Development of a measure of professional collaboration in primary health care

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Abstract

Study objective—The aim was to develop indices of the degree of collaboration between district nurses, general practitioners, and health visitors.

Design—Semistructured interviews were conducted with each member of a pair of professionals who had patients in common. In each district a stratified random sample of six general practitioners and six community nurses was drawn, and for each a "partner" of the other profession was sampled.

Setting—A stratified random sample of 20 district health authorities in England.

Participants—Complete interviews were obtained with 148 doctor-nurse and 161 doctor-health visitor pairs.

Main results—Only 27% of general practitioners and district nurses with patients in common and 11% of general practitioners and health visitors collaborate. Stepwise logistic discriminant analysis was used to develop measures of collaboration between general practitioners and district nurses and between general practitioners and health visitors. The indices of collaboration were calculated from the responses of the community nurse to at most 10 questions.

Conclusions—The indices developed here might be used as a measure of one aspect of the quality of service offered by a primary health care team or to assess the effect of changes in working patterns or the degree of collaboration within the organisation.

In recent years there has been an increasing interest in how primary health care is delivered and in particular in the organisation of community nursing resources in relation to those of general practice. Much health care depends on cooperation and teamwork, and lack of adequate understanding between team members can lead to uncertainty and inefficiency in service provision.¹ In *Promoting better health*,² the government set out its programme for improving primary health care, attaching "considerable importance to the strengthening of the primary health care team". They felt that primary care was at its best when provided by a range of professional staff, including district nurses, health visitors, and general practitioners, working together as members of a primary health care team. Although the Cumberlege report³ proposed a neighbourhood nursing approach to the organisation of community nursing services, it

argued that nurses were at their most effective when they and general practitioners worked together in an active primary health care team. However, neither *Promoting better health* nor the Cumberlege report suggested any method for assessing how well a team was working together.

The first approaches to teamwork were in the mid-1950s when local health authorities in Britain began to move towards bringing district nurses and health visitors into closer working relationships with general practitioners. Nursing administrators were encouraged to develop experimental schemes such as "attachment" and "liaison" between community nursing and medical services.⁴ There was an assumption that "attachment" was synonymous with "teamwork". However, in practice "attachment" is not always successful and, even where it has appeared so, there is often doubt that the team is achieving its full potential. The increase in the number of health centres and larger group practices was also thought to encourage teamwork, but again their presence is not sufficient to guarantee the existence of collaboration.

In 1981 the Harding Report⁵ received evidence a wide range of views about the existence and effects of teamwork. However, there have never been any realistic criteria by which joint working could be judged.

In response to a growing need for information on the extent of joint working in primary health care organisations in England, the then Department of Health and Social Security funded us to conduct a survey of interprofessional collaboration in primary health care organisations. Our study had two main aims: (1) to investigate the existence and extent of collaboration in primary health care organisations in England; and (2) to develop indices of the degree of collaboration between district nurses, general practitioners, and health visitors. We have discussed our findings in relation to our first aim elsewhere.⁶⁻⁹ This paper is concerned with the second aim—the development of indices of the degree of collaboration between a district nurse and a general practitioner and between a health visitor and a general practitioner. Such indices could be used as one measure of quality of primary health care.

Methods

POPULATION

This study was concerned only with the three most numerous professionals working in the community: general practitioners, district nurses, and health visitors. However, since collaboration

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is an attribute of groups rather than individuals, our target population was pairs of professionals who shared the care of patients. Having patients in common does not predict the extent of any working relationship between the pair which was therefore known as a “*potential collaborative unit*” or PCU. To arrive at a sample of PCUs, a three stage procedure was established.

(1) The 199 district health authorities in England were stratified by attachment rates of district nurses and, health visitors, proportion of general practitioners in health centres, and whether urban or rural. A representative sample of 20 districts was then drawn.

