis from 1922 to 1935 inclusive. For comparison death rates and recovery rates (female) are also given for England and Wales, taken from the annual reports of the Board of Control.

By comparing the two periods of ten years each it is seen that in the second period (1926-35) the average death rate has been halved, and that it has been reduced by almost 5 per cent. How is this 5 per cent. made up?

It is evident that about two-fifths of it is due to the lessening of phthisis. Probably another fifth is due to compulsory feeding. These will be considered later. The remaining two-fifths of the halving of the death rate in the same period are attributed to two factors—namely, open air and the improved dieting. It is considered that these two factors have probably acted in conjunction with equal force, and that similar results would not have been obtained from either acting alone.

The Patients' Diet

In a mental hospital the psychological effect of varied and attractive meals is of great importance. Most acute cases of mental disease on admission are in a poor state physically, under weight, and require "feeding up"; for these the ordinary diet has to be supplemented with milk and extras. In any mental hospital the chronic patients make up the great majority, over 95 per cent. of the total, excepting, of course, those special hospitals like the Maudsley and Royal Bethlem, which only deal with acute and recent cases. These chronic patients have little hope of discharge, and must lead a dull and featureless existence, in spite of all that is done for them in the way of occupation and amusement. They can be compared to the passengers of a liner on a long sea voyage, when, as everyone knows, the bugle calling to meals has a vastly exaggerated importance. A liberal diet does much to make these patients happy and contented.

A question frequently asked by laymen is "Why prolong the lives of these unfortunates?" Apart from it being a doctor's duty to keep his patients alive and in the best of health, it is a fact that many of these chronic patients do enjoy their limited existence in a way not comprehended by normal people. It also happens rarely and for reasons outside our present knowledge, that an apparently hopeless chronic case will suddenly begin to improve, eventually make a complete mental recovery, and be discharged after as long as fifteen or twenty years' residence in hospital.

The patients in St. Andrews Hospital have extras at breakfast, tea, and supper, the latter meal only for those allowed to sit up late. All workers have an additional meal called lunch at 11 a.m., consisting of bread and cheese and tea. The excellent dinners are arranged on a twenty-one-day rota, so that each dinner is a daily surprise. The food is of the best quality, and all meat is from beasts home bred or reared.

Open Air

The system of open air, or rather "open windows," adopted was as follows. Every window in all day rooms, sick wards, dormitories, corridors, and kitchens was kept fully open day and night, winter and summer. This was not so drastic as it sounds, for many of the windows on the upper story were "blocked," and could only be opened to a limited extent at top and bottom. Common

sense also dictated some modification during driving rain and snowstorms, but not for mere fall in temperature.

The only difficulty was in dormitories with no nurse on fixed duty. Here the patients could and did shut the windows, and the air by morning used to be extremely foul. To obviate this, small wooden blocks, 4 inches in length and $1\frac{1}{2}$ inches in depth, were screwed to the upper part of the window frame, preventing closing of the upper sash, and thus securing a double supply of fresh air at the top and in the middle where the sashes overlapped. As a further aid to the prevention of contagion all beds where practicable were arranged with the head of one opposite the foot of the next alternately, as hammocks are always slung in the Navy. This doubles the interval between the patients' heads and thus lessens bed-to-bed infection in catarrh and influenza.

There was no system of central heating, open fires being in use everywhere excepting in a few corridors, where there were hot-water radiators. In the day rooms, occupation rooms, and sewing rooms, with ample fires kept up, there was no discomfort even in winter. In the sick wards the temperature on the coldest nights in winter was frequently as low as 45°F . This was immaterial so long as the patients were warm in their beds, which could always be secured by the use of extra blankets and hot-water bottles. The minimum temperature advocated in the approved textbook for nurses is unnecessarily high, and on really cold nights cannot be adhered to without producing a stuffy atmosphere.

An experience of the writer when in charge of the Royal Naval (Mental) Hospital at Great Yarmouth was illuminating. There was in that hospital one long twenty-bed ward, with windows on each side, in which were patients in the third stage of general paralysis—than whom none have a more precarious hold on existence. The experiment was tried of open windows in the very severe winter 1920-1. All windows were kept open day and night, with the exception that during gales the windows on the weather side only were closed. No deaths occurred in this ward until the June following, when two patients died during a heat wave.

The female patients at St. Andrews Hospital accepted this regime with little trouble. There were, of course, some recalcitrants; on the other hand, there were not a few "fresh air fiends." An aesthetic advantage, noticeable after forty-eight hours' adoption of open windows, was the entire absence of the disagreeable so-called "asylum odour," which by many is still thought to be a necessary concomitant of mental patients.

