Computer-based Support for Patients with Limited English

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Abstract

The paper describes a proposal for computer-based aids for patients with limited or no English. The paper describes the barriers to health-care experienced due to linguistic problems, then suggests some computer-based remedies incorporating a multi-engine machine translation system based on a corpus of doctor-patient interviews which provides a dialogue model for the system. The doctor's and patient's interfaces are described. Ideas from Augmentative and Alternative Communication and in particular picture-based communication are incorporated. The initial proposal will focus on Urdu- and Somali-speaking patients with respiratory problems.

1 Introduction

This paper describes a proposed framework for the development of computer-based aids for patients with limited or no English. Aimed at users of the Health Services who are disadvantaged by their (lack of) linguistic skills, the system will assist the patient in different ways at different stages of their interactions with health-care providers. In its ful conception it will embrace a wide range of NLP technologies.

Focusing on the GP's clinic, it will provide *i* kind of FAQ help-desk and act as a kind of Receptionist to help determine whether the patient needs to see the GP or some other health-care specialist. If a GP consultation is indicated, the computer can be used for history note-taking. During the consultation itself, it can act as *i* mediator between the doctor and patient. Afterwards, in help-desk mode again, it can help the patient understand the diagnosis, any tests needed, and the proposed treatment regime.

We propose in the first instance to develop systems aimed at Urdu- and Somali-speaking patients, focusing on respiratory problems (e.g. asthma).

2 Patients with Limited English

In many parts of the UK there are recent or long-term immigrants, refugees, and asylum seekers and other people whose command of English, while often adequate for day-to-day activities such as shopping and other domestic chores, is not sufficient for more formal situations such as interactions with health services, especially visits to their GP. There is no shortage of literature reporting disparities in health, health-care, and social care provision in these communities and communication difficulties are identified as a major factor [1]. The problem is also well recognised in other countries [2].

People in this situation will only rarely be lucky enough to find a homolingual GP, which is probably the preferred option [3] or (less than ideal) an interpreter or linkworker, who may also

1. e.g. McAvoy and Sayeed (1990), Chalabian and Dunnington (1997), Acheson (1998), Smith (2000), Woodhead (2000), Burnett and Peel (2001)
2. e.g. USA (Uba 1992; Hornberger et al 1996; Jackson 1998), Canada (Fowler 1998), New Zealand (Blakely 1996), Australia (Sinnerbrink et al. 1996; Silove et al. 1999; Nerad et al. 2000), Norway (Karlsen et al. 1998), Sweden (Sundquist et al. 1999), Austria (Pöchhacker 2000), Switzerland (Blöchliger et al. 1997; Graz et al. 2002), Ivory Coast (Zotti 1999)
3. Bhui (1998)

have varying appropriateness [4]. Even then they will still have to communicate with other persons (receptionist [5], community nurse, pharmacist, specialist). Some may take with them an "interpreter", typically a family member (including an inappropriate child [6]) or someone from their religious community, or else will just "muddle through" (with both clients and providers often using ingenious ways to express themselves) [7]. The outcome is undesirable in either case, for numerous reasons. In recent systematic literature searches of a range of medical and social science journal databases since 1990, on barriers to accessing health-care experienced by refugees in the UK [8], language difficulties were identified as the largest single barrier to care and as such repeatedly identified as a major concern for refugees [9]. In a study in London [10], 53% of GPs felt that language difficulties were a problem. A survey of the Vietnamese community in Greenwich [11] revealed that 17% of respondents had changed their minds about visiting the GP because of lack of access to an interpreter. Effective communication is important in all areas of health care [12], from finding out about services available through to complying with treatment.

There have been only a few suggestions for initiatives to tackle this problem [13], including a cheap national specialist medical telephone interpreting service, with hands-free conferencing to enable concurrent discussions and examination if needed [14], use of the Red Cross multilingual phrasebook [15], and multilingual phrase cards for use by health-care practitioners and receptionists (simple words like days of the week could make a significant difference to people trying to access health care). Further initiatives urgently need to be developed.

