

DELIVERY PATTERNS IN A REAL AND ARTIFICIAL PRACTICE

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ONE OF THE criticisms of general-practitioner research is that there is confusion between work load and morbidity (Lees and Cooper 1963). This confusion was unavoidable because the morbidity and work load of a practice are related.

Work load studies have more meaning when the overall item rates are qualified by the A/V ratio (Taylor 1955). This ratio allows one to calculate the consultation/visit ratio and so determine the manner in which the medical care of the practice is delivered. This is the delivery pattern of the practice. The delivery pattern may be studied in greater detail by making direct observations on the number of new visits, revisits, consultations and late calls. Both methods have been used in the past.

The observations do not add to the understanding of the factors which control the delivery pattern of a community unless they are related to the population subgroups which constitute the community, but they are valuable in studies which are concerned solely with operational research.

Most of the delivery studies in the past have been concerned with general rather than detailed patterns, and so this opportunity was taken to study the delivery patterns of the artificial practice and to compare them with the general pattern of the real practice before beginning the projected morbidity study.

Definitions

Medical attention may be delivered in the consulting room or the patient's home. Since home visits may be made on the initiative of either patient or doctor it is necessary to distinguish between the different types, and in order to do this the following definitions were applied throughout this work.

Consultation. This is an item of service at which the patient visits the doctor and which usually takes place in the surgery. A consulta-

tion can take place only if the patient is prepared to take an active part in attending.

New visit. This is an item of service which is made at the request of the patient or responsible adult. The patient receives a home visit between the hours of 8 a.m. and 12 noon in response to this request. The visit is made at the initiative of the patient or R.A.* but his part in attendance is passive.

Revisit. This is an item of service which is made at the initiative of the doctor and takes the form of a home visit made for continuation care. The patient is passive in this item although the decision to make a revisit may be made when it is felt that the patient will request further visits for personal reasons.

Late call. This item of service is made on receipt of a request made after 12 noon for a home visit to be made on the same day. It should be added that visits made between 12 midnight and 8 a.m. are included in this category. The distinction between new visits and late calls rests on the convention that the latter implies a need for urgent medical attention while the former does not. It has already been demonstrated that the 'urgency' in the majority of late calls is 'patient-determined' rather than 'disease-determined' (Jacob 1962).

The expression c/v (consultation/visit) ratio is used in this work in preference to A/v (attendance/visit) ratio since the convention 'attendance pattern' has been used in the classification of the patients of the artificial practice. Attendance in this context refers to the number of episodes of illness which a patient experiences and the number of items in each episode required to satisfy his demand. c/v ratio and A/v ratio should be considered identical in meaning. This ratio has been defined by others (Taylor 1955).

Delivery pattern of the artificial practice

(A) *Personal delivery pattern.* This includes all the attention to the personal group and the personal fraction of attention to the modified and unmodified family adults. The number of each type of item delivered to the different groups is shown in table I.

These figures are grouped for analysis in table II in which the suprimean groups B, C, and D are taken together.

The percentages are calculated from the total number of items to each group. It will be shown in the next section that there is reason to believe that the amount of recorded visits to the perimean group may not give an accurate estimate of the frequency of visits for that group under natural conditions. For this reason the personal group has been excluded from the χ^2 test.

*Responsible adult.

TABLE I
NUMBER OF ITEMS OF SERVICE TO EACH PATIENT CATEGORY

<i>Patient category</i>	<i>Number of</i>			
	<i>New visits</i>	<i>Revisits</i>	<i>Consultations</i>	<i>Late calls</i>
Perimean low A	2	—	82	—
Perimean low B	—	—	9	—
Perimean moderate A	2	—	138	—
Perimean moderate B	4	—	94	—
Perimean high A	6	3	126	—
Perimean high B	7	—	145	4
Perimean high C	10	4	168	4
Supramean A	21	18	640	9
Supramean B	5	1	87	1
Supramean C	—	—	18	1
Supramean D	105	60	2,167	32
Unmodified family A	2	—	82	1
Unmodified family B	6	—	53	3
Unmodified family C	—	—	—	—
Unmodified family D	75	22	1,424	37
Modified family α	9	—	108	1
Modified family β	19	2	173	6
Modified family γ	8	3	61	1
Modified family δ	3	—	11	—

TABLE II
GROUPED PERSONAL DELIVERY PATTERN OF THE ARTIFICIAL PRACTICE.