(2) To sample PCUs from within each district health authority, a list of general practitioners was obtained from the family practitioner committee administrator and lists of district nurses and health visitors from the district nursing officer. These were stratified to ensure we obtained a representative sample of general practitioners from health centres and from single handed practices and a representative sample of district nurses and health visitors who worked part time or who were attached to the practice. From the lists a systematic random sample of six general practitioners, three district nurses, and three health visitors was drawn.

(3) These “first respondents” were asked to complete a short questionnaire in which district nurse and health visitor respondents listed all the general practitioners whose patients they had seen in the last month, and estimated the proportion of their time they had spent with the patients of each practitioner. General practitioner respondents gave similar information in relation to district nurses and health visitors. A “second respondent” for each first respondent was sampled randomly from these lists after weighting according to the proportions of time stated. These two, first and second respondents, were then known as a “potential collaborative unit”, and formed the basis of our research.

DATA COLLECTION

The major device for data collection was the structured interview which was administered personally by a member of the project team. The information gathered included the organisation of the respondents’ work, background, working environment, and working relationship with the other members of the PCU, including some details of interprofessional consultation and referral pattern. Finally, the interviewer rated the closeness of the respondents’ working relationship with their PCU partner on a five point scale of collaboration devised by the project team. This ranged from a state of “no direct communication” through incremental points of “formal, brief communication”, “regular communication and consultation” and “high level of joint working” to “multi-disciplinary working” (see table I).

The interviewer selected the most appropriate point of this scale, basing his or her judgement on the interview and any other information

Table I A taxonomy of collaboration^a

Stages of collaboration	Definitions
(1) No direct communication	Members who never meet, talk or write to one another
(2) Formal, brief communication	Members who encounter or correspond with others but do not interact meaningfully
(3) Regular communication and consultation	Members whose encounters or correspondence include the transference of information
(4) High level of joint working	Members who act on that information sympathetically; participate in patterns of joint working; subscribe to the same general objectives as others on a one to one basis in the same organisation
(5) Multidisciplinary working	Involvement of all workers in a primary health care setting

^a After Amitage¹⁰

volunteered by the respondent. After both members of a PCU had been interviewed the interviewers met to determine that point on the scale which would most appropriately describe collaboration between the two respondents, taking into account all information received at both interviews.

STATISTICAL ANALYSIS

The aim of our analysis is to summarise the various influences on collaboration in the form of mathematical equations which predict the level of collaboration between a general practitioner and a district nurse or between a general practitioner and a health visitor. This multivariate analysis selects some of the variables and allocates weightings which together predict the degree of collaboration between members of PCUs.

To produce these predictive equations or indices we need to discriminate between the different ratings on the five point collaboration scale. The statistical technique used, logistic discriminant analysis, was developed by Anderson.¹¹ Logistic discriminant analysis has previously been used to predict the behaviour of patients suffering from minor trauma,¹² to construct an index of general practitioner trainer performance,¹³ and to predict whether an individual mother will breast feed.¹⁴

The simplest form of logistic discriminant analysis discriminates between just two populations, in this case PCUs showing a high degree of collaboration and those not. In particular, it estimates the probability with which a particular PCU with characteristics $x_1, x_2, \dots, x_p$ belongs to either population:

$$\begin{aligned} \text{Probability (high collaboration)} &= e^z / (1 + e^z) \\ \text{Probability (low collaboration)} &= 1 / (1 + e^z) \end{aligned}$$

where z , technically known as a discriminant function but better described here as an index of collaboration, is given by:

$$z = \beta_0 + \beta_1 \times x_1 + \beta_2 \times x_2 + \dots + \beta_p \times x_p$$

The coefficients (or weightings) $\beta_0, \beta_1, \dots, \beta_p$ are estimated from the data by the method of maximum likelihood.

Before including predictor variables in the statistical analysis it is necessary to give them a mathematical form. A binary variable, such as gender, was given a value of “1” for one response

and "0" for the other. A variable with three or more categories that cannot be ordered, such as "location of majority of practice population", was replaced by binary variables indicating the presence or absence of each category. A variable with ordered categories such as "how far away from your base is your PCU partner's base?", was coded such that the response most associated with high collaboration, according to univariate analysis, was most positive and the response most associated with the low collaboration was most negative. Thus a variable with five categories was coded -2, -1, 0, 1 or 2.

