The feasibility and cost-effectiveness of a novel telepaediatric service in Queensland
Statement of originality

The work contained within this thesis has not been previously submitted for a degree or diploma at any other tertiary institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Anthony C. Smith

Signed: ................................. Date: .................................
Acknowledgements

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I dedicate this work to my family and to the memory of my late brother David Bruce Smith (1974-2003).
Publications

The following publications by the candidate have emanated from the work presented in this thesis. All papers have been published or accepted for publication in peer-reviewed journals. Copies, where available have been included as an appendix of this thesis (Appendix 4).


Williams M and Smith AC. Paediatric outreach services. *Journal of Paediatrics and Child Health* 2004, 40: 501-503


The following presentations have been made at local, national and international conferences during the candidature period.

m-Health. Providing excellence in quality of care through wireless, tele and mobile technology integration
30-31 March, 2004
The Sydney Boulevard, Australia
Providing innovative solutions through telehealth technology

Data Communication Systems and Telemedicine Department of Information Systems
15 March, 2004 (lecture presented via videoconference)
Brunel University, Middlesex, UK
The development and evaluation of telepaediatrics in Queensland

The Cardiac Society of Australian and New Zealand 51st Annual Scientific Meeting
10 – 13 October, 2003 (poster)
Adelaide Convention Centre, Australia
Videoconferencing for the management of children with suspected cardiac defects

Asia Pacific Burns Congress
September, 2003
Brisbane Convention and Exhibition Centre, Queensland, Australia
1. Post-acute burns care for children: a virtual outpatient service in Queensland
2. Diagnostic accuracy of telemedicine for the follow-up of paediatric burns patients
3rd Successes and Failures in Telehealth Conference
25th August, 2003
Royal Children’s Hospital, Queensland, Australia
*Family costs of outpatient appointments via videoconference compared to conventional appointments (face-to-face)*

3rd Successes and Failures in Telehealth Conference
25th August, 2003
Royal Children’s Hospital, Queensland, Australia
*Online techniques to assist with the delivery of specialist diabetes services in Queensland*

Nursing in a Technological World, International Nursing Conference
1st July, 2003
Brisbane Convention and Exhibition Centre, Queensland, Australia
*Innovative communication techniques for the delivery of specialist nursing services*

Royal Australian College of Physicians Annual Conference
26th May, 2003 (poster)
Hobart Function Conference Centre, Tasmania, Australia
*The trial and development of a telepaediatric service in Queensland*

Queensland Child and Adolescent Diabetes Conference
28th February, 2003
Royal Children’s Hospital, Queensland, Australia
*Telemedicine and the delivery of health services for children and adolescents with diabetes*

Australia New Zealand Burns Association - Conference
21st October, 2002 (poster)
Auckland, New Zealand
*Using online communication techniques for the delivery of paediatric burns care in Queensland*
APEG Annual Scientific Meeting
22-24 August, 2002 (poster)
Darwin, Northern Territory, Australia
*Diabetes and endocrinology: Using innovative techniques to improve the delivery of paediatric health services in Queensland*

2nd Successes and Failures in Telehealth Conference
1st August, 2002
Royal Children’s Hospital, Queensland, Australia
*A comparison of telepaediatric activity at two regional hospitals in Queensland*

Camp Diabetes “An Oasis of Learning”
21st June, 2001
Rydges Oasis Resort, Caloundra, Australia
*Rural kids with diabetes – improving the outcomes with telehealth*

Royal Australasian College of Physicians & Royal College of Physicians Thailand
6th May, 2002
Brisbane Convention and Exhibition Centre, Queensland, Australia
*Isolated health service delivery – telemedicine*

Italian Australian Technology Innovation Conference and Exhibition
26th March, 2002
Le Meridien at Rialto & Rialto Towers, Melbourne, Australia
*Telemedicine and technological innovation in medicine*

Health Telematics Unit – Multipoint Conference
15th August, 2001
University of Calgary, Calgary, Canada
Visiting Scholarship
*An overview of telepaediatrics in Queensland*
Centre for Health & Technology
10th August, 2001
University of California, Sacramento, California, USA
Visiting Scholarship
*An overview of telehealth in Australia*