There can be no doubting the importance of doctor-patient communication, which has for many years been the focus of medical attention. Everything in medical practice arguably derives from the consultation, during which the doctor must acquire and impart information, and set up a relationship with the patient; the consultation itself can also have a therapeutic role. Valuable consultation time may be saved by having the patient complete a pre-consultation questionnaire which allows information to be expressed which may be given reluctantly in a hurried interview. There is a considerable literature on the structure of the consultation, from various angles including the linguistic, pragmatic, ergonomie, social and of course medical aspects. Effective communication improves outcomes [16] and it is argued [17] that doctors have responsibilities to their patients that can only be met by effective communication

Use of computers in the doctor-patient consultation paradoxically has been recognised as both potentially detrimental and potentially hugely helpful. The early use of computers on the consultation desk was seen as a threat, detracting from interaction with the patient, reducing eye contact and rapport build up. More recently the help of computers to increase communication and rapport has begun to be recognised. Computers can help in accessing records of other 6-minute interactions, reducing the need for repetition. A recent systematic review of UK literature in the 1990s [18], described as rich in description but low on evaluative information, did conclude that Primary Care computing systems can improve practitioner performance, particularly for health promotion interventions. It also reported that this may be at the expense of patient-initiated activities, and that many practitioners are suspicious of the negative impact on relationships with patients. The review showed that there remains a dearth of evidence evaluating effects of use of computers on patient outcomes.

3 A Computer-based Solution

As mentioned above, the proposed system will operate in various "modes". The most intricate of these is during the consultation itself, when it will serve as a kind of interactive phrase-book, designed to run on the typical PC that might be found on a GP's desk.

4. Phelan and Parkman (1995), Gillam and Levenson (1999).
5. Free (1998).
6. Jones and Gill (1998), Burnett and Peel (2001b)
7. Montgomery (2000)
8. Jary (2001), Hays (2002)
9. Lam and Green (1994), Tang and Cuninghame (1994),
10. Ramsay and Turner (1993)
11. Lam and Green (1994)
12. Voelker (1995)
13. Reviewed in Jary (2001)
14. Wolmuth (1996), Jones and Gill (1998a,b)
15. Matthews (1999)
16. Stewart (1995)
17. Meryn (1998)
18. Mitchell and Sullivan (2001)

At the core of the system is a hybrid multi-engine embedded MT system: essentially an EBMT system with a "translation memory" (TM) extracted from corpora of doctor-patient interviews, supplemented with a simple rule-based MT (RBMT) system and a word-by-word lexical look-up facility. It will have a highly flexible interface: a simple set-up like in a chat-room, where each user types at a keyboard with the results shown on a split-screen is not practical when one of the users may not be a regular computer user.

The system in this mode has two users: the doctor and the patient, with significantly different profiles of computing experience. Accordingly, the user-interfaces will be quite different for the two users, while necessarily being integrated. Whereas the doctor can be expected to use the keyboard and mouse, and be comfortable with a sophisticated GUI, the patient's interface presents a number of problems.

Obviously, in the long-term we would want to consider speech input and output for both the doctor's and patient's interfaces. In the short term, and given the current state-of-the-art, text-based interfaces are proposed.

It should also be remembered that some patients will not need to use the system for every part of the interview, their English being sufficient for some interactions. In addition to the "Consultation mode", we will simultaneously develop a "Reception mode" with an interactive FAQ/help system and a "History mode" involving a computer-aided patient interview system.

In the following sections, we give some more details about the design features of the different modes of the proposed system.

3.1 Multi-engine MT system

MT has now proved itself viable under conditions of restricted input and interactive use. Particularly effective is an architecture which tries various strategies in parallel and then tries to reconcile the results. This is the "multi-engine" approach seen in the PANGLOSS and DIPLOMAT systems [19]. The engines that our system will use will be an EBMT/TM system, a rule-based transfer system, and a simple lexical look-up system; it is to be expected that the input from the doctor will usually go through the EBMT system, while the patient's input, being more varied, may more often be translated by RBMT or on a word-by-word basis. In the proposed scenario, it is an example of an "embedded" MT system [20].

EBMT is akin to case-based reasoning (CBR) [21] in that new translations are composed on the basis of past translations, as provided by the "example base" of utterances taken from a corpus of doctor-patient interviews, manually translated into the target language. This method gives a very high quality of translation when the input can be matched against an appropriate example. The match does not have to be exact: as in CBR, a partial match can lead to a successful outcome.

