

# Modelling the implications of boundary changes to health care planning using GIS

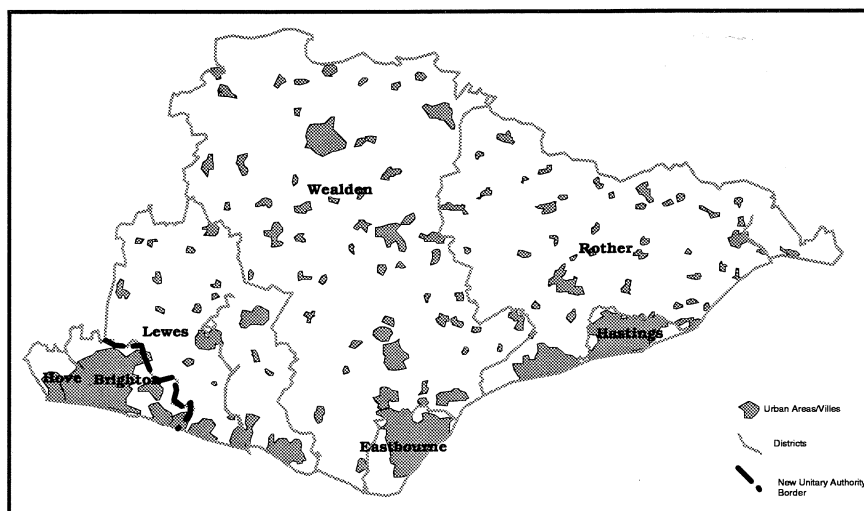
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## Introduction

As part of a rolling national program to re-organise local authority structures in England from 1996 on, the decision was taken to alter the structure of the existing county of East Sussex, which at that point consisted of seven administrative districts. The decision was taken to take the two districts of Brighton & Hove and form them into a new « unitary » authority. Unitary authorities were created across the country and are completely independent within the local authority structure with no formal relationship to the previous district/county structure. The remaining five districts of Lewes, Eastbourne, Hastings, Rother & Wealden continued to exist as the « new » county of East Sussex. (Fig.1 )

Fig. 1 : Administrative Map of East Sussex, Brighton & Hove  
Carte administrative de East Sussex, Brighton of Hove



The whole process of local authority boundary change had significant implications for service and resource planning across a number of health and social care related areas. The county council had traditionally provided a number of key services in these areas of health through the provision of special education, social services and other health-related services, often in conjunction with local health authorities and trusts. To try and identify the specific implications of service boundary change, it was felt that one particular group should be chosen to illustrate the broader implications and difficulties in a manageable way. The planning of services to carers/parents of children with disabilities was identified as a useful application to show these spatial implications as it provided a good example of the complex workings of a cross-service client-group with implications beyond the councils service remit as well.

## 1. Service Planning

### 1.1. Client Group

The particular interest in Parents of Children with Disabilities stems from ongoing research in the area of Respite and Short-term care planning for Carers. Carers, who are generally, though not exclusively, the parents of children with disabilities, have, over the past few decades, been the

recipients of a number of services aimed at giving them a break from caring. This can take the form of three principal service types including; 1) respite care (ranging from overnight to a week or more's break), where the child stays at a centre or home, 2) day care at a recognised centre or 3) care in the home, where health/social care staff come into the home to give the carer a break (Foley & Frost 1996). In many cases (Stalker 1996) this care has been a by-product of a service to the child and the actual service takes the form of a combined service to the carer and the cared-for person. While this is not always appropriate for carers there is a sense that a service which supports both partners is a suitable one. This paper will not go into any great depth on these complex carer issues (Twigg 1992) but rather will consider elements of the nature of the clients and their needs to illustrate the complexity and equity of the planning process. At a strategic level the increased recognition of Carers through legislation and the impact of advocacy organizations such as the Carers National Association has also raised the profile of carers within the wider health arena (Warner 1995).