**Annual Asia Pacific Medical Student Conference (AMSE)**
10th July, 2001
Monash University – Melbourne, Australia
*Telehealth - an Australian perspective*

**Telemedicine Summer Symposium**
4th July, 2001 (presented via videoconference)
University of Calgary, Canada
*Telehealth Integration in Queensland*

**Successes & Failures in Telehealth Conference**
22nd June, 2001
Royal Children’s Hospital & Health Service District
*The point of referral barrier - a factor in the success of telehealth*

**Child and Youth Mental Health Conference**
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Abstract

Telehealth has the potential to improve access to health services for patients living in rural and remote communities. Despite the long distances in Queensland, telehealth has been significantly under-utilised. One possible reason is that it has generally been easier for the referrer to send patients to a specialist than to organise a telehealth consultation. This thesis describes a novel model of telehealth, in which a small scale call centre was accessible by a single telephone number. All calls made to the centre were received by a telepaediatric coordinator. The coordinator was responsible for facilitating the appropriate response.

The principal hypothesis was that by shifting the responsibility for telepaediatrics from the referrer to the provider, the telehealth process could be made equally or more attractive than the conventional alternative. The model was tested and proven to be an effective method for the coordination of telehealth services. During the first three years of operation, about 1400 patient consultations were coordinated by the telepaediatric service. The continued usage of the service has been an encouraging sign of its acceptance amongst clinicians. Telepaediatric activity steadily increased to about 20 h of videoconferencing time per month for clinical consultations. On average 50 patient consultations were conducted per month. Paediatric subspecialties included burns, cardiology, child development, dermatology, diabetes, endocrinology, gastroenterology, nephrology, neurology, oncology, orthopaedics, paediatric surgery and psychiatry.

Activity data at selected regional sites pre and post telepaediatrics showed a marked reduction in the number of children travelling to Brisbane for an outpatient appointment and a substantial increase in the number of children accessing specialist services in their local hospital (via videoconference).
An economic analysis of telepaediatric activity showed savings made to the state health department. The total cost of providing 975 patient consultations through the telepaediatric service was $740,248. The estimated potential cost of providing an outpatient service to the same number of patients at the Royal Children’s Hospital (RCH) in Brisbane was $1,060,231. Based on the analysis of 975 patient consultations, telepaediatrics was a more cost-effective method for the delivery of outpatient services when the workload exceeded 597 patient consultations and resulted in a net saving of about $320,000 to the health service provider. A sensitivity analysis showed that the threshold point was most sensitive to changes related to videoconference equipment costs, staff salaries and patient travel costs; other factors (e.g. telecommunication costs) were less important.

The family costs of attending outpatient appointments in person at the RCH and via videoconference at a regional hospital close to home were compared by interviewing 300 families. There were significant differences between the two groups. It cost families more to attend an appointment at the RCH than to attend a videoconference. 95% of families (n=100) in the RCH group reported at least one type of expense (median cost $18). In contrast, only 10% of families (n=200) who had a local videoconference reported any additional costs (median cost $0). Families who had their specialist appointment via local videoconference spent less time travelling to and from their appointment and less time off work.

The accuracy of clinical assessments for burns conducted via videoconference was investigated. Agreement between the two consultants when seeing patients face-to-face (FTF) was moderately high, with an overall concordance of 85%. When videoconferencing was used, the level of agreement was almost the same, 84%. This confirms that the quality of information collected during a videoconference appointment is similar to that information collected during a conventional FTF appointment for a follow-up burns consultation.
The routine use of telepaediatrics for the delivery of post-acute burns care meant that families in regional and remote parts of Queensland had more convenient access to specialist services which were normally only available in Brisbane. 293 patient consultations were conducted during the first three years.

A substantial proportion of outpatient care could be delivered using videoconferencing, email and the telephone. Telepaediatric burns services proved valuable in two key areas. The first area involved the delivery of routine specialist clinics via videoconference. The second area related to ad-hoc patient consultations for collaborative management during acute presentations.

Telepaediatrics was used to complement the conventional outreach programme for children with diabetes and endocrine conditions. In three years, 194 patient consultations and 13 education sessions were conducted via videoconference. Telepaediatric services in endocrinology and diabetes were established at three levels: (1) the coordination of routine specialist clinics via videoconference; (2) ad-hoc patient consultations for collaborative management during acute presentations and at times of urgent clinical need; and (3) the delivery of education to staff and patients throughout the state.