RBMT and word-by-word translation methods tend to result in more stilted translations, closely following the syntax of the source language. In our scenario, this is more likely to be used for translating the patient's replies into English: thus the burden of understanding a less polished translation will normally fall on the doctor, who will gain experience of the system with use, and - on the evidence of early users of less sophisticated MT systems [22] - will quickly get used to its quirky style.

The notion of "restricted input" relates to the widely accepted notion of "sublanguage"-based approaches to MT [23], especially inasmuch as a corpus can help to define the sublanguage [24].

The experience of the DIPLOMAT project is especially relevant to this proposal, since their system was developed specifically with rapid development of new language pairs for use in a dialogue situation between an experienced user and a naive interviewee who may have little experience of computers, and may not even be literate. Versions of DIPLOMAT have been developed for English-Croatian and English-Haitian Creole, for use in the field to allow English-speaking soldiers on peace-keeping missions to interview local residents [25]. An additional feature of DIPLOMAT is the use of speech-recognition and synthesis front and back ends, and the extensive use of on-screen

19. Frederking et al. (1994, 1997)

20. Van Ess-Dykema et al. (2000)
21. See Somers and Collins (2003)
22. cf. Church and Hovy (1993)
23. Kittredge and Lehrberger (1982)
24. cf. Deville and Herbigniaux (1995), McEnery and Wilson (1996:147ff), Sekine (1997)
25. See also www.avt-actii.lmowego.com/

interactive correction by both participants. As the language pairs indicate, it has been tested in the former Yugoslavia, and in Haiti. The success of the DIPLOMAT project gives a strong indication of the viability of the current project.

3.2 Corpus of doctor-patient interviews

Transcribed corpus data from doctor-patient interviews is readily available in the British National Corpus, which contains about 100 examples of short (300-900 words) medical consultations in GP surgeries or hospitals, already annotated for POS tags and some other aspects. Several other similar corpora have been collected [26]. Other researchers have collections of tape-recordings [27], and there are even conferences dedicated to the analysis of doctor-patient discourse [28]. Data from consultations where an interpreter was present may also be relevant [29].

This corpus will serve multiple purposes, and accordingly we should distinguish various of its characteristics. For example, transcriptions of interpreter-mediated interviews, and interviews where the patient has a poor command of English, will be useful as an indication of how such interviews tend to proceed. They will not however serve as a direct model for the system, which aims to bypass some of the difficulties that arise in such situations. For most of our purposes, what is important is not so much the verbatim transcripts, but the model of the discourse and the examples of the kinds of things that are said [30]. This being the case, the utterances in the corpus can legitimately be "cleaned up". The corpus will be marked up, especially for dialogue function in a TEI-conformant manner.

Another purpose of the corpus is to provide a source of examples for the EBMT system, and so a parallel target version will have to be provided. It will also serve as a training corpus for the development of the translation lexicon and the RBMT system. To some extent, some of this linguistic information can be extracted semi-automatically [31]. Finally, it can serve as a dialogue model, simplifying and determining the options offered in the menu-driven mode for both doctor and patient [32].

3.3. The doctor's interface

Doctors greet and observe patients in all doctor-patient encounters, and in the UK the consultation proceeds normally these days in the presence of a computer which is used for recording all personal details, history taking of a problem, diagnosis, and treatment. Thus it is a small step to consider the possibility of using a computer to aid communication as part of the existing situation.

For the doctor's interface, two main possibilities are envisaged: typing at the keyboard, augmented by auto-completion; and a menu-based approach, enriched by dynamic domain knowledge.

The menu-based interface, which is also appropriate for the patient's interface, involves "intelligent" menu-driven selection. Several script- or frame-based interfaces have been reported, for example the UNICORN system [33], which is specifically aimed at multilingual communication, DRAFTER [34] for multilingual document preparation, Floorgrabber [35] and Frametalker [36] for users with communication difficulties. The "intelligence" derives from domain knowledge and a discourse model which permit the interface to be simplified by determining the options offered. This type of interface is most appropriate when the consultation is following a predictable course, and "standard" questions or comments are being made, for example "How long have you had this problem?"