## 1.2. Planning & Resource Issues

The period leading up to the official change in local authority units, April 1st, 1997, was marked by a series of operational changes not all of which helped the smooth running of services. For a year beforehand a series of shadow departments were set up while there was considerable and understandable concern for staffing and funding implications. This had an obvious knock-on effect on planning both in terms of service provision, and particularly in the case of service planning. There was an effective planning « blight » over an eighteen month period from mid-1996 to late-1997<sup>1</sup> as new organisational structures were put in place. From a practical point of view there were now two separate Special Education and Social Services Departments running what had been a previously unified service. Some of the existing staff remained and needed to be integrated with new staff. From a financial resource perspective, budgetary considerations meant that existing services needed to be looked at closely and new services, where affordable came under the same scrutiny.

Among the issues which arose was the extent to which existing East Sussex arrangements could be continued in the new two-authority scenario. There were obvious resource implications in that the responsibility of both Brighton & Hove and East Sussex was to their constituent populations but prior to April 1st, 1997 there was considerable overlap between the location of services and particularly the users of those services. This applied across a number of levels for carers of children with disabilities and there was some concern among representatives of carers interests that access to services would be restricted in future depending on location and proximity to services. There was also concern as to what the precise nature of the new « boundary » between Brighton & Hove and East Sussex would be in terms of sharing of resources, recognition of existing service provision arrangements and the implications for existing services in both authorities in terms of demand and need. If the boundary were to be rigidly adhered to it might be perceived as a « hard » boundary with little cross-border service delivery whereas a « soft » boundary might be considered as one where the previous fluid service was maintained.

## 2. GIS Approaches

The nature of the re-organisation of local authority service provision changes emphasised a spatial dimension as the change in boundaries and the location of service delivery systems could be expressed in geographical form. There had been a long academic literature in location-allocation of health facilities in the previous decades (Oppong 1994) and as new technology has entered the workplace these approaches have been increasingly carried out by using Geographical Information Systems (GIS/SIG) (Bertrand & Mock 1995, Birkin et al. 1996). It was suggested that GIS (SIG) technology would be an important approach in helping to identify spatial information which would influence the planning of services (Gould 1992, Campbell 1994). Thus aspects of service planning

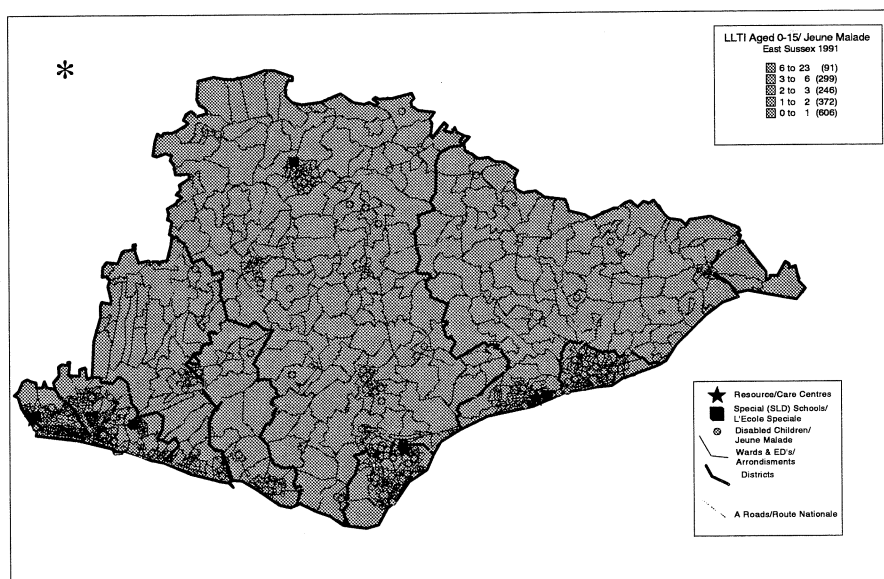
<sup>1</sup> Interview with Senior Manager, Children's & Families Division, East Sussex Social Services, 28/10/96.

such as access, proximity and location were also assuming a position of increased significance within the geography of health (Moon 1995, Kearns & Joseph 1994) and fitted in well with a GIS approach.