<i>Patient category</i>	<i>Number of</i>				<i>Total</i>
	<i>New visits</i>	<i>Revisits</i>	<i>Consultations</i>	<i>Late calls</i>	
Perimean low and moderate No. per cent	8 2	—	323 98	—	331 100
Perimean high No. per cent	23 5	7 1	439 92	8 2	477 100
Supramean A No. per cent	21 3	18 3	640 93	9 1.5	688 100
Supramean B, C and D No. per cent	110 4	61 3	2,272 92	34 1	2,477 100
Family unmodified No. per cent	83 5	22 1	1,559 91	41 3	1,705 100
Family modified No. per cent	39 10	5 1	353 87	8 2	405 100

$\chi^2=20.995$ (family groups only) degrees of freedom=3 P<0.001

These figures indicate that the adult population under observation is predominantly a surgery population with a general C/V ratio of 11.25/1. This ratio shows fluctuation within the groups and has a maximum of 16.6/1 in the personal perimean group and a minimum of 6.8/1 in the modified family group. For reasons discussed in detail below the figure for the perimean personal group is probably too high and it is estimated that this should lie in the 5.5/1 to 7.2/1 range. If this estimate is correct the maximum would be the supra-mean figure of 11.5/1. Although the modified family group makes most frequent use of the visiting service the bulk of its demand in this respect is for new visits.

This contrasts with the unmodified family group which has a higher proportion of late calls. The perimean high group comes second to the unmodified family group in the relative frequency with which it uses the late call service. Although the percentage incidence of home visiting in all groups is small, table I indicates that the absolute number of home visits is not negligible.

(B) *Vicarious delivery pattern.* This is the delivery pattern of that fraction of the total medical attention which is concerned with the children at risk in the artificial practice. The absolute figures are shown in tables III and IV.

TABLE III

DELIVERY PATTERN OF CHILDREN IN 'PERSONAL' AND 'COMBINED PERSONAL AND VICARIOUS' GROUP.

<i>Patient category</i>	<i>Number of</i>			
	<i>New visits</i>	<i>Revisits</i>	<i>Consultations</i>	<i>Late calls</i>
Unmodified A	—	—	1	—
family B	9	6	31	5
C	—	—	—	—
D	79	19	318	49
Total	88	25	350	54
Modified <i>a</i>	24	2	71	6
family <i>β</i>	49	15	105	16
<i>γ</i>	35	11	89	15
<i>δ</i>	8	1	18	5
Total	116	29	283	42

The statistical evaluation of table III is shown in table V which indicates that the unmodified group has a lower rate for new visits and revisits and a higher rate for consultations and late calls.

TABLE IV
DELIVERY PATTERN OF CHILDREN IN 'VICARIOUS ONLY' GROUP

<i>Patient category</i>	<i>New visits</i>	<i>Revisits</i>	<i>Consultations</i>	<i>Late calls</i>
Perimean low A	1	—	5	—
Perimean high B	5	—	9	2
Supramean D	5	4	12	3
Total	11	4	26	5

TABLE V
EVALUATION OF DELIVERY PATTERN OF CHILDREN IN 'PERSONAL' AND 'COMBINED PERSONAL AND VICARIOUS GROUPS'

<i>Patient category</i>	<i>Number of</i>				<i>Total</i>
	<i>New visits</i>	<i>Re-visits</i>	<i>Consultations</i>	<i>Late calls</i>	
Unmodified family No. per cent	88 17	25 4.8	350 67.7	54 10.4	517 100
Modified family No. per cent	116 24.7	29 6.2	283 60.2	42 8.9	470 100
Total No. per cent	204 20.7	54 5.5	633 64.5	96 8.9	987 100

$$\chi^2=10.53$$

$$\text{degrees of freedom}=3$$

$$0.01 < P < 0.05$$

These observations raise the question: To what extent is the general delivery pattern of a community related to the detailed delivery pattern of the subgroups which compose it? It was to answer this that the following reconstruction of the work of the real practice was undertaken.