In the keyboard-based typing interface, the doctor simply types the input, or parts of it that the patient does not understand. Typing is aided by auto-completion proposals based on the corpus, an idea already demonstrated in the TRANSTYPE project [37]. Typing is necessitated when what the doctor wants to say is not sufficiently similar to anything that the menu-driven interface is offering,

26. For example by Thomas and Wilson (1996) and Wynn (1999)
27. See for example ww2.mcgill.ca/ Psychiatry/ transcultural/ primary.html
28. For example, the Conference on Medical Interaction, 18-20 October 2000, at the University of Southern Denmark, Odense. See www.conversationanalysis.net/Conferences/Medical/program_doc-pat.htm.
29. Cambridge (1997)
30. cf. Passonneau and Litman (1997), Berthelin et al. (1999)
31. See for example Brent (1993), Smadja (1993), Melamed (2000), Véronis (2000)
32. cf. Alm et al. (1989)
33. Dye et al. (1997), Iwabuchi et al. (2000)
34. Hartley and Paris (1997)
35. Alm and Arnott (1998)
36. Higginbotham et al. (2000)
37. Langlais et al. (2000)

for example a much more specific question or comment which relates to things the patient may have said earlier, e.g. "When did your step-mother pass away?"

3.4 The patient's interface

Some patients will be highly experienced in using computers while for others, a keyboard- or mouse-driven interface may not be appropriate. Therefore, a range of interfaces must be made available to the patient. We can include simple interfaces like a drop-down menu, as in the doctor's interface. If the patient's language involves a different character set (as is the case with Urdu), it is not viable to assume the patient might want to use the keyboard: character-handling of non-Roman writing systems is not a problem as such (and is necessary for output), but we cannot assume that the patient can quickly learn to use an Urdu keyboard, or, worse still, to learn a set of mappings from a QWERTY keyboard. The problem may be less acute for Somali-speaking patients, whose language is written using the Latin alphabet on a straightforwardly phonemic basis. All these issues represent an important and innovative aspect of the research proposed here: we need to discover the best way to integrate all the possibilities so as to provide an interface that both doctor and patient are comfortable with, that promotes an equitable exchange (rather than giving one or other user excessive control), and makes best use of their respective skills and experience. There are important socio-cultural issues here which we cannot address fully in this paper

Of relevance here is the field of Augmentative and Alternative Communication (AAC) and in particular the work on picture-based communication (PBC) interfaces [38]. AAC is usually focused on disabled users, and AAC techniques have apparently not been applied to users whose only "handicap" is lack of a shared language [39]. Langer and Hickey (1999) report on growing There are growing contacts between the AAC and NLP research communities [40]. One group [41] developed a GUI for healthcare workers in rural India, like us facing the problems of inexperienced computer users and a non-Roman writing system. HCI issues are of paramount importance here: robustness and flexibility are essential; alternative modes of input, such as touch screens, may be preferred, since the patient may lack experience of mouse manipulation.

3.5 "Reception mode": FAQ/Help desk

Consultations often include obtaining answers to the same series of questions (such as how long has the problem been continuing). This may lend itself to identification of a series of frequently asked questions in the form of a pre-consultation computer-mediated help-desk and interview [42]. By "help desk", we mean a simple on-line interface containing potted texts in answer to frequently asked questions (FAQs).

These interfaces can be run with a simulated natural-language interface based on key-word matching. This could be installed on a computer terminal in the Health Centre reception area, so that potential patients could get relevant information without even making an appointment with the GP. There has been a considerable amount of relevant work in this area, notably on Tailored Patient Information (TPI) systems [43]. Navigation of the help facility can be system-led or patient-led, In the latter case it would work in much the same way as the help facility in, say, a word-processor offers "Type in your query here". In the former case, the user is lead through the interaction with a structured database depending on the choices made at each point. Different start points might relate to basic symptoms (answering the question "Do I need to see the doctor?"), general procedure ("What can I expect when I go to the hospital?") or, after diagnosis, what the course of treatment involves, e.g. general information about the drugs or therapy that have been prescribed, and the likely outcomes and progress of the patient's condition.

38. Blenkhorn (1992), Loncke et al. (1999)
39. Personal communication: Pat Mirenda, editor of the journal *AAC Augmentative and Alternative Communication.* See also Johnston (in prep.).
40. Copestake et al. (1997), Langer (1998)., Langer and Hickey (1999),
41. Grisedale et al. (1997)
42. cf. Osman et al. (1994)
43. Buchanan et al. (1995), Cawsey et al. (1995), Reiter and Osman (1997)

3.6 "History mode": Computer-mediated interviewing

Many services in general are finding it helpful nowadays to gather basic information from the patient prior to meeting with the professional. This is the important element of "history" note taking which can be partly accomplished using computer-mediated interviewing techniques, which can make better use of the time the patient spends in the waiting room. These widely-used techniques have been found to be particularly useful in sensitive applications like taking patient's medical details [44], where decreased time pressure leads to fuller responses, especially when questions are of a sensitive or embarrassing nature. Most systems are based on flexible multiple-choice questionnaires, while the use of free text [45] is more complex, and brings us into the area of conversation systems. An on-line consultation might be appropriate in the case of patients returning with chronic problems.