This study provides quantitative evidence to support the feasibility and cost-effectiveness of a novel telehealth service model in Queensland. Telepaediatrics has been successfully introduced as a routine service at the RCH, alongside conventional methods of health service delivery.
Table of contents

STATEMENT OF ORIGINALITY................................................................................................. i
ACKNOWLEDGEMENTS ........................................................................................................... ii
PUBLICATIONS........................................................................................................................ iv
CONFERENCE PRESENTATIONS ........................................................................................... vi
ABSTRACT............................................................................................................................. x
TABLE OF CONTENTS........................................................................................................... xiii
LIST OF FIGURES................................................................................................................ xvii
LIST OF TABLES................................................................................................................... xx
GLOSSARY AND ABBREVIATIONS ................................................................................. xxiii

CHAPTER 1 INTRODUCTION................................................................................................. 1
  1.1 Background ................................................................................................................. 1
  1.2 Communication technology ...................................................................................... 1
  1.3 Telemedicine and telehealth ..................................................................................... 2
    1.3.1 Types of telemedicine .......................................................................................... 4
  1.4 What is telepaediatrics? ............................................................................................. 5
    1.4.1 Literature search .................................................................................................. 6
  1.5 Conclusion.................................................................................................................... 11

CHAPTER 2 A FEASIBILITY STUDY OF A NOVEL MODEL FOR THE
COORDINATION OF TELEPAEDIATRIC SERVICES ........................................................... 13
  2.1 Introduction................................................................................................................ 13
  2.1.1 Telepaediatrics.................................................................................................... 15
  2.2 Aim ............................................................................................................................ 16
  2.3 Method ...................................................................................................................... 16
  2.4 Results ....................................................................................................................... 19
    2.4.1 Telepaediatric activity ......................................................................................... 19
    2.4.2 Savings ............................................................................................................... 27
    2.4.3 Patient satisfaction ............................................................................................ 30
    2.4.4 Family costs ....................................................................................................... 31
  2.5 Discussion.................................................................................................................... 33
  2.6 Conclusions................................................................................................................ 35

CHAPTER 3 REFERRAL ACTIVITY DURING THE TRIAL OF A
TELEPAEDIATRIC SERVICE ............................................................................................... 37
  3.1 Introduction................................................................................................................ 37
  3.2 RCH admissions....................................................................................................... 38
  3.3 RCH outpatients...................................................................................................... 41
  3.4 Local admissions...................................................................................................... 43
# Table of Contents

**CHAPTER 6**  THE FAMILY COSTS OF ATTENDING A SPECIALIST OUTPATIENT APPOINTMENT VIA VIDEOCONFERENCE AND IN PERSON .......................... 107  
6.1 Introduction ........................................................................................................ 107  
6.2 Methods ............................................................................................................. 107  
6.3 Results ................................................................................................................ 109  
6.3.1 Comparison 1: non-burns outpatients ............................................................. 109  
6.3.2 Comparison 2: burns outpatients .................................................................... 113  
6.4 Discussion .......................................................................................................... 115  
6.5 Conclusion ......................................................................................................... 117  

**CHAPTER 7**  DIAGNOSTIC ACCURACY AND PATIENT SATISFACTION OF TELECONSULTATIONS FOR POST-ACUTE BURNS CARE ............................. 119  
7.1 Introduction ....................................................................................................... 119  
7.2 Method .............................................................................................................. 119  
7.2.1 Comparison 1 and 2 ....................................................................................... 120  
7.2.2 Comparison 3 ................................................................................................ 122  
7.2.3 Outcome measures ........................................................................................ 122  
7.2.4 User satisfaction ............................................................................................. 122  
7.2.5 Comparison .................................................................................................. 123  
7.3 Results ............................................................................................................... 123  
7.3.1 Comparison 1 and 2 – different observers ...................................................... 123  
7.3.2 Comparison 3 – same observer ..................................................................... 125  
7.3.3 Consultant satisfaction ................................................................................... 126  
7.3.4 Patient satisfaction ........................................................................................ 126  
7.4 Discussion .......................................................................................................... 128  
7.5 Conclusion ......................................................................................................... 130  