Comparison between reconstructed and observed delivery patterns of the real practice

There are two stages in the reconstruction of the delivery pattern of the real practice; the first is the estimation of the constitution of the practice (stage A) and the second is the reconstruction proper (stage B). Before these two stages are shown in detail it is necessary to remember that the artificial practice was constructed in the surgery. This means that a group of people who are permanently unable to attend the surgery are excluded from the artificial practice. This group, a supramean group which will be called a 'permanent revisit' group must, of course, be included in the reconstruction of the real practice.

STAGE A. Estimated constitution of the real practice.

Mean number of patients at risk	=4167*
Mean number of children at risk	=1092*
Mean size of D.F.P.	=3075*
Number of adults in permanent revisit group	= 60*
Remaining D.F.P.	=3015
Child/adult ratio in family group	=2.2/1**
Therefore Total adults in D.F.P. of family group	= 403
and Total adults in D.F.P. of personal group	=2612

The D.F.P. is divided into a perimean fraction=85 per cent and a supramean fraction=15 per cent** (Jacob 1965).

If the family fraction of the D.F.P. is divided in the same way, the estimated constitution of the real practice becomes

Number of personal group perimean adults	=2215
Number of personal group supramean adults	= 397
Number of modified family adults	= 343
Number of unmodified family adults	= 60
Number of adults in permanent revisit group	= 60
Number of children	=1092
Total practice	=4167

*indicates figure obtained by direct observation in real practice.

**indicates figure observed or calculated from observations in artificial practice.

STAGE B. Reconstruction of delivery pattern of real practice

Mean item rate/child=2.8** Number of children=1092

Number of items for children=3058.

Since the item rate/child is the same in the unmodified and modified family groups this work load can be divided into a 15 per cent fraction for the unmodified group and an 85 per cent fraction for the modified group. If the special work

load equation $T = \sum_{i=1}^{\chi} m_i m_i$ is applied, the reconstituted practice work load and delivery patterns shown in table VI are obtained:

The observed figures for the real practice were $t=24,549$ items; c/v ratio=3.6/1 and number of visits and consultations=5,360 and 19,179 respectively.

There are three discrepancies between the calculated and observed figures:

1. T is overestimated in the calculations by 548.
2. The calculated number of visits is too small by 1081.
3. The estimated general c/v ratio of 4.9/1 is too large.

The third discrepancy is a direct result of the second.

The first discrepancy is not serious since it represents an error of +2.3 per cent in figures which are subject to random variation.

The second is more serious and requires further study.

The most likely source of this error is in the selection process. The artificial practice was constructed in the surgery and consecutive cases were accepted without discrimination. In consequence a number of subjects entered the experiment in the middle or at the end of an episode. This leads to exclusion of the initial items in the

TABLE VI
RECONSTITUTED WORK LOAD AND PRACTICE PATTERNS

		Visits	Consultations
n ₁ = 928 modified family children with item rate	m ₁ = 2.8** = 2,599 items at c/v ratio 1.6/1** =	999	1,600
n ₂ = 164 unmodified family children with item rate	m ₂ = 2.8** = 459 items at c/v ratio 2.1/1** =	148	311
n ₃ = 343 modified family adults with item rate	m ₃ = 5.2** = 1,781 items at c/v ratio 6.8/1** =	228	1,553
n ₄ = 60 unmodified family adults with item rate	m ₄ = 21.3** = 1,271 items at c/v ratio 10.7/1** =	109	1,169
n ₅ = 2215 perimean adults with item rate	m ₅ = 4.6** = 10,189 items at c/v ratio 16.6/1** =	578	9,611
n ₆ = 397 supramean adults with item rate	m ₆ = 18.0** = 7,149 items at c/v ratio 11.5/1** =	572	6,577
n ₇ = 60 permanent revisit adults with item rate	m ₇ = 27.41** = 1,645 items at c/v ratio 0/1* =	1,645	—
T = 25,097 items at c/v ratio 4.9/1		4,279	20,821

first episode and results in a loss of visits. This error would be reflected as an exaggeration of the c/v ratio of all groups, but is most marked in the perimean group because of the low individual demand. There is an additional exaggeration of the underestimate because this is the largest single group in the practice population.