4 Conclusion

We have presented here a proposal for a highly innovative multi-modal system. While plan-based communication or authoring tools have been proposed previously, the multilingual profile coupled with the dialogue situation for the doctor's and patient's interfaces is quite novel. The application of AAC techniques to use by non-handicapped but linguistically disadvantaged users is likewise a new idea. This presentation has focused on the language technology aspects, but the work has a simultaneous impact for researchers in primary care, implying research on doctor-patient communication, access to health services by, and improving the quality of access and quality of care to hard-to-reach groups [46], reducing perceived time wasting with perceived difficult patients, developing training agendas for health care professionals, and agendas for community development initiatives [47] so that newly arrived communities make better use of the local health services and get a better quality of care not only in the UK but in other countries across Europe, Australasia and North America. It is at the moment a proposal, but we hope in due course to be able to report on its implementation, and on results of trials and evaluations.

44. Lilford et al. (1985)
45. For example Peiris et al. (1995)
46. Lovel et al. (1998)
47. Moran et al. (2000)

References

Acheson, D. 1998. *Independent enquiry into inequalities in health.* London: Stationery Office.

Alm, N. and J. L. Arnott. 1998. 'Computer-assisted conversation for nonvocal people using prestored texts'. *IEEE Transactions on Systems, Man, and Cybernetics* **28**, 318-328.

Alm, N., J. L. Arnott and A. F. Newell. 1989. 'Discourse analysis and pragmatics in the design of a conversation prosthesis'. *Journal of Medical Engineering and Technology* **13**, 10-12.

Berthelin, J.-B., B. Grau, I. Robba and A. Vilnat. 1999. 'A cross-corpus vision of conversation and dialogue'. *Language Technologies - Multilingual Aspects: Workshop in the framework of the 32nd Annual Meeting of the Societas Linguistica Europaea,* Ljubljana, www.limsi.fr/Individu/jbb/cross-corpus.html.

Bhui, K.1998. 'The public favours bilingual staff over interpreters'. *Britsh Medical Journal* **317**, 816.

Blakely, T. 1996. 'Health needs of Cambodian and Vietnamese refugees in *Porirun'. New Zealand Medical Journal* **109***,* 381-384.

Blenkhorn, P. 1992. 'A picture communicator for symbol users and/or speech impaired people'. *Journal of Medical Engineering and Technology* **16**, 243-249.

Blöchliger, C., M. Tanner, C. Halz, and T. Junghanss. 1997. 'Asylsuchende und Flüchtlinge in der ambulanten Gesundheitsversorgung: Kommunikation zwischen Arzt und Patient'. *Praxis: Schweizerische Rundschau für Medizin* **86**, 800-810.

Brent, M. R. 1993. 'From grammar to lexicon: unsupervised learning of lexical syntax'. *Computational Linguistics* **19**, 243-262.

Buchanan, B., J. Moore, D. Forsythe, G. Garenini, G. Banks and S. Ohlsson. 1995. 'An intelligent interactive system for delivering individualized information to patients'. *Artificial Intelligence in Medicine* **7**, 117-154.

Burnett, A. and M. Peel. 200la. 'Asylum seekers in Britain: What brings asylum seekers to the UK?' *British Medical Journal* **322**, 485-488.

Burnett, A. and M. Peel. 2001b. 'Asylum seekers in Britain: Health needs of asylum seekers and refugees'. *British Medical Journal* **322***,* 544-547.

Cambridge, J. 1997. *Information Exchange in Bilingual Medical Interviews.* MA dissertation, Department of Linguistics, University of Manchester.

Cawsey, A., K. Binsted and R. Jones. 1995. 'Personalised explanations for patient education'. *Proceedings of the 5th European Workshop on Natural Language Generation,* Leiden, Netherlands, pp. 59-74.