The location of facilities in appropriate areas is often an issue and the inverse care law referred to by Eyles & Woods (1986) emphasises the imbalance between facility location, deprivation and demand. Location is also a factor at a series of levels from national right down to local facilities (Joseph & Phillips 1984). At a national and a regional level there are generally a number of specialist facilities which cannot be provided at a local level and the relative location of such services should be carefully planned to see that there is an equality of access across the country or region. In many real cases however, the location of national and regional specialist services have developed in an ad-hoc and unmanaged way with the attendant location and access problems. The same applies at a more localised level and this applies in particular say in a locality planning or social care environment where the statutory provision of services is split between say, rural and urban areas, with the latter, often losing out (Wain 1997, Bullen, Moon & Jones 1994). The need for a broader or fairer service is something which has also concerned central health and social care planners for a number of years. From a social care perspective, the identification of the location of demand for services is important for the optimal planning of those services to reach the greatest number of users. A word of warning may be apposite here in that GIS have traditionally been seen as a management tool but the intention of this paper is to look at how it can reflect and represent both a user and an 'enlightened' purchaser perspective as well.

The second key factor in using GIS is its ability to present a framework for the integration of datasets from a number of different sources. Fundamentally a GIS consists of a series of digital map layers, each of which is linked to its own individual database, thus enabling spatial query and analysis within and between map layers. As these layers form the core of a GIS structure, each layer can be developed as a spatially referenced representation of the service provision and usage of each of the different providers who make up the health and social care system for parents of children with disabilities (Fig 2). This enables the construction of a final total dataset of service usage and location across both authorities. The potential value of this for all service agencies is obvious with implications for joint working, integrated planning and efficiency saving, all elements as essential for future development (Goss & Miller 1995).

Fig. 2 : Basic Map of GIS Layers

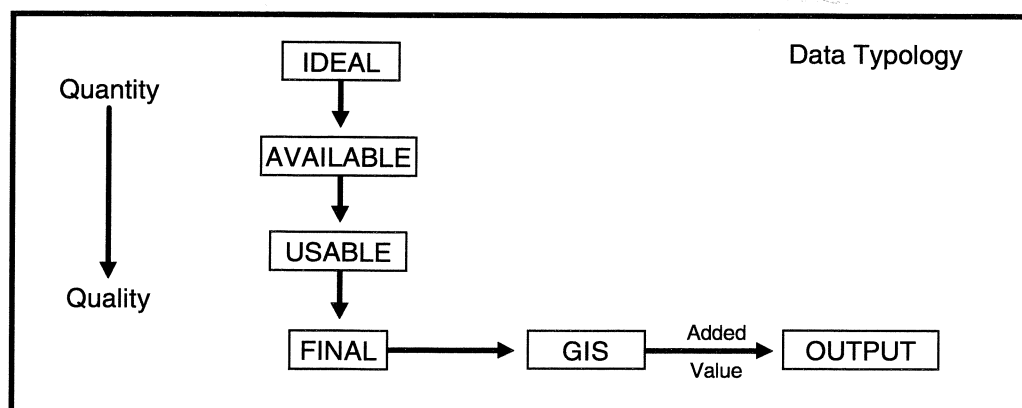


### 3. Method

#### 3.1. Data Issues

To effectively develop a planning tool using a GIS involves first and foremost a foundation of sound quantitative data. This involves the identification of the data requirements for any given project and an assessment of the suitability of those data (Birkin et al. 1996, Martin 1996). The main data sources then need to be identified with an emphasis on potential data access and availability. For the creation of any GIS system which can be used in the planning of health care services for carers it is important to identify clear sets of data which may prove valuable. In many ways these initially identified data sets might be considered in audit terms as the « IDEAL » data ( Fig. 3) Once these data have been identified the likelihood of their existence and accessibility can then be assessed. There are a number of recurring issues related to data access and availability within GIS (Pickles 1995, Taylor & Overton 1995, Fotheringham & Rogerson 1993 ). Within a health-related area these include the non-availability of data, non-computerisation of data, data unavailability due to confidentiality and ethical issues, non-compatibility of comparative data and data at inappropriate scales and levels. When non-available data are excluded, the remaining data, which can be characterised as « AVAILABLE » data, forms the initial core of the GIS system.