With the system of "open windows" as described there is a great lessening of all infectious diseases. Ordinary catarrh is greatly reduced; influenza, although there have been several epidemics in the last few years, seems to have lost its virulence. There were two deaths from influenza in the ten years 1926-35, and no deaths from dysentery. Paratyphoid infection, which at one time threatened to become endemic, has almost disappeared, and only two cases have been notified in the last three years. During the whole period there has been on the female side a certain amount of overcrowding. This to a moderate degree is of little consequence, for with open windows the cubic capacity is infinitely expansile.

Another great advantage of "open windows" is the consequent improved health of the nursing staff. The nurses co-operated enthusiastically. When very cold they were allowed to wear their uniform great-coats on night duty. This confirms a statement, often made, that women are far more tolerant of cold and draughts than men. For the last ten years there has been among the nurses almost complete immunity from catarrh, with no serious cases of influenza, and, excepting for a trouble-

some epidemic of Vincent's angina, little serious illness. With a staff of over one hundred nurses there have been only three cases of phthisis in the last ten years, 1926-35, all of which responded favourably to treatment.

Pulmonary Tuberculosis

Two-fifths of the reduction in the death rate was attributed to the lessening of this disease. Comparing the two decades in the figures given above it is seen that the total deaths from phthisis have fallen from 112 in the years 1905-14 to ten in the second period 1924-35. It is evident, in the first four years 1922-5, how closely the fall in death rate from phthisis coincides with a steady lowering of the general death percentage. It was anticipated that fully ten years must elapse before the phthisis rate would show marked improvement. Results came along much sooner than was expected, for as early as 1926 almost the lowest figure was recorded.

This under-estimate was due to the writer holding the old, and probably incorrect, view of phthisis—namely, that most cases are due to a quite recent infection. But the modern view of phthisis, as put forward by that pioneer of open-air treatment Sir Robert Philip, seems more nearly to meet the case. He holds that tuberculosis is primarily an infection of the lymphatic system, the tubercle bacillus gaining entry during infancy through the mucous membrane of the nasal passages, and that phthisis is a late manifestation of this generalized infection. According to this theory it would appear that a majority of the children in a civilization such as ours are infected in infancy, resistance varying with the individual. For all those showing signs of poor resistance, as evidenced by such signs as glandular enlargements and subnormal physique, Sir Robert practises what he calls "detuberculization," which in essence comprises open air and a liberal diet. It appears that what has been done during the last thirteen years at St. Andrews Hospital is an experiment in "detuberculization" on over 750 individuals, including the nurses.

No stress was laid on sputum examination or x-ray examination of the chest, for these are considered to indicate only late manifestations of the disease. The earliest sign is loss of weight. Every patient in the hospital was weighed monthly, and a record was kept in each ward, loss of weight being entered in red ink. Thus any repeated loss at once claimed attention. If any patient showed loss of weight for several months, for which no other cause such as refusing food, undue excitement, or definite physical illness such as diabetes could be assigned, the temperature was taken at 2 p.m., 4 p.m., and 6 p.m. Any slight but repeated rise above the normal was considered to be an indication of phthisis, and the patient was at once transferred to the open-air ward.

Without an open-air ward for the segregation of suspects and early cases little can be done; the medical superintendent provided an excellent open-air ward with nineteen beds. Such a ward need not be an expensive affair. It can be constructed against any solid wall facing south. It needs a sloping tiled roof of sufficient depth to prevent rain falling on the beds, a concrete floor with linoleum strips, electric lighting, a bath and sanitary annexe at one end, a nurses' room at the other, with a small day room for patients, and with a small kitchen or scullery fitted with a gas ring. In addition, roll-up canvas screens must be provided to exclude driving rain and snow.

The statement frequently made that patients suffering from dementia praecox are the class most prone to develop phthisis was not found to be true. This idea is probably due to the fact that these patients form the majority of the young people in a mental hospital and are at the age of the greatest phthisis incidence.

Against the slight discomfort caused by open windows must be weighed the very real suffering that the disease entails. With ten deaths yearly there would constantly be at least twenty patients in various stages of illness. In any institution showing a high incidence of phthisis, as was the case at St. Andrews Hospital before the war, the cause must be looked for in the conditions of the institution itself. It is not due to fresh admissions.

In Norfolk, taking the figures of the medical officer of health as to the number of cases of phthisis in the county, the expectation of admitting a female patient with the disease already established is only about once in two years. Such cases too, in these days, would probably have been already notified.

Compulsory Feeding

To compulsory feeding is attributed one-fifth of the reduction in the death rate. The gospel of prompt and energetic tube feeding, as taught at the Royal Bethlem Hospital thirty years ago, seems nowadays to be largely disregarded. It has been stated on excellent authority that at one large mental hospital no forced feeding has been imposed for the last twenty years.