Chalabian, J. and G. Dunnington. 1997. 'Impact of language barrier on quality of patient care, resident stress, and teaching'. *Teaching and Learning in Medicine* **9**, 84-90.

Church, K. W. and E. H. Hovy. 1993. 'Good applications for crummy machine translation'. *Machine Translation* **8**, 239-258.

Copestake, A., S. Langer and S. Palazuelos-Cagigas (eds) 1997. *Natural Language Processing for Communication Aids: Proceedings of a workshop sponsored by the Association for Computational Linguistics,* Madrid.

Deville, G. and E. Herbigniaux. 1995. 'Natural language modelling in a Machine Translation prototype for healthcare applications: a sublanguage approach'. *Proceedings of the Sixth International Conference on Theoretical and Methodological Issues in Machine Translation, TMI* 95, Leuven, Belgium, pp. 142-157.

Dye, R., N. Alm, J. L. Arnott, G. Harper and A. I. Morrison. 1997. 'A script-based AAC system for transactional interaction'. *Natural Language Engineering* **1**, 1-13.

Fowler, N. 1998. 'Providing primary health care to immigrants and refugees: the North Hamilton experience'. *Canadian Medical Association Journal* **159**, 388-391.

Frederking, R., S. Nirenburg, D. Farwell, S. Helmreich, E. Hovy, K. Knight, S. Beale, C. Domashnev, D. Attardo, D. Grannes and R. Brown. 1994. 'Integrating translations from multiple sources within the Pangloss Mark III Machine Translation system'. *Technology Partnerships for Crossing the Language Barrier: Proceedings of the First Conference of the Association for Machine Translation in the Americas,* Columbia, Maryland, pp. 73-80.

Frederking, R., A. Rudnicky and C. Hogan. 1997. 'Interactive speech translation in the DIPLOMAT project'. *Spoken Language Translation: Proceedings of a Workshop Sponsored by the Association for Computational Linguistics and by the European Network in Language and Speech (ELSNET),* Madrid, pp. 61-66.

Free, C. 1998. 'Some ethnic groups may have problems getting as far as a consultation'. *British Medical Journal* **317**, 816.

Gillam, S. and R. Levenson. 1999. 'Linkworkers in primary care'. *British Medical Journal* **319**, 1215.

Graz, B., J.-P. Vader and M.-F. Raynault. 2002. 'Réfugiés, migrants, barrière de la langue: opinion des praticiens sur les moyens d'aide a la traduction'. *Santé Publique* **14**, 75-81.

Grisedale, S., M. Graves and A. Grünsteidl. 1997. 'Designing a graphical user interface for healthcare workers in rural India'. *Human Factors in Computing Systems: CHI 97 Conference Proceedings,* Atlanta, Georgia, pp. 471-478.

Hartley, A. and C. Paris. 1997. 'Multilingual document production from support for translating to support for authoring'. *Machine Translation* **12**, 109-128.

Hays, L. 2002. *Barriers to health care for refugees and asylum seekers*. Special Study Module, Medical Undergraduate Course, Manchester, Supervisor Dr Hermione Lovel.

Higginbotham, J., B. J. Moulton, G. W. Lesher, D. P. Wilkins and J. Cornish. 2000. 'Frametalker: development of a frame-based communication system'. *Proceedings of the CSUN Conference on Technology and Disability,* Los Angeles. Proceedings online www.csun.edu/cod/conf2000/proceedings/0156Higginbotham.html.

Hornberger, J. C., C. D. Gibson Jr., W. Wood, C. Dequeldre, I. Corso, B. Palla and D. A. Block. 1996. 'Eliminating language barriers for non-English-speaking patients'. *Medical Care* **34**, 845-856.

Iwabuchi, M., N. Alm, P. Andreasen and K. Nakamura. 2000. 'The development of UNICORN - a multilingual communicator for people with cross-language communication difficulties'. *Proceedings of the CSUN Conference on Technology and Disability,* Los Angeles. Proceedings online www.csun.edu/cod/conf2000/proceedings/0025Alm.html.

Jackson, C. 1998. 'Medical interpretation, an essential service for non-English speaking immigrants'. In S. Loue (ed.) *Handbook of Immigrant Health,* London: Plenum Press, pp. 61-79.