**CHAPTER 8**  TELEPAEDIATRIC SERVICES FOR DELIVERY OF POST-ACUTE BURNS CARE ................................................................. 131  
8.1 Introduction ....................................................................................................... 131  
8.2 Method .............................................................................................................. 132  
8.3 Results ............................................................................................................... 135  
8.3.1 Telepaediatric clinics .................................................................................... 135  
8.3.2 Consultation time .......................................................................................... 138  
8.3.3 Patient satisfaction ........................................................................................ 138  
8.4 Discussion .......................................................................................................... 140  
8.5 Conclusion ......................................................................................................... 142  

**CHAPTER 9**  TELEPAEDIATRIC SERVICES FOR THE MANAGEMENT OF CHILDREN WITH DIABETES AND ENDOCRINE CONDITIONS ........................ 143  
9.1 Introduction ....................................................................................................... 143  
9.2 Aim .................................................................................................................... 144  
9.3 Method ............................................................................................................... 144  
9.4 Results ............................................................................................................... 144  
9.4.1 Routine telepaediatric consultations............................................................... 145  
9.4.2 Non-routine telepaediatric consultations ....................................................... 147  
9.4.3 Staff education ............................................................................................. 148  
9.4.4 Patient education ......................................................................................... 149  
9.5 Discussion .......................................................................................................... 150  
9.6 Conclusion ......................................................................................................... 151  

**CHAPTER 10**  FACTORS IN THE SUCCESS AND FAILURE OF TELEHEALTH .......................... 153  
10.1 Introduction ..................................................................................................... 153  
10.2 Literature search ............................................................................................. 154  
10.3 Main factors ..................................................................................................... 155  
10.3.1 Routine telepaediatric clinics ....................................................................... 155
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.3.2</td>
<td>Matching technology to clinical needs</td>
<td>157</td>
</tr>
<tr>
<td>10.3.3</td>
<td>Telecommunications infrastructure</td>
<td>158</td>
</tr>
<tr>
<td>10.3.4</td>
<td>Technical support</td>
<td>159</td>
</tr>
<tr>
<td>10.3.5</td>
<td>Organisational readiness</td>
<td>160</td>
</tr>
<tr>
<td>10.3.6</td>
<td>User acceptance</td>
<td>161</td>
</tr>
<tr>
<td>10.3.7</td>
<td>Training and education</td>
<td>161</td>
</tr>
<tr>
<td>10.3.8</td>
<td>Clinical champion</td>
<td>162</td>
</tr>
<tr>
<td>10.3.9</td>
<td>Financial support and funding</td>
<td>163</td>
</tr>
<tr>
<td>10.3.10</td>
<td>Licensure and legislation</td>
<td>164</td>
</tr>
<tr>
<td>10.3.11</td>
<td>Privacy and confidentiality</td>
<td>165</td>
</tr>
<tr>
<td>10.3.12</td>
<td>Evaluation</td>
<td>165</td>
</tr>
<tr>
<td>10.4</td>
<td>Hypothetical case study: establishing a telepaediatric service in Western Australia</td>
<td>166</td>
</tr>
<tr>
<td>10.4.1</td>
<td>High importance</td>
<td>167</td>
</tr>
<tr>
<td>10.4.2</td>
<td>Medium importance</td>
<td>170</td>
</tr>
<tr>
<td>10.4.3</td>
<td>Low importance</td>
<td>172</td>
</tr>
<tr>
<td>10.5</td>
<td>Conclusion</td>
<td>172</td>
</tr>
<tr>
<td>11.1</td>
<td>Introduction</td>
<td>173</td>
</tr>
<tr>
<td>11.2</td>
<td>Summary of key findings</td>
<td>173</td>
</tr>
<tr>
<td>11.2.1</td>
<td>Feasibility</td>
<td>174</td>
</tr>
<tr>
<td>11.2.2</td>
<td>Impact on patient referrals – admissions and outpatients</td>
<td>175</td>
</tr>
<tr>
<td>11.2.3</td>
<td>Service development</td>
<td>175</td>
</tr>
<tr>
<td>11.2.4</td>
<td>Cost-effectiveness</td>
<td>176</td>
</tr>
<tr>
<td>11.2.5</td>
<td>Diagnostic accuracy</td>
<td>177</td>
</tr>
<tr>
<td>11.2.6</td>
<td>Post-acute burns care</td>
<td>178</td>
</tr>
<tr>
<td>11.2.7</td>
<td>Specialist diabetes services</td>
<td>178</td>
</tr>
<tr>
<td>11.3</td>
<td>Implications of the key findings</td>
<td>179</td>
</tr>
<tr>
<td>11.4</td>
<td>Suggestions for future research</td>
<td>181</td>
</tr>
<tr>
<td>11.5</td>
<td>Conclusion</td>
<td>182</td>
</tr>
<tr>
<td>REFERENCES</td>
<td></td>
<td>183</td>
</tr>
<tr>
<td>APPENDIX 1</td>
<td>APPROVAL DOCUMENTATION</td>
<td>195</td>
</tr>
<tr>
<td>APPENDIX 2</td>
<td>SURVEY FORMS</td>
<td>201</td>
</tr>
<tr>
<td>APPENDIX 3</td>
<td>TELEPAEDIATRIC SUMMARY FORMS</td>
<td>209</td>
</tr>
<tr>
<td>APPENDIX 4</td>
<td>PUBLICATIONS</td>
<td>213</td>
</tr>
</tbody>
</table>
List of figures