Fig 3 - Data Model



There is a varied relationship, however, between « AVAILABLE » and « USEABLE » data. Many of the available data are far from usable and usable data are often not available in an appropriate form. The key to the creation of sound data sets for the end user is the linkage of both available and usable data to produce a « FINAL » data set. These usable data sets will by definition be a compromise, with the key element being their validity and suitability for the task they are intended to perform. The identification of a series of strategies to convert data from an available form to a usable form as close as possible to the « ideal » is also a key element in the creation of viable data sets (Martin 1996, Chrisman 1997). These strategies include the identification of gaps or data-poor areas and the processes of creating alternative data. Additionally there is a considerable amount of data conversion work generally involved to get data into the required format. In all cases the process can be seen to have a decreasing quantity of data which is however paralleled by an increase in data quality as validation occurs all the way down to the final data sets.

#### 3.2. Stage 1 - Data Identification

The first stage was to identify the data requirements of the project and to identify potential difficulties with data access. It was also essential to consider additional or alternative data sets which could add value to the project. Two broad forms of data were identified, background spatial and demographic data, and

service data. The background data needed included digital data on roads, railways, urban areas and demographic information at both ward and ED (Enumeration District) level.

The service data was divided into two sectors, service provision and service use. The former consisted of information about service centres and the details of each provider and the type of resource involved was identified and marked as layers within the GIS. Thus for example there was to be a layer for all special schools in the county with information on location, number of places, catchment, age-groups catered for etc., while in the case of Resource Centres a layer would be created showing their location, number of places/beds, age-groups and type of care provided. The data for each of the service layers were to be complemented by datasets relating to the users of the services with information on age, gender and location of users and where available, some information on the nature of their disability. Additional cost information was also to be added in both cases with some indication of resourcing in the form of direct, indirect and overhead costs. There was also an intention to look at aspatial data elements which will be discussed at a later stage.

### **3.3. Stage 2 - Data Collection**

Background digital maps and boundary data were available from a number of sources including the UK Borders service at the University of Edinburgh and the Ordnance Survey at Southampton. Demographic information was available from the MIDAS service at the University of Manchester. Information on the location of services was a slightly more complex process. Information was relatively easy to collect from the statutory providers such as the county and district councils and the social services departments of each. Health service data was also available from the newly formed East Sussex, Brighton & Hove Health Authority, the main purchaser of health care for the county and unitary authorities. Information on private and voluntary services was collected from individual organisations and from collaboration with the main organisation representing carers interests in the area, East Sussex Care for the Carers.

For service usage data the statutory agencies were again relatively helpful. The data provided included anonymous computerised lists of all users of the 3 main statutory resource centres over a single year drawn from the county's SOSGIS database. This included information on frequency of visits, age, gender and length of stay. The social services department, through a collaborative arrangements with the appropriate NHS Trusts, also provided a list of registered children with disabilities with a breakdown of severity levels of disability. This data was broken down on a broad spatial level, that of postcode district (BN1).

Data on special education was more difficult to access. The central Department suggested contacting the schools directly which was done by contacting the heads of all of the five Severe Learning Disability (SLD) schools in the two authorities and writing letters to all. These letters were circulated and having received no adverse response, the data was then passed back in a variety of formats, some written lists, some computerised. Additionally some cross-referencing was possible from the NHS Trust Registers listed above. Data from voluntary and private service providers was more difficult to come by. Some users of private care via NHS Trusts were listed in social services data. In the absence of a comprehensive set of data for both these sources a mix of survey and sample data was used to augment existing data. These included some information from a series of surveys of carers in East Sussex and Brighton & Hove carried out at the University of Brighton (Frost 1997).

### **3.4. Stage 3 - Data Standardisation and Integration (Entry)**

Having collected the basic data sets the next stage was to standardise the data in a number of ways. Data on the geographical location of both services and service users came in a variety of forms ranging from addresses to postcodes (district and full unit) to electoral wards. All of the different information was converted into an Enumeration District<sup>2</sup> (ED) standard as this allowed for a suitable link onto the map

<sup>2</sup> Enumeration districts are the smallest areal unit used by the ONS decennial census, contain approximately 500 inhabitants, and consist of between 50 and 200 households, depending on the area.

layers within the GIS. This process was also important for confidentiality as data on individuals was aggregated to this areal unit.

