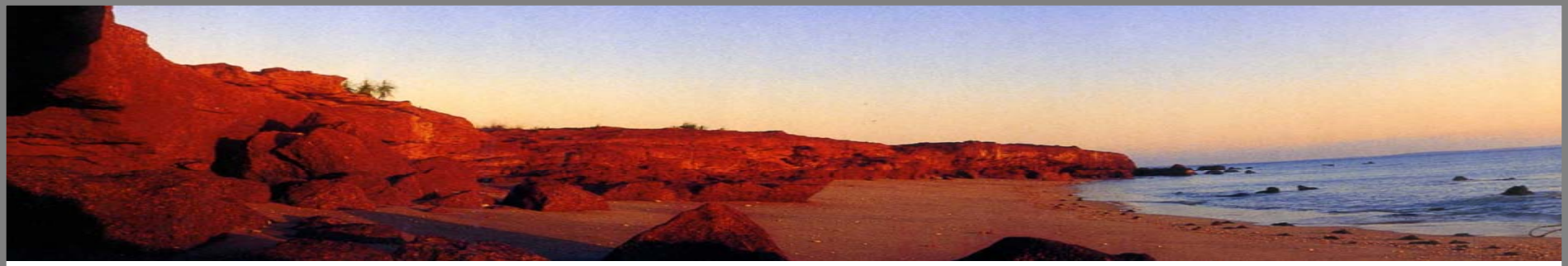
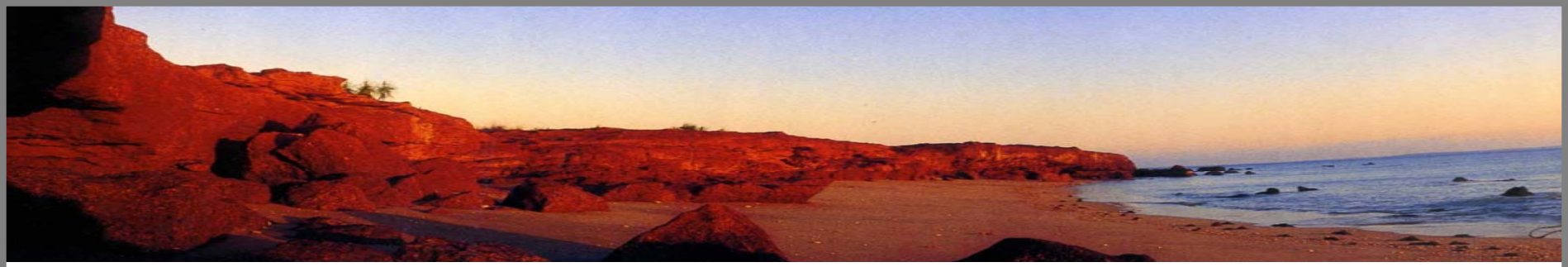


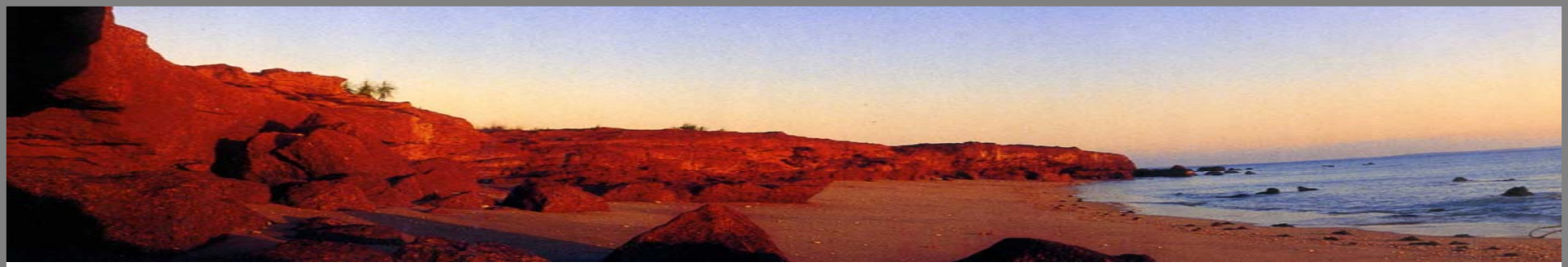
Guideline-based visualization of medication in chronic disease