This is deplorable, for nearly all the patients needing this form of treatment are "recent admissions," and therefore patients in whom the hope of mental recovery is good; if not fed they certainly die. Cases of melancholia are obvious, and easy to treat by tube feeding.

On the other hand, the feeding of acutely maniacal patients is extremely difficult, but with proper technique and a well-trained staff there is no danger. A general anaesthetic was never required, but to several very violent patients it was necessary to give hyoscine 1/100 grain an hour previous to the feed. A preliminary gastric wash-out was frequently needed before feeding could be commenced.

Medical officers do not appreciate the urgent need for compulsory feeding in cases of acute mania. Vilhjalmur Stefansson, the Arctic explorer, states that after four days of complete deprivation of food appetite is entirely lost. Many cases of acute mania on admission to hospital have probably had next to no nourishment for quite this period, so it is readily understood that in their mental state, and with no desire for food, they are extremely resistant. The prolonged and intensive restlessness in these patients is equivalent to severe hard work, and imposes a terrific strain on the physique. The writer has become more and more sceptical about that textbook entity "acute delirious mania." The signs and symptoms given are in complete accord with acute mania plus famine. For the last ten years, during which compulsory feeding of all cases of acute mania requiring it was carried out, no case has been seen.

In all acute mental states the primary essentials are food, sleep, and fresh air, and not until these have been attained can the physician begin to rebuild the mind by psychotherapy, occupational therapy, or such other methods as his experience may dictate. Statistics of tube feeding were only kept during the last five years, 1930-4 inclusive. In that period 2,376 tube feeds were given. Being single-handed in charge of 650 patients, including recent admissions, there was no need to look for work, and this number must be taken as the minimum requisite. During the five years fifty-five patients were compulsorily fed; of these only five were chronic cases—that is, patients who had been in hospital a year or more.

Of the fifty "recent admissions" seventeen were "discharged recovered," giving a "recovery rate" of 34 per cent., which, considering the type of case, compares well with the recovery rate 34.1 for all classes of patients from England and Wales for the same five years.

Of the seventeen patients discharged recovered nine were cases of mania, one of stupor, and seven of melancholia. Many of these patients arrive in hospital too late, and a grave responsibility rests on the practitioner attending the case. There is much talk to-day of the "early treatment" of mental patients; here early treatment is of vital importance.

In any case of serious refusal of food the medical practitioner in attendance should put the patient on fluid diet, and the amount of nourishment taken in each twenty-four hours should be exactly recorded in ounces by a nurse or a responsible relative. If at the end of a day or two it is evident that sufficient food is not being received the patient should at once be sent to hospital, where compulsory feeding can be carried out. Some patients with melancholia can be persuaded to come to hospital voluntarily; in all other cases certification must be resorted to.

Conclusions

The death rate in mental hospitals, although falling steadily, can be very materially reduced. Phthisis can be practically abolished in all mental hospitals and kindred institutions.

I have to thank Dr. Connell, medical superintendent, for encouragement in doing this work, and for permission to use the figures quoted.

OPHTHALMOSCOPIC SIGNS OF DEATH

BY

C. RUSSELL SALSURY, M.D.

AND

G. SPENCER MELVIN, M.D.

(From the Departments of Anatomy and Physiology, Queen's University, Kingston, Ontario)

It has been a repeated clinical observation of one of us (C. R. S.) that definite changes, easily visible with the ophthalmoscope, appear in the retina in the dead or dying patient. In life the actual movement of the column of blood is visible in the retinal veins. As death approaches the stream seems to become slightly irregular and "lumpy," although without any actual breach of continuity. Later there is definite fragmentation of the column, and it is a striking spectacle to see these masses of blood move toward the optic disk and then drop over the edge of the optic cup. If one can imagine watching, from the air, long columns of infantry marching along converging roads, the men finally falling over a steep cliff shortly before the intersection, he will have a very accurate picture of the actual phenomenon observed.

This is not a transitory effect. Although no actual timing has been attempted, one would estimate that the movement is visible for about ten to twelve minutes on an average. During this time two changes very gradually occur. The rate of motion becomes progressively less, and the fragmentation progressively more definite. It is as though the marching columns of men, at first in close formation and without organization, gradually formed into companies, with definite intervals between them. These intervals become greater as the rate decreases.

After all movement has ceased the interrupted columns are still plainly visible. So long as the media remain transparent there is no difficulty in differentiating this appearance from the former or from the normal appearance during life.

The Problem

The exact significance of this observation was not clear on clinical findings alone. The early stages, as described above, have not been seen in the human subject, the