The next stage was to geo-reference this data against the maps so that the precise location of data within each service and user layer was correctly displayed against a set of background layers including boundaries, urban areas and different road levels (A, B and unclassified). The geographical projection used was the British National Grid with 6 figure grid referencing producing metre accuracy. The associated databases were then automatically overlaid against the map layers to allow them to be spatially searched and analysed.

Proxy data (to further protect confidentiality) on the location of children with disabilities was also entered into the GIS. This included slightly falsified information on service users. Additionally the data derived from the NHS Trust Registers, originally available at a broad postcode district level, was converted as proxy data down to the lower and more detailed ED level to give an indicative distribution of users which would be more appropriate to service providers and planners.

### **3.5. Stage 4. Data Analysis**

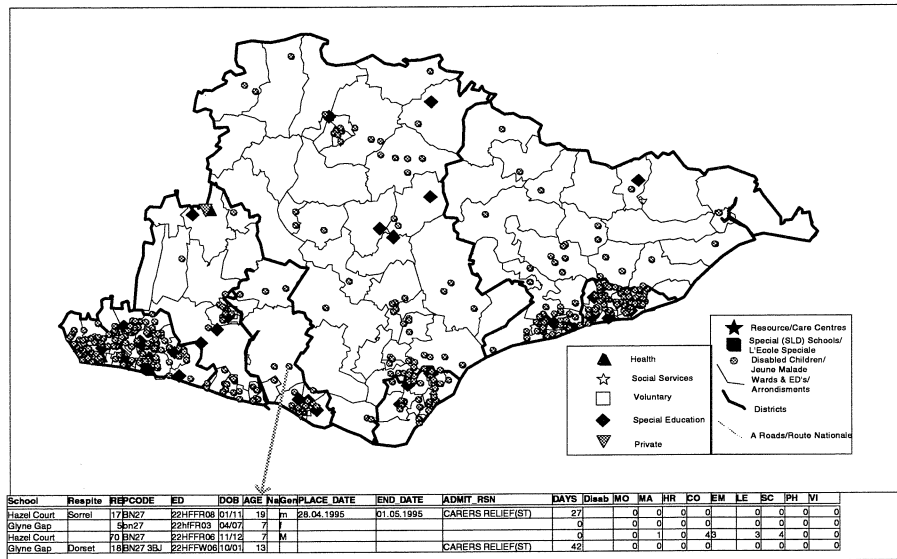
This information was mapped and analysed using a number of GIS approaches. The use of SQL database query techniques within the GIS allowed for cross-database analysis to pick out individuals and patterns. The ability to then analyse the new dataset picked out was also a key GIS function. For example it was possible to identify carers of all children between the ages of 2-5 who were more likely to be affected by the boundary changes than carers of older children as they would be a « new demand » within the newly divided services. The spatial pattern of distributions of service locations and users also gave some useful initial insights for planners and carers and included some basic information on costings as well, drawn from local primary sources and national costings (Netten 1993, Glendinning 1992). This included costed estimates of service provision for users such as delivery costs per child as well as charges to carers for the different sorts of care.

From a modelling perspective ( which is the key additional element unique to GIS) it was possible to do a series of scenarios models to identify resource implications of changes inherent in the planning process. These could include network modelling to identify optimisation of service locations against user demand, modelling of access and proximity to services and the resource implications of change and inequality. Data could be presented in a number of forms including maps, tables, database reports and statistical summaries.