Jan Stanek, Michelle J. Davy
University of South Australia
ACRC



The problem

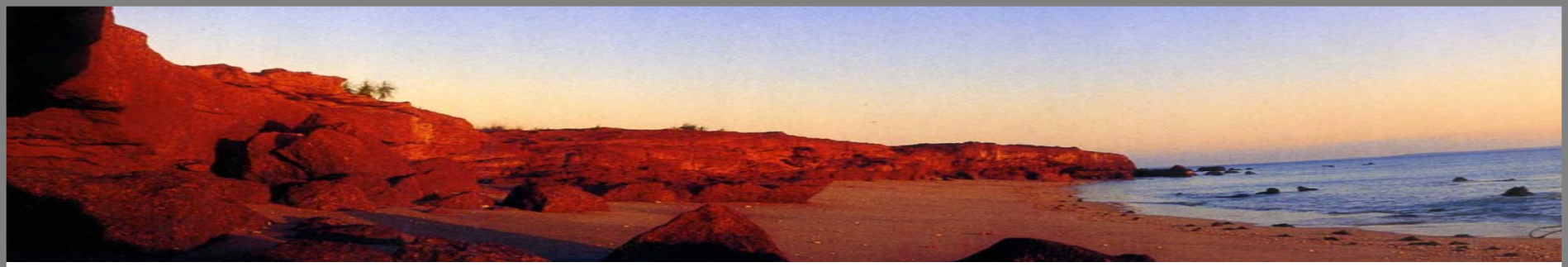
- Growing complexity of medicine
- Growing pace of change
- Growing focus on evidence and *demonstrated* quality of care
- Restricted budget – especially at GP level



Opportunity

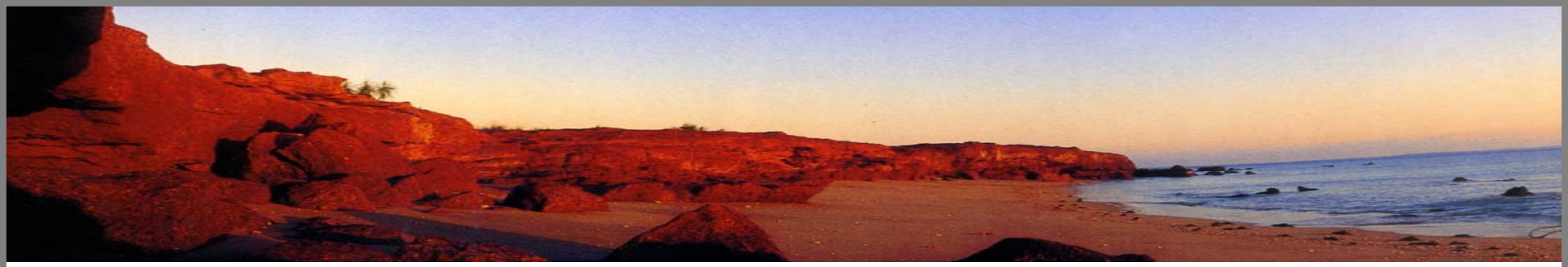
- Over 96% of Australian general practitioners (GPs) use computers
- Prescription data is the best data at GP level *)
- Treatment guidelines are available

*) Thiru K, Hassey A, Sullivan F, Systematic review of scope and quality of electronic patient record data in primary care. BMJ 2003; 326: 1070-80.



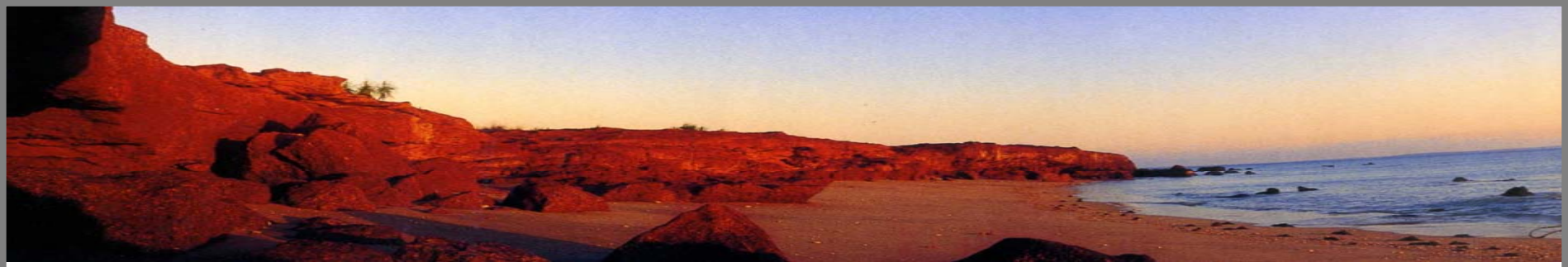
Hypothesis

1. Additional significant information can be extracted from routinely collected data in general practice
2. Feeding this information back to GPs is useful
3. This information can be presented in a way which does not require extensive user training of clinicians