All variables which might affect the degree of collaboration between the two members of the PCU were included in the discriminant analysis. Even if univariate analysis suggests that they were not significantly correlated with collaboration, it is possible that their univariate effects have been masked by their correlation with other variables.

Indices of collaboration are easier to understand and to use if they include only those variables which make a statistically significant contribution to the index. Therefore, the index was generated in a series of steps. At each step that variable not yet included which achieved the best improvement in the predictive power of the index was added. This process continued until no statistically significant improvement in predictive power was detected. Since many variables compete at each step for inclusion in the index of collaboration, the choice of an appropriate statistical test is not clear cut. This problem of "multiple comparisons" is discussed in detail elsewhere.¹³ The predictive power of the model is summarised in statistical terms by the log likelihood. In this analysis the increase in log likelihood was deemed to be significant if it was at least 1.96 when 60 or less variables were competing and 3.32 when there were more variables competing.

Results

After initial analysis which is reported elsewhere⁶⁻⁸ we concentrated on the PCUs and the data were arranged into the pairs or units themselves. Excluded were respondents whose PCU partners were not interviewed for various reasons. This left us with 161 doctor-health visitor PCUs and 148 doctor-nurse PCUs.

Table II shows the distribution of ratings given by the interviewers to the two types of PCU. For the 148 doctor-nurse PCUs, the distribution of the ratings of collaboration is symmetrical with half the PCUs rated in the middle group—"regular communication"—and a small percentage in each of the two extreme categories. For the 161 doctor-health visitor PCUs the distribution is slightly skewed with most of the PCUs allocated to "formal, brief communication" or "regular communication".

Table II Interviewer ratings of potential collaborative units (PCU)

Rating	Doctor-nurse PCU (n=148)	Doctor-health visitor PCU (n=161)
No direct communication	3%	13%
Formal, brief communication	20%	35%
Regular communication	50%	41%
Joint working	24%	8%
Multidisciplinary working	3%	3%

Thus, doctor-health visitor PCUs are significantly less collaborative than doctor-nurse PCUs.

Some of these categories contain too few observations to contribute usefully to a reliable discriminant function. We therefore report the results gained by using binary logistic discriminant analysis. For the doctor-nurse PCUs the variable distinguishes between "regular communication or less" in one population and "joint and multidisciplinary working" in the other; for doctor-health visitor PCUs the two populations are "at most formal, brief communication" and "regular communication or joint working".

Since collaboration was rated by interviewers on the basis of information provided by PCU members at interview, the ratings reflect variables that the interviewers considered important. Thus an analysis using only variables from the interview questionnaire is essentially an investigation of interviewers' judgements and the relative value they placed on the different variables in reaching their decision.

DOCTOR-NURSE PCU

Of those variables collected at interviews with the general practitioner and the district nurse, 109 were possible predictor variables. The stepwise analysis was performed using all these variables and for just the set collected at one interview, to see how accurately collaboration between two members of the PCU could be predicted with information from just one member. The results of these analyses are shown in table III. The characteristics of the variables making a significant contribution to each index are very similar. There is always a variable concerned with whether the general practitioner asks the district nurse for her opinion and at least one variable concerning the organisation of the district nursing services with respect to general practice. These concern the number of practices the district nurse works with, whether the district nurse is attached to a general practice, and whether she is based in the same building or spends a long time in the same building as the general practitioner. Other variables common to the indices are concerned with referrals between the two members of the PCU, use of one another's records and understanding of one another's responsibilities.

Each of these analyses produces an index with a weighting attached to each variable included in the index. If this index is then applied to the values of the variables for each PCU a score is obtained. A positive score predicts a collaborating PCU while a negative score predicts a PCU which is "at most communicating". Table IV compares the observed rating with the predicted rating for each PCU and shows that the prediction based on variables obtained only at the district nurse interview is as good as that from variables obtained from both general practitioners and district nurse interviews.