## **4. Results & Policy Considerations**

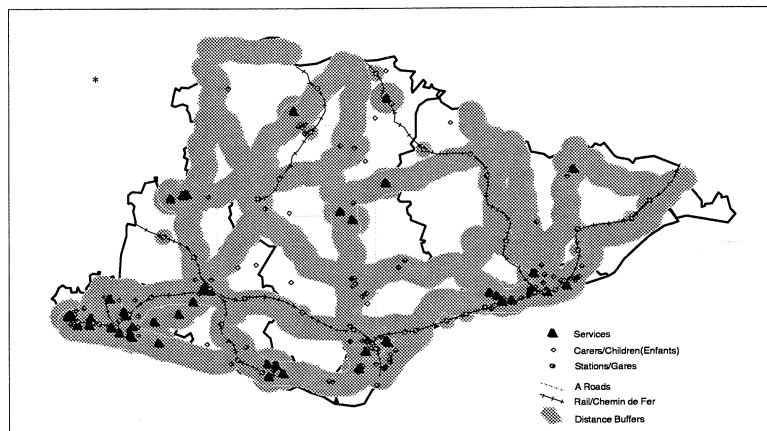
The geographical results were presented in a set of map layers. These identified the value of an integrated approach to service planning. A final integrated database included a listing of all locations for carers and children with disabilities with information on the schools attended and services received as well as information on costs, gender, age and where identifiable, the level of disability. From this database information could be examined in detail for the areas of East Sussex which were most likely to be affected by the local boundary changes, in particular the districts of Lewes and Wealden. It also identified individuals and areas which were well served and those where access and service availability were less well supplied (**Fig 4**). The value for joint planning was also evident in the data with information drawn from and standardised across different providers.

Fig. 4 - Integrated GIS of Disabled Children/Données représentatives du nombre d'enfants atteints



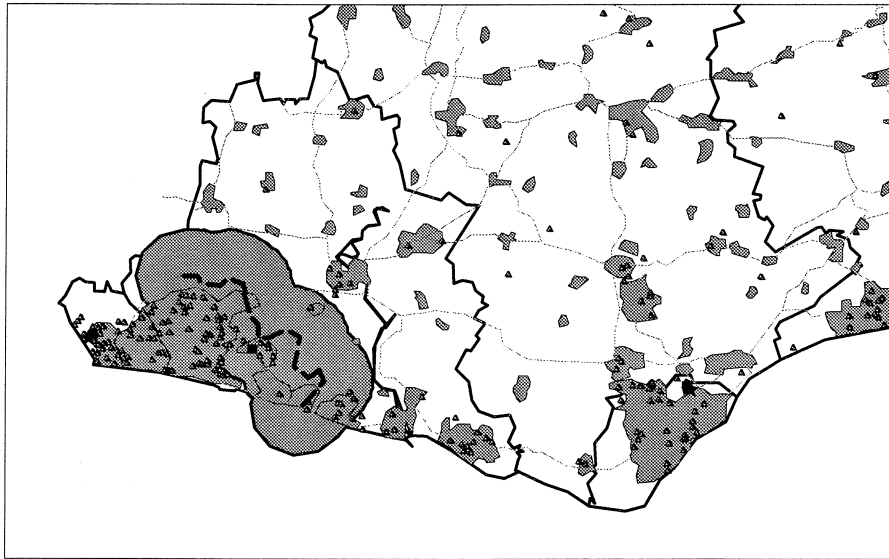
At another level GIS analysis produced some useful results on essential spatial features of service provision such as access and distance (Fig 5). Although at first glance the figure seems to indicate a good fit between proximity to transport and the location of users, physical distance is just one measure of access whereas elements such as travel time, access to public transport and even aspects such as affordability and budgetary restrictions are all part of a more accurate assessment of accessibility (Khan & Bhardwaj 1994). Some of this information, such as car ownership and coverage of the public transport network were also considered in the GIS model.

Fig. 5 - Access/Distance to/a Services



The implications of the boundary service changes were then examined across a number of levels and allow for the potential identification of « spatially vulnerable » individuals (Fig.6). These individuals were identified within a « buffer zone » of the Brighton & Hove boundary and the implications for the individual carer/families could also be identified in additional cost/access times. The costing and resource planning element of the process could also be modelled for this group in the form of estimates of new cases x cost x resource/budget availability. Additionally the boundary effects could be examined by identifying where users of services in the Lewes district were going to the adjoining counties to use their services.