The Project

1. Use guideline to structure the problem space (create state-transition model based on a guideline)
2. Fit relevant data from the GP electronic records into the model
3. Use the model for information syntesis and feedback to the practice

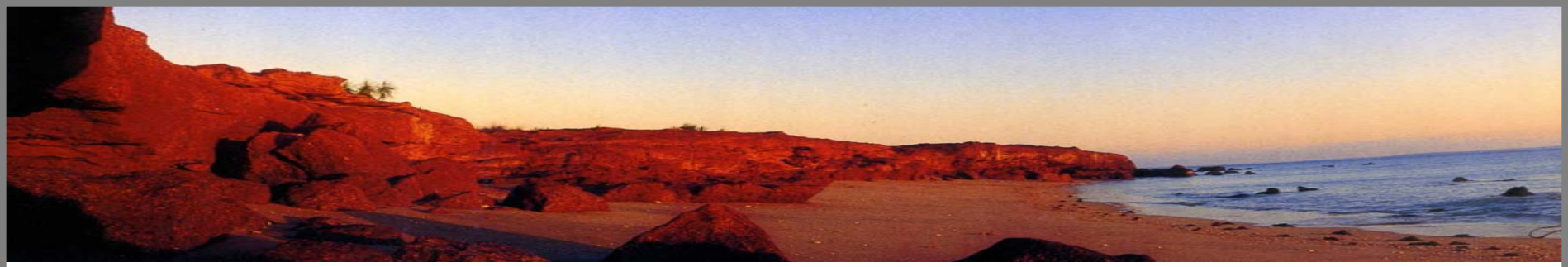


Project components

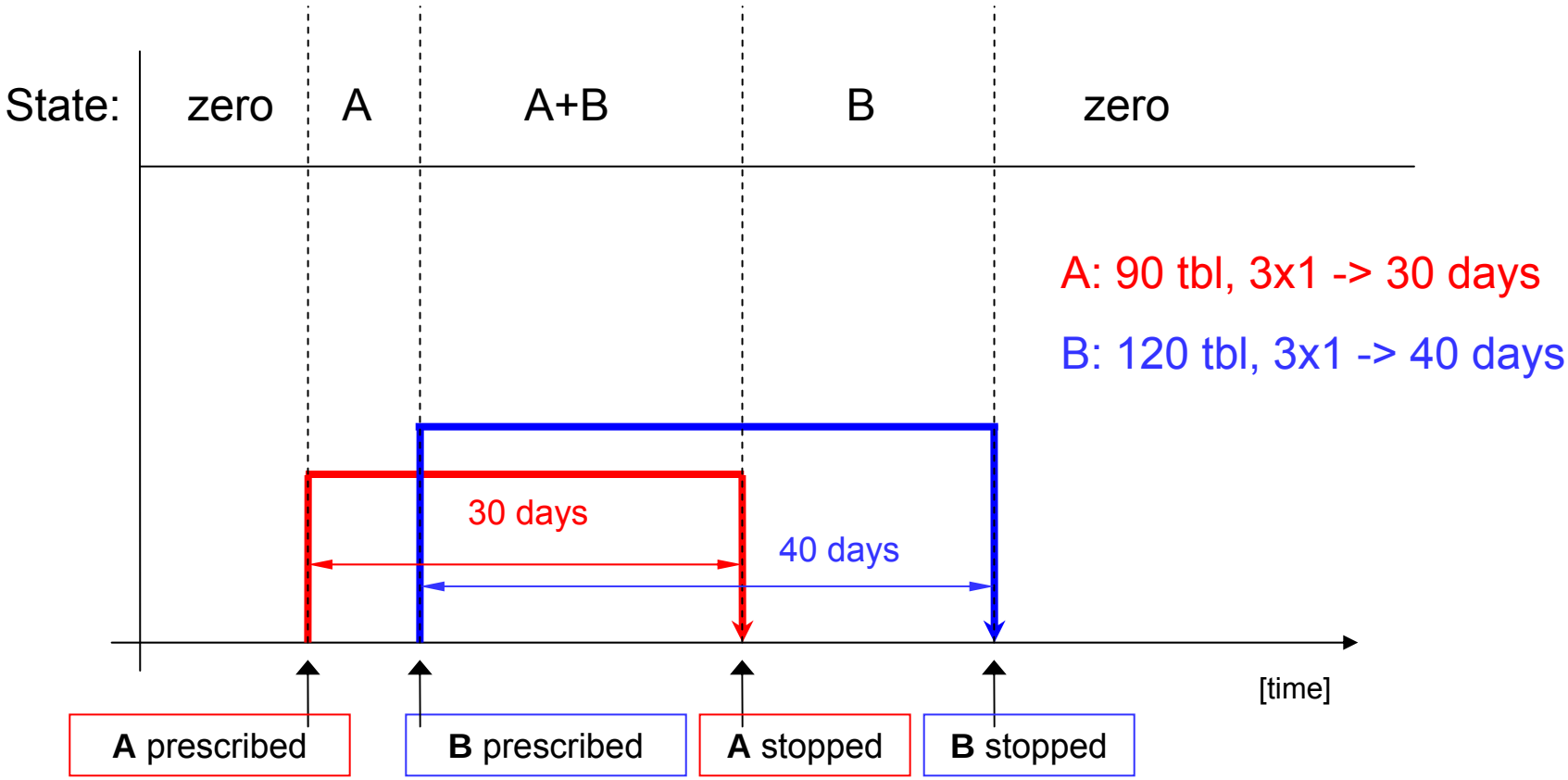
- Guideline: Treatment of hypertension in diabetic patients *)
- Prescriptions – drugs classified according to ATC and organised into groups reflecting the guideline**)
- Data extracts form GPs (70000 prescriptions across 6 years)