The questions asked at the district nurse interview which led to the variables being included in that index are listed in table V and fig 1 shows the distribution of individual scores.

Table III Results of logistic discriminant analysis of collaboration in doctor-nurse potential collaborative units, showing the maximum increase in log likelihood achieved by including each interview variable

Interview questionnaire	Variable	Log likelihood
<i>Both interviews</i>		
GP	Number of times asked DN's opinion in last month	10.34
DN	Go to GP to find out result of referral	7.31
DN	Reason for moving into community—not community orientation	5.34
DN	Does GP understand responsibility of a DN?	4.81
DN	Number of practices you work with	4.33
GP	Do you comment to DN on her work?	3.56
<i>District nurse interview only</i>		
	How long in each week in same building as GP?	8.90
	Are you attached to GP?	4.75
	Reason for moving into community—not community orientation	5.10
	Number of times GP asked your opinion in last month	5.70
	Are you currently a practical work teacher?	3.16
	Did you have a choice as to whether you worked with the GP?	3.02
	How many patients have you referred to this GP in last month?	2.99
	Do you feel GP understands responsibilities of a DN?	3.69
	Do you go to GP to find out result of your referrals?	2.26
	Do you hold practical work teacher certificate?	2.04
<i>General practitioner interview only</i>		
	Number of times asked DN's opinion in last month	10.34
	Does DN comment to you on your work?	3.67
	Is DN based in same building as you?	2.43
	Have you worked in community 5–10 years?	2.19
	Do you ever make entries to DN's records?	2.33
	Does DN ever consult your records?	2.17

DN = district nurse; GP = general practitioner

Table IV Comparison of predicted collaboration with observed collaboration for each doctor-nurse potential collaborative unit for each index of collaboration.

Observed	Predicted	Source of predictive variables for index		
		Both	DN only	GP only
Collaborating	Collaborating	27	26	19
	Communicating or less	14	15	22
Communicating or less	Collaborating	9	8	11
	Communicating or less	98	99	96
Sensitivity		66%	63%	46%
Specificity		92%	93%	90%

DN = district nurse, GP = general practitioner

DOCTOR-HEALTH VISITOR PCU

Three analyses were performed as for the doctor-nurse PCU, one including all possible predictor variables collected at the two interviews and one each including only the variables collected at one interview. These results are given in table VI.

Again, all three analyses include at least one variable concerned with opinion seeking between the professionals and one concerned with referral of patients between them. Other variables which occur in the indices include consultation of partner's records and understanding responsibilities of the PCU partner's profession.

Table V Coding of variables in the index for doctor-nurse potential collaborative units and weightings attached by the discriminant analysis

Variable	Coding					Weighting
	-2	-1	0	1	2	
Official working relationship with Dr X			Other	Attached		3.75
In an average week how long do you and Dr X spend in the same building at the same time?	Never	< 1h	1–5h DK	5–< 10h	10h or more	0.75
How many patients have you referred to Dr X in the last month?		None	1–5 DK	6–10	> 10	0.84
If you want to know what has happened to any of your referred patients how do you usually find out?			Telephone, leave message, ask patient, other	Go to doctor		1.50
Number of times Dr X asked your opinion in the last month		None	1–5 DK	6–10	> 10	0.51
Do you feel that Dr X understands the responsibilities of a DN?			No, DK	Yes		2.27
Did you have any choice as to whether you worked with Dr X?			No, DK	Yes		2.20
Reason for moving into the community			Community orientation	Family, career, other		3.65
Do you hold the PWT certificate?			No	Yes		-2.90
Are you currently a PWT?			No	Yes		5.32
Constant						-11.32

DK = don't know; PWT = practical work teacher

There is often a variable concerned with the organisation of health visiting resources, either the number of general practitioners they work with or whether they are attached and the length of time they spend in the same building.