Jary, D. 2001. *What are the barriers to accessing health care experienced by refugees in the United Kingdom?* Special Study Module, Medical Undergraduate Course, Manchester, Supervisor Dr Hermione Lovel.

Johnson, M. in prep. *'Disabled* by language? How can we *enable* ethnic minority patients with limited/no English to communicate with health-care professionals?' (Paper in prep, for submission to *Language and Communication).*

Jones, D. and P. Gill. 1998a. 'Breaking down language barriers, the NHS needs to provide accessible interpreting services for all'. *British Medical Journal* **316**, 1476.

Jones, D. and P. Gill. 1998b. 'Refugees and primary care: tackling the inequalities'. *British Medical Journal* **317**, 1444-1446.

Karlsen, W. B. and A. L. Haabeth. 1998. 'Telefontolk: Et godt alternativ til tradisjonell tolkebruk.' *Tidsskrift for Den norske laegeforening* **118**, 253-254.

Kittredge, R. and J. Lehrberger (eds) 1982. *Sublanguage: Studies of Language in Restricted Semantic Domains,* Berlin: Walter de Gruyter.

Kolodner, J. 1993. *Case-Based Reasoning.* San Mateo, CA: Morgan Kaufmann.

Lam, T. and J. Green. 1994. 'Primary Care and the Vietnamese community: a survey in Greenwich'. *Health and Social Care in the Community* **2**, 293-299.

Langer, S. (ed.) 1998. 'Special issue on Augmentative and Alternative Communication'. *Natural Language Processing* **4.1**.

Langer, S. and M. Hickey. 1999. 'Augmentative and Alternative Communication and Natural Language Processing: current research activities and prospects'. *AAC Augmentative and Alternative Communication* **15**, 260-268.

Langlais, P., G. Foster and G. Lapalme. 2000. 'Unit completion for a computer-aided translation typing system'. *Machine Translation* **15**, 267-294.

Lilford, R. J., P. Bingham, G. L. Bourne and T. Chard. 1985. 'Computerized histories facilitate patient care in a termination of pregnancy clinic: the use of a small

computer to obtain and reproduce patient information'. *British Journal of Obstetrics and Gynaecology* **92**, 333-340.

Loncke, F. T., J. Clibbens, H. H. Arvidson and L. L. Lloyd. 1999. *Augmentative and Alternative Communication: New Directions in Research and Practice.* London: Whurr.

Lovel, H. J., Z. Mohamed and R. Moran. 1998. 'Needs assessment with a hard-to-reach group (the example of Somali refugees in Manchester)'. *Needs and Outcomes Assessment in Primary Health Care,* World Health Organisation, Geneva.

Lynch, M. A. and C. Cuninghame. 2000. 'Understanding the needs of young asylum seekers'. *Archives of Disease in Childhood* **83**, 384-387.

Matthews, P. 1999. 'Meeting health needs of asylum seekers; practical approaches can make care easier'. *British Medical Journal* **318***,* 671.

McAvoy, B. and A. Sayeed. 1990. 'Communication'. In B.R. McAvoy and L.J. Donaldson (eds), *Health care for Asians,* Oxford: Oxford University Press, pp. 57-71.

McEnery, T. and A. Wilson. 1996. *Corpus Linguistics.* Edinburgh: Edinburgh University Press.

Melamed, I. D. 2000. *Empirical Methods for Exploiting Parallel Texts.* Cambridge, Massachusetts: MIT Press.

Meryn, S. 1998. 'Improving doctor patient communication. Not an option, but a necessity'. *British Medical Journal* **316**, 1992.

Mitchell, E. and F. Sullivan. 2001. 'A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980-97'. *British Medical Journal* **322**, 279-282.

Montgomery, S. 2000. 'Health care for asylum seekers: Main obstacles are inflexibility of NHS and bureaucracy of support systems '. *British Medical Journal* **321**, 893.

Moran, R., Z. Mohamed and H. J. Lovel. 2000. 'Taking action on refugee health needs'. *2nd International Conference on Women's Health,* Edinburgh.

Nerad, S. and A. Janczur. 2000. 'Primary Care with immigrant and refugee populations: Issues and challenges'. *Australian Journal of Primary Care-Interchange* **6,** 222-229.

Osman, L., M. Abdalla, J. Beattie, S. Ross, I. Russell, J. friend, J. Legge and J. Douglas. 1994. 'Reducing hospital admissions through computer supported education for asthma patients'. *British Medical Journal* **308**, 568-571.