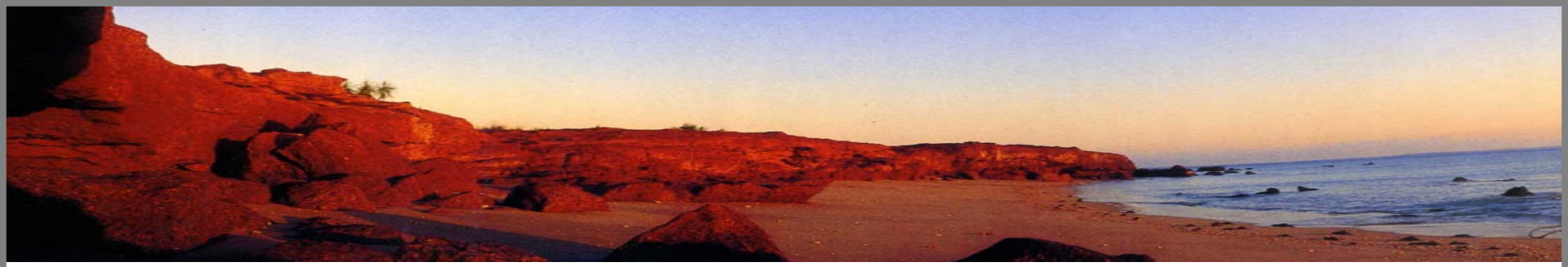
*) American Diabetes Association, Hypertension management in adults with diabetes. Diabetes Care 2004; 27:S65-S67.

**) Gadzhanova, S. et al.: Developing High-Specificity Anti-hypertensive Alerts by Therapeutic State Analysis of Electronic Prescribing Records. JAMIA, 2007;14, pp 100-109.



Converting prescription events into states:





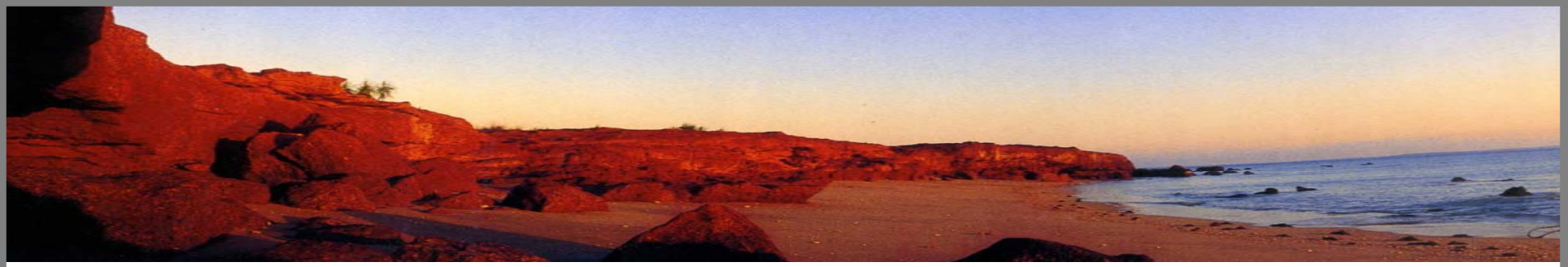
Results

Prescription path = showing the sequence of prescription events (**A** - **B**)

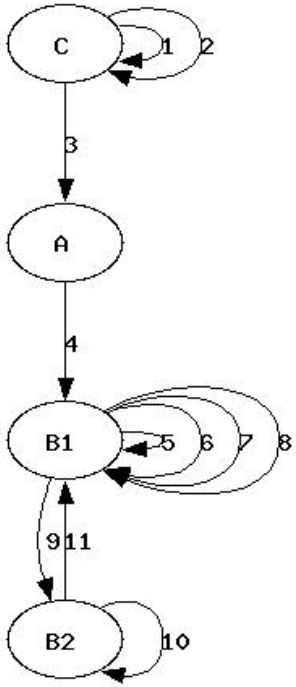
Treatment path = showing the sequence of guideline-derived states

(zero → A → A+B → B → zero)

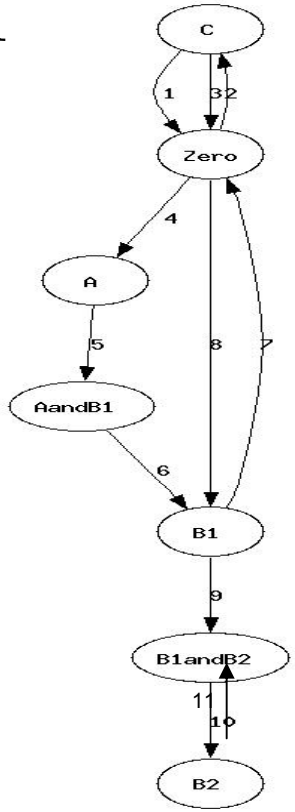
Zero indicates the patient does not appear to have any medication