The error would be less in the high demand groups because they have predominantly multiple episode patterns and in the family group because of the number of possible patient/doctor contacts which arise from vicarious demands subsequent to the initial episode.

If one accepts that the visit loss in the perimean group is of the order, one visit for every two to three patients, a recalculation results in a reduction of the c/v ratio of that group from 16.6/1 to the range 7.2/1 to 5.5/1. This estimated loss is not unreasonable since a number of people must have lost more than one visit through the selection process. If the sampling method had been designed so that the episode came at the end of the observation year there would be a loss of consultations instead.

A recalculation using the adjusted c/v ratio range for the perimean group makes the following alterations:

- (1) An increase in the visits to the perimean group in the range 666 to 989 to give a total of 1244 to 1567.
- (2) An increase in the total visits to the range 4,944 to 5,268 which is in closer agreement with the observed figure.
- (3) A reduction in the estimated general c/v ratio to the range 4.1/1 to 3.65/1 which is again close to the observed figure.

The reduction of the c/v ratio of the perimean group to the range 7.2/1 to 5.5/1 agrees with the c/v ratio of the corresponding modified family group. This also suggests that the discrepancy between the calculation and the observed figures is due to visit loss in the perimean group.

Reconstruction of the visiting pattern

A different ratio is used to reconstruct the visiting fraction of the delivery pattern of the real practice. This is the new visit/revisit/late call ratio (N/R/L ratio). The ratio was calculated for each of the groups from the observations made in the artificial practice. The numbers of each type of visit in the whole practice was then calculated by modifying the number of visits estimated in stage B of the calculation above with the N/R/L ratio. Since the predicted total number of visits was an underestimate, the correction used in stage 2 of the first calculation was also applied. The three results are given in the following calculation (table VII).

It was to be expected that a calculation based only on the observed figures in the artificial practice would underestimate the number of all three types of visits because it is based on an underestimated total.

TABLE VII
RECONSTRUCTED VISITING PATTERN

	New visits	Revisits	Late calls
999 visits to modified family children at N/V/R ratio 4/1/1.5	617	155	227
148 visits to unmodified family children at N/V/R ratio 3.6/1/2.16	79	22	47
228 visits to modified family adults at N/V/R ratio 7.8/1/1.6	171	22	35
109 visits to unmodified family adults at N/V/R ratio 3.78/1/1.87	62	16	31
578 visits (observed) to perimean adults at N/V/R ratio 4.43/1/1.4	390	88	100
1,244 visits (lower correction to perimean adults at N/V/R ratio 4.43/1/1.4	839	189	216
1,567 visits (upper correction) to perimean adults at N/V/R ratio 4.43/1/1.4	1,057	238	272
572 visits to suprimean adults at N/V/R ratio 3.05/1.84/1	296	179	97
1,645 revisits to permanent revisit group	—	1,645	—
(1) calculated from observation in the artificial practice	1,615	2,127	537
(2) calculated after applying lower correction	2,064	2,228	653
(3) calculated after applying upper correction	2,282	2,277	709
Total observed in real practice	2,102	2,234	761

However, the use of the correction brings the figures into close agreement with those which were observed in the real practice. The accuracy range when the correction is used is -1.8 per cent to $+3.8$ per cent for the new visits, -0.3 per cent to $+6$ per cent for the revisits and -14.5 per cent to -6.8 per cent for the late calls. There is a residual discrepancy in the late call figures, because the perimean group is one of the groups which contributes least to the late call fraction, in relation to its size.

Discussion

The first point is whether the two calculations given in detail above are accurate. The accuracy depends on the validity of the correction introduced to adjust the figures observed for the perimean group in the artificial practice. This problem arises from the method of selection at surgery sessions. Although not ideal, this was the only practical method. It was expected that the loss of initial items in each case would not seriously alter the overall picture. It is estimated in the correction that the number of lost visits is of the order 52-78. Since the total work load of the artificial practice is 7,204 items of service this loss is equivalent to 0.72 per cent to 1.8 per cent of the total.