Passonneau, R. J. and D. J. Litman. 1997. 'Discourse segmentation by human and automated means'. *Computational Linguistics* **23**, 103-139.

Peiris, D. R., N. Alm and P. Gregor. 1995. 'Computer interviews: an initial investigation using free text responses'. In M. A. R. Kirby, A. J. Dix and J. E. Finlay (eds) *People and Computers X: Proceedings of HCI '95, Huddersfield, ...,* Cambridge: Cambridge University Press, pp. 281-288.

Phelan, M. and S. Parkman. 1995. 'How to do it: work with an interpreter'. *British Medical Journal* **311**, 555-557

Pöchhaker, F. 2000. 'Language barriers in Vienna hospitals'. *Ethnicity & Health* **5**, 113-119.

Ramsay, R. and S. Turner. 1993. 'Refugees' health needs'. *British Journal of General Practice* **43**, 480-481.

Reiter, E. and L. Osman. 1997. 'Tailored patient information: some issues and questions'. *ACL Workshop From Research to Commercial Applications: Making NLP Technology Work in Practice,* Madrid, pp. 29-34.

Sekine, S. 1997. 'A new direction for sublanguage NLP'. In D. B. Jones and H. L. Somers (eds) *New Methods in Language Processing,* London: UCL Press, pp. 165-177.

Silove, D., Z. Steel, P. McGorry and J. Drobry. 1999. 'Problems Tamil asylum seekers encounter in accessing health and welfare services in Australia'. *Social Science and Medicine* **49**, 951-956.

Sinnerbrink, I., D. M. Silove, V. L. Manicavasgar, Z. Steel and A. Field. 1996. 'Asylum seekers: general health status and problems with access to health care'. *Medical Journal of Australia* **165**, 634-637.

Smadja, F. 1993. 'Retrieving collocations from text: Xtract'. *Computational Linguistics* **19**, 143-177

Smith, T. 2000. 'A refuge for children? The impact of the Immigration and Asylum Act'. *Poverty* **105**, 6-10.

Somers, H. and B. Collins. 2003. 'EBMT seen as case-based reasoning'. To appear in M. Carl and A. Way (eds) *Recent Advances in Example-Based Machine Translation,* Dordrecht: Kluwer Academic.

Stewart, M. A. 1995. 'Effective physician and patient communication and health outcomes: a review of the literature'. *Canadian Medical Association Journal* **152**, 1423-1433.

Sundquist, J., L. Bayard-Burfield, L. M. Johansson and S.-E. Johansson. 2000. 'Impact of ethnicity, violence and acculturation on displaced migrants: psychological distress and psychosomatic complaints among refugees in Sweden'. *Journal of Nervous and Mental Disease* **188**, 357-365.

Tang, M. and C. Cuninghame. 1994. 'Ways of saying'. *Health Service Journal* **104**, 28-30.

Thomas, J. and A. Wilson. 1996. 'Methodologies for studying a corpus of doctor-patient interaction'. In J. Thomas and M. Short (eds) *Using Corpora for Language Research,* London: Longman, pp. 92-109.

Uba L. 1992. 'Cultural barriers to healthcare for southeast Asian refugees'. *Public Health Reports* **107**, 545-548.

Van Ess-Dykema, C., C. R. Voss and F. Reeder (eds) *ANLP/NAACL 2000 Workshop: Embedded Machine Translation Systems,* Seattle, Washington.

Véronis, J. (ed.) 2000. *Parallel Text Processing: Alignment and Use of Translation Corpora.* Dordrecht: Kluwer.

Voelker, R. 1995. 'Speaking the languages of medicine and culture'. *Journal of the American Medical Association* **273**, 1639-1641.

Wolmuth, P. 1996. 'Removing the barriers'. *Health Visitor* **69**, 93-94.

Woodhead, D. 2000 *The Health and Well-being of Asylum Seekers and Refugees.* London: King's Fund. www.kingsfund.org.uk/asar.PDF

Wynn, R. 1999. Provider-Patient Interaction: A Corpus-Based Study of Doctor-Patient and Student-Patient Interaction. Kristiansand, Norway: Høyskoleforlaget.

Zotti, M. 1999. 'Public health education for Liberian refugees'. *Nursing and Health Care Perspectives* **20**, 302-306.