Visualisation

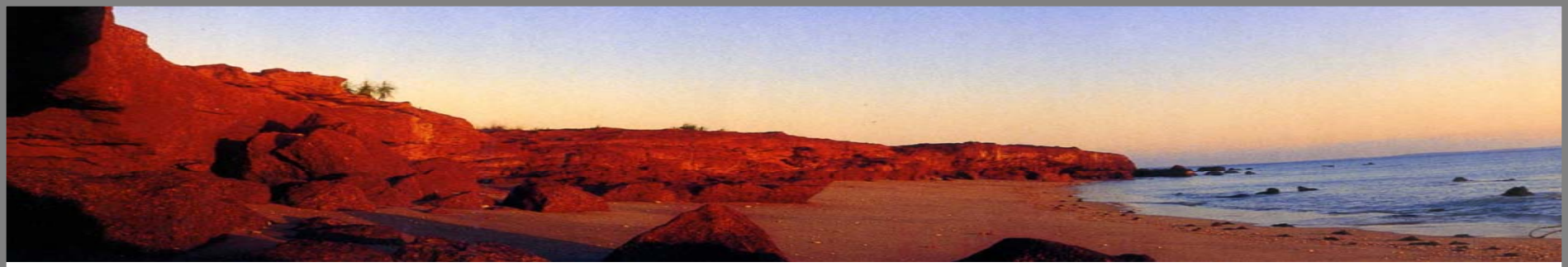


Prescription path



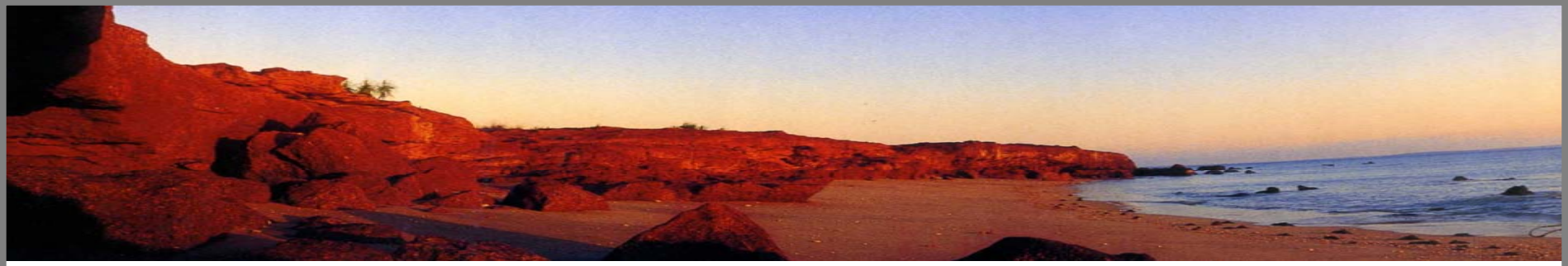
Treatment path

Group A: Angiotensine converting enzyme inhibitors (ACEi) - ATC codes C09A and C09C
Group B1: β-blockers (BB) - ATC codes C07AA, C07AB
Group B2: Diuretics - ATC codes C03AA, C03CA or C03D
Group B3: Non-dihydropyridine Ca-channel blockers (NCCB) - ATC code C08D
Group C: Dihydropyridine Ca-channel blockers (DCCB) - ATC code C08CA
Group D: α-blockers, hydralazines, clonidine - ATC codes C02CA, C02DB, C02AC



Use of the paths

1. Direct use:
   - both paths are directly related to the practice and (given the GPs know the guideline) readily understandable
   - Unusual paths can be picked from the image itself
2. Indirectly
   - both types of paths can be used to generate alerts (e.g. unusual states, transactions, cycles) – serving as a possible screening of unusual cases.



Related work

- Probably closest to our approach were authors*) using a guideline to lead their data-mining exercise, although on a smaller sample of patients in hospital setting
- Others**) too worked in a hospital, data rich setting and focussed more on intentions, guideline compliance and quality control.

*) Říha A., Svátek V., Němec P., Zvárová J.: Medical guideline as prior knowledge in electronic healthcare record mining. In: 3rd International Conference on Data Mining Methods and Databases for Engineering, Finance and Other Fields, 25-27 September 2002, Bologna, Italy.

Svátek, V., Říha, A., Peleška, A., Rauch, J.: Analysis of guideline compliance – a data mining approach. Praha 13.04.2004 – 16.04.2004. In: Kaiser, K, Miksch, S., Tu, S. W. (ed.). *Computer-Based Support for Clinical Guidelines and Protocols.* Amsterdam, IOS Press, 2004, s. 157–161. ISBN 1-58603-412-X.

**) Advani, A.,Shahar, Y., Musen, M.A.: Medical Quality Assessment by Scoring Adherence to Guideline Intentions. 2001 Annual AMIA Conference, Washington, DC, Hanley and Belfus 2001.

Chan, A.S., Coleman, R.W., Martins, S.B., Advani,A , Musen,M.A., Bosworth, H.B., Oddone, E.Z., Shlipak, M.G., Hoffman,B.B., Goldstein, M.K.: Evaluating Provider Adherence in a Trial of a Guideline-Based Decision Support System for Hypertension.MedInfo 2004, San Francisco, California, Sept 7 - 11. 2004.

Marcos, M., Berger, G., van Harmelen, F., ten Teije, A., Roomans, H., Miksch, S: Using Critiquing for Improving Medical Protocols: Harder than It Seems. In: Quaglini, S., Barahona, P., and Andreassen, S. (Eds.): AIME 2001, LNAI 2101, Springer-Verlag Berlin Heidelberg 2001, pp.431–441

Aigner, W, Miksch, S.: Supporting Protocol-Based Care in Medicine via Multiple Coordinated Views. Proceedings of the Second International Conference on Coordinated & Multiple Views in Exploratory Visualization (CMV'04), 2004.

Future directions

1. Clinical validation of assumptions of user-friendliness, utility and acceptability of our graphs and alerts
2. Linking therapeutic path and prescription path into a single graph and exploring utility of such representation
3. Exploring path-mining as a method for structuring the problem space*)

*) e.g.: van der Aalst, W., Weijters, T., Maruster, L.: Workflow mining: discovering process models from event logs. IEEE Transactions on Knowledge and Data Engineering, 16 (9), September 2004.