Table VII shows that the index based on an analysis only of data from the health visitor interviews is as accurate in predicting the degree of collaboration between the two members of the PCU as the index obtained from the analysis of data from both interviews. The questions asked in the interview with the health visitors are listed in table VIII and fig 2 shows the distribution of individual scores.

Discussion

While logistic discriminant analysis is an effective method of summarising various influences on collaboration it does not explain the mechanisms behind collaboration. Nor does the final index necessarily suggest the characteristics which should be changed in order to improve collaboration. The index can only be used as a method of measuring the degree of collaboration between a pair of individuals.

Tables IV and VII show that it is not necessary to interview both partners of a PCU to obtain a satisfactory score on the index of collaboration. Since the index derived only from information from general practitioner interviews is less sensitive or specific than that from district nurse or health visitor interviews, the indices from community nurse interviews are recommended as a cost-effective measure of collaboration.

Table V shows the index for doctor-nurse PCUs in detail. The fact that the index does not include a particular variable does not necessarily indicate that this variable is not related to collaboration but that it is so highly correlated with the variables already in the index that it can add nothing more to the index. This index thus includes variables relating to district nurse referrals to the general practitioner but not general practitioner referrals to the district nurse, and includes opinion seeking by the general practitioner of the district nurse, but not by the district nurse of the general practitioner.

The index also includes a variable about feedback following referrals. This indicates not

Note: Low collaboration is regular formal or no communication
High collaboration is joint multidisciplinary working

Figure 1 Distribution of scores from index of collaboration between general practitioner and district nurse using district nurse variables only

only the method of finding out about referrals but that there had been referrals, that the district nurse desired feedback, and that the general practitioner was accessible.

District nurses who gave as reasons for choosing to work in the community their dislike of the institutional atmosphere of hospitals and their desire to be more involved in total patient care were much less likely to collaborate than those that gave other reasons. Collaboration was higher where the district nurse was currently a practical work teacher. However, if the district nurse was not currently teaching although holding the certificate, collaboration with the general practitioner was less likely as indicated by the negative weighting on this variable. In most districts the district nurse was "allocated" to specific practices or neighbourhoods, but in some

Table VI Results of logistic discriminant analysis of collaboration in doctor-health visitor potential collaborative units, showing the increase in the log likelihood achieved by including each interview variable

Interview questionnaire Variable		Log likelihood
<i>Both interviews</i>		
GP	How many referrals to HV in last month?	28.51
HV	Does GP ever ask your opinion?	12.87
GP	When discuss patients does person taking lead vary?	8.68
HV	Do you comment to the GP on his/her work?	7.79
HV	Does GP ever consult your records?	4.58
HV	Does GP understand responsibilities of a HV?	3.64
GP	Marital status of GP	2.65
<i>Health visitor interview only</i>		
	Does GP ever ask your opinion?	25.74
	Do you comment to GP on his/her work?	12.99
	Does GP understand responsibilities of a HV?	8.19
	Does GP ever consult your records?	5.34
	How many patients have you referred to GP in last month?	3.85
	Number of GPs you work with	2.58
	Reason for moving into community—need for a change	2.07
	Are you on first name terms with GP?	1.81
<i>General practitioner interview only</i>		
	How many referrals to HV in last month?	28.51
	When discuss patients does person taking lead vary?	12.06
	Is HV attached to your practice?	4.41
	How often HV asked your opinion in last month?	3.09
	How long each week are you in same building as HV?	2.54
	How many clinics are you regularly involved with?	1.71

HV = health visitor; GP = general practitioner.

Table VII Comparison of predicted collaboration with observed collaboration for each doctor-health visitor potential collaborative unit for each index of collaboration.

Observed	Predicted	Source of predictive variables for index		
		Both	HV only	GP only
At least regular communication	At least regular communication	71	76	71
	Formal or no communication	12	7	12
Formal or no communication	Regular communication	12	12	17
	Formal or no communication	66	66	61
Sensitivity		85%	92%	85%
Specificity		85%	85%	78%

HV = health visitor, GP = general practitioner

places it was possible for the district nurse to ask for a transfer to a specific practice or geographical area when a vacancy became available and this was associated with more collaboration.