Fig. 6 - Buffer Zone at New Administrative Border/Zone-tampon près de la nouvelle frontière



This information allowed for the identification of users of services across the different services and providers. Obviously much of the information collected and analysed would be subject to wider policy considerations which will be discussed in the next section. It is important to remember that in any given application a GIS approach may provide specific answers or a broad range of supporting information represented in a spatial form (Birkin et al. 1996). It depends on the application as to how detailed and specific these GIS results are. In the case of health care planning the results would seem to fall into a « supporting data » category with the spatial patterns inherent in the finished maps/databases forming the core data for consideration by the various interested bodies.

## 5. Policy and Qualitative Feedback

The data was discussed with a number of the key decision-makers in the various agencies as well as to carers groups, as to the potential efficacy of the GIS approach. It was also necessary to discuss wider policy issues in decision-making in this particular application.

As the primary « purchasing » element in the planning of health and social care the East Sussex, Brighton & Hove Health Authority perspective was important. A representative stated that they had received few complaints from the west of the old county but had received some feedback from the east of the county that users of services, including carers, were unhappy with the centralization of service administration in the « new » East Sussex to Lewes. Feedback from social services obviously looked at the issue from a « purchaser perspective » and they more than most were conscious of the resource constraints inherent in the provision of care services. This was also reflected in the choice of where to concentrate resources.

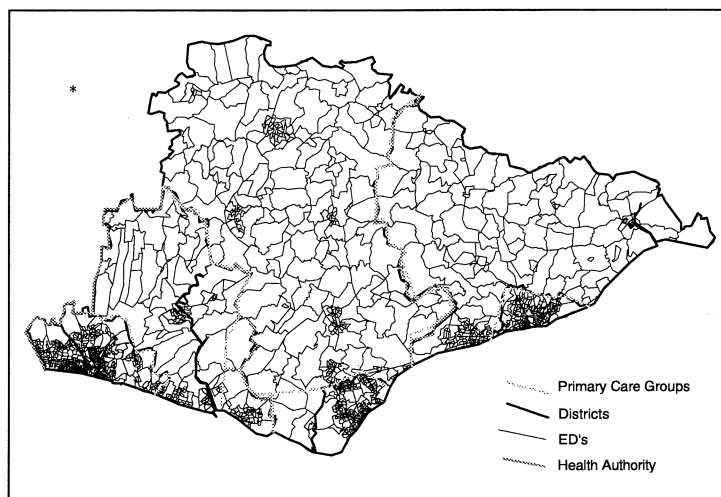
Representatives from voluntary organisations with responsibility for carers interests in Brighton & Hove and Lewes was quite blunt about the difficulties suffered under the administrative changes both within the statutory and private sector. Originally representing carers in Brighton, Hove and Lewes under the old East Sussex structure she has, since the change, received numerous complaints from carers about the lack of access both to services and information, especially within the Lewes district. This is especially difficult in the case of Lewes District which traditionally was allied to Brighton & Hove both in terms of health and social services planning but has now been effectively « cast adrift ». The situation is also difficult in that where services are still offered in the new unitary authority, no special consideration is made with respect to the transport and access difficulties of rural people, the so-called « rural premium »



(SRCC 1997) with the result that rural users do not avail of the services or feel marginalised by the existing provision. The issue of co-terminosity is also problematic as the Health Authority and Social Services are both under pressure within the new structure to try and amalgamate Lewes with the neighbouring Wealden district. This would have the effect of a) exacerbating the « rurality » problem and b) mean even longer access/journey times for current residents of Lewes district who may have to make journeys of up to 40 miles from Newhaven to Crowborough for basic services. They also made the point that in, for example, youth services, clients/users in the north of the Lewes district used West Sussex services and completely bypassed official structures, emphasizing the earlier reference to 'hard' and 'soft' boundaries !

The Local Authority changes of 1997 are also likely to be affected by imminent National Health Service (NHS) changes. These changes relate particularly to the organisation of community care services (Department of Health 1997). There are current proposals to create a new layer within the health service based around GP's and community care services to create what will be known as Primary Care Groups (PCG). All of these new organisations are likely to have a significant impact on the location of services for carers as these new groups will create perhaps a new geographical set of community care boundaries to set across existing ones. Additionally the new PCG's are intended to be more focused on creating a more local and accessible focus for users. The planning for these groups (also called locality commissioners) has a strong geographical element and is another area where GIS may be of considerable benefit. One of the key geographical issues is boundary co-terminosity. It has been suggested that the new primary care groups boundaries should fall into existing local and health authority areas for easier joint working and co-ordination of community care with consideration of appropriate size, access to service delivery and the precise geographical areas involved. As can be seen the use of GIS is likely to aid this planning process and allow for a more equitable allocation of resources and services for carers of children with disabilities and other groups alike (Fig.7).