It was also anticipated that since most of the work is done in the surgery the constitution of the artificial practice would approximate more closely to the constitution of the real practice than was actually the case. This discrepancy enhances the use of the artificial practice as a tool for studying people and their diseases, since the minority groups are well represented, but it exaggerates the error from dropped visits when an attempt is made to reconstitute the work of the real practice, because the visits dropped from the lowest adult demand group produce an exaggerated C/V ratio. This error is further increased by the size of the perimean group in the real practice.

It should be noted that the correction was applied to the observations of the artificial practice and not to the calculations themselves. If the correction had been based on a false assumption it would be expected that the discrepancies between the recalculated general delivery pattern and the observed delivery pattern would have been larger. It should also be remembered that observations in a practice are subject to chance fluctuation so that theoretical calculations based on sample observations cannot give accuracy correct to the last item of service. However, it would seem an easy matter in future work of this kind to introduce a recording method which details the number of dropped visits and perhaps allows retrospective recording when observation begins during an episode.

Certain firm conclusions can be drawn from the observations and calculations above whether these arguments are accepted as valid or

not. The first is that the general delivery pattern of a practice or community depends on the constitution of the community and the delivery patterns of the constituent groups in the community. It follows that two practices which are different in character may have similar general delivery patterns. This means that the conventional use of the C/V ratio is misleading in studies which involve more than one practice unless the constitution of the practices is known.

The most important subgroup from the point of view of visits is the permanent revisit group, and it is obvious that changes in the size of this group which accounts for a small proportion of the D.F.P. of a practice will be reflected in a disproportionate alteration of the general C/V ratio and the general $N/R/L$ ratio. The second most important group in the visiting population is the children. They are less important in the consultation fraction. Unlike the permanent revisit group they feature most in the new visit and late call fractions. While the unmodified family children contribute a proportionately greater share of the late calls they are not sufficiently numerous to produce a marked effect in the general pattern. The observations on the children confirm previous work (Jacob 1962). It is also interesting to note that the observed attendance rate for the children was 2.8 items per patient. This is the smallest demand in any of the groups. It is generally accepted that the children of a community form one of the higher demand groups. In this investigation the definition of a child was an individual under 15 years of age. It would appear that high demand in childhood occurs only in infancy and during the period of vulnerability to the exanthemata of childhood. It seems that if the whole group of children are studied the lower demand of older and immune children more than balances out the high demand of the infants and those who have yet to be exposed to the ailments of childhood. It will be possible to investigate this suggestion in detail at a later date.

The position of the primean adults is equivocal. There is no doubt that they contribute most to the consultation fraction of the delivery pattern, but this is produced by weight of numbers rather than by high individual demand. Even in the uncorrected figures this group contributes substantially to the visit fraction and its visits are predominantly new visits. If the corrected figures are accepted, then this group would also become the most important group in the production of new visits as well as consultations. Since this is a low demand group this would suggest that its work constitutes the bulk of the sporadic work in a practice and that the submerged part of the 'iceberg' of undiagnosed disease lies in this group.

The supranean group contributes disproportionately to visits and consultations and this disproportion is distributed evenly within the

visiting pattern. A similar disproportion is contributed by the unmodified family adults but because this is a small group the effect on the general pattern is less marked.

The variations in demand and delivery patterns are interesting in themselves but their explanation lies in an understanding of the factors which produce them. These can only be understood in terms of morbidity and characteristics of the population at risk, and a study of the morbidity pattern of the artificial practice is to be the next stage of this work.

Summary

The delivery patterns of the artificial and real practice have been studied in detail.

The evidence indicates that the general expression based on average figures to describe a delivery pattern is misleading.

The delivery pattern appears to depend on the constitution of the population under study and the demand and delivery patterns of the subgroups within the community.

It is anticipated that the features of these subgroups will depend on their diseases and the personal characteristics of those who are in them.

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REFERENCES

- Jacob, A. (1962). *M.D. Thesis, University St Andrews.*
Jacob, A. (1965). *J. Coll. gen. Practit.* In press.
Lees, D. S. and Cooper, M. H. (1963). *J. Coll. gen. Practit.*, 6, 408.
Taylor, S. (1955). *Good General Practice*, Oxford University Press.
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