The variables included in the doctor-health visitor index shown in table VIII are very similar to those shown for the doctor-nurse index. Although the index includes no variable about the official working relationship if the health visitor worked with a small number of general practitioners, attachment to the practice was more likely. Although there was no question about the length of time they spend in the same building at the same time there are variables concerned with opinion seeking and whether the health visitor ever comments to the general practitioner about his work. Only 14% of the health visitors said that their general practitioner partner consulted their records but if they did this was associated with higher collaboration. If the health visitor gave "need for a change" as the reason for moving from hospital work to the community collaboration was more likely.

It is important to consider the reliability of the indices: that is, their ability to give the same result under the same conditions. In common with most studies of this type, it is not possible to assess the reliability using test-retest methods as respondents may remember their first answers or characteristics may change between the two tests.

The indices described contain three types of variables: those which describe attitudes, those which describe the general method of working together, and those which describe the current processes. The first two types are unlikely to be subject to much variation, providing the wording of the question is not ambivalent. However the third type may vary from one month to another with the natural variation in work patterns. The reliability that can be attached to these variables due to problems of recall may therefore be much lower. The effect of this variability has been reduced by grouping these variables and it will be noted that the weights associated with these are on the whole much lower than the weights attached to other variables.

The aim of this study was to develop indices of collaboration between professional staff of primary health care organisations and to investigate the existence and extent of collaboration in these organisations in England. Collaboration does exist between general practitioners and district nurses and between

Table VIII Coding of variables in the index for doctor-health visitor potential collaborative units and weightings derived from discriminant analysis

Variable	Coding of responses					Weighting
	-2	-1	0	1	2	
How many GPs do you work with altogether?	9 or more DK	6-8	4,5	1-3		0.58
How many patients have you referred to Dr X in the last month?		None	1-5 DK	6-10	> 10	1.01
Does Dr X ever ask for your opinion?			No, DK	Yes		1.82
Does Dr X ever consult your personal records?			No, DK	Yes		2.64
Do you feel that Dr X fully understands the responsibilities of a HV?			No, DK	Yes		2.18
Do you ever comment to Dr X on his/her work?			No, DK	Yes		2.06
Why did you move into community work?			Family, career, community, other	Need a change		1.69
Constant						-3.24

DK = don't know; GP = general practitioner; HV = health visitor

Note: Low collaboration is regular formal or no communication
High collaboration is joint or multidisciplinary working

Figure 2 Distribution of scores from index of collaboration between general practitioner and health visitor using health visitor variables only

general practitioners and health visitors but it is not widespread. From table II, less than 30% of general practitioners and district nurses with patients in common collaborate, and less than half this percentage of general practitioners and health visitors collaborate. However, we have shown that we can measure collaboration and can produce indices of collaboration.

The uses of these indices, once they have been tested on another population, vary from informing NHS management decisions to providing a rigorous instrument for future research into collaboration. Such an instrument might be used to investigate the effects which policies, resources, and other characteristics of primary care organisations and district health authorities have on collaboration, or to relate the measures of collaboration to the achievements of these organisations.

For instance, an index might be used by the family practitioner service authorities in administering the new general practitioner contract as a measure of quality of service offered by a primary health care team. Alternatively, an index could be used to measure collaboration between pairs of professionals before and after certain changes were made to their environment or their way of working in order to assess the effect

that the changes have on their collaboration. The index used would depend upon the purpose and the resources available. It would be essential to choose an index that did not include any variable concerned with the changes themselves.

The choice of index would also depend on the degree of precision required. Our misallocation rates were higher when only variables collected from the general practitioner were used in the index. In general, the higher the precision required the greater the amount of data that have to be collected or the more complex they have to be and therefore the more costly. If the central purpose is to look at collaboration then a costly index may be required; if collaboration is just one of many variables being examined, then a cheaper index may be preferred. From our data we can develop an index for different purposes and we have illustrated the process using data from the interview questionnaire.

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