Fig.7 - Planning of Primary Care Groups/Situation des Groupes Santé Primaire



A number of other qualitative issues are also likely to affect the use of GIS within service planning from a users (carers) perspective. These are complex functional elements tied up with needs assessment and the specific requirements of the group in question (Stalker 1996, Twigg 1992, Twigg & Atkin 1994). Local carers organisations such as Care for the Carers and aMAZE<sup>3</sup> are key agencies in representing the carers interests in strategic planning and policy-making and are involved in number of joint initiatives such as Carers control of their own budgets, joint planing with GP practices to identify carers and also with wider policy debates such as the link between special schools and mainstream integration (Thompson 1995).

<sup>3</sup> aMAZE are a local organisation based on an amalgamation of two previously separate voluntary agencies called Network of Parents for Children with Disabilities and Parent Link.

## Conclusions

The acronym of GIS identifies clearly its potential – to take a **G**eographical approach, to provide **I**nformation for all partners in the health and social care environment to inform equitable decision making and to form a proper **S**ystem with continuous feedback and re-application. GIS does have potential to aid the planning of resource allocation as the proxy dataset developed in this model could be replaced with the real data on users of services. This would considerably aid in the production of a realistic needs assessment for carers services. Provided that the individual agencies responsible for providing services were willing to share data this could be aided by the data standardisation features of a GIS. This is of course a big « if », especially when statutory agencies are dealing with the private and voluntary sectors, a situation exacerbated by the creation of the quasi-market in the NHS (Department of Health 1989), though hopefully one of the effects of the new changes in primary care provision will be to force different agencies to work more closely together. The study also showed the data modelling ability of a GIS to provide a valuable potential link into a statutory providers planning and decision-making process, with the proviso again, that the key data is kept up-to-date and relevant. Issues of inequity could then be addressed with the GIS being particularly useful for picking up issues related to spatial inequity, access and the rural/urban split. Issues of scale are also interesting and the notion of planning at an individual rather than an aggregated level, while it may well be difficult for an external researcher in terms of ethics and confidentiality, seems to be more feasible in the areas of joint working and planning at a local level for the benefit of the client group. This applies particularly to the client group of children with disabilities where they are assessed at a relatively early age (between X and X years – check Maze stuff) for their needs. As the results of this assessment are used and shared already by health and social care staff, this might provide a useful starting point for comprehensive data gathering for joint planning purposes. GIS approaches can certainly assist in this process.

The difficulties of trying to make an essentially quantitative GIS process model the more « random » qualitative behaviour of service providers and service users will remain a problem. It is important to remember is the extent to which peoples behaviour reflects geographical constraints. Several commentators have commented on the need for a more open joint qualitative and quantitative approach (Moon 1995, Phillip 1998). This is certainly one way in which tackling the difficulties can improve the model, especially through the introduction of weighting process to introduce greater flexibility. For example people within a strict quantitative model will be assigned to the nearest resource centre. However, individual behaviour sometimes means that the user/client does not use the nearest service for a number of reasons or moves to areas where they get a better service. Also service provision, especially specialist service provision is not always restricted by geography or administrative boundaries. Chailey School, although part of the East Sussex « system », is a « national » resource and within the county many of the most severe cases, known as « Agency Placements », have needs which can only be catered for outside the county boundaries, so the notion of a specific geographical entity is not appropriate for all cases. This is especially true of the non-coterminosity of administrative boundaries across different service areas (Wise 1994, Bullen, Moon & Jones 1994). Yet the majority of carers do fall into this constrained geographical category and GIS is a start to help come to terms with the complex spatial and aspatial planning issues to the benefit of service providers and users alike.

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