Figure 1.1  The annual number of articles published on telemedicine or telehealth. The results are based on a Medline search of articles published from 1966 to 2002 ................................................................. 6
Figure 2.1 QTN usage (November 1997 - May 2000) .................................................. 14
Figure 2.2 QTN usage by purpose (November 2000) ................................................ 15
Figure 2.3 Telepaediatric activity (May 1997 - May 2000) ........................................ 15
Figure 2.4 Location of regional intervention sites and the tertiary hospital in Queensland ................................................................. 17
Figure 2.5 Videoconference facilities in the Child and Adolescent Unit at Mackay - (a) before and (b) after refurbishment .............................................................. 18
Figure 2.6 Videoconference facilities at Hervey Bay Hospital - (a) before and (b) after refurbishment ................................................................. 18
Figure 2.7 Telepaediatric service activity - enquiries and requests ......................... 20
Figure 2.8 Number of single patient consultations and the number of telepaediatric clinics conducted per month ...................................................... 21
Figure 2.9 Videoconference usage (h) - clinical consultations only ....................... 23
Figure 2.10 Responses to telepaediatric requests - each method expressed as a proportion of monthly activity ................................................................. 23
Figure 2.11 Telepaediatric responses – each method expressed as a proportion of all activity conducted during the first 15 months ........................................ 24
Figure 2.12 Telepaediatric consultations - (a) cardiology, (b) respiratory medicine, (c) oncology/palliative care, (d) dermatology, (e, f) post-acute burns care, (g) diabetes / endocrinology, and (h) child development ................. 26
Figure 3.1 Telepaediatric consultations from intervention sites and other sites (n=387) .................................................................................................................... 37
Figure 3.2 RCH admissions from the Mackay region ............................................. 39
Figure 3.3 RCH admissions from the Hervey Bay region ........................................ 40
Figure 3.4 RCH admissions from all other Queensland sites ................................. 40
Figure 3.5 RCH outpatients from the Mackay region .......................................... 42
Figure 3.6 RCH outpatients from the Hervey Bay region .................................... 42
Figure 3.7 RCH outpatients from all other Queensland sites ................................ 43
Figure 3.8 Local paediatric admissions – Mackay ............................................. 44
Figure 3.9 Local paediatric admissions – Hervey Bay ........................................ 44
Figure 3.10 Local paediatric outpatients – Mackay ...................................... 46
Figure 3.11 Local paediatric outpatients – Hervey Bay ...................................... 46
Figure 3.12 Summary of referral trends pre and post telepaediatrics. The average number of patients referred per month to the RCH for admission or outpatient appointments (1998-2003) and activity at the local hospital (1998-2002) ................................................................. 47
Figure 3.13 Approval process for the PTSS – standard process............................ 49
Figure 3.14 Approval process for the PTSS – revised process for the telepaediatric service, as used in Mackay ................................................................. 50
Figure 3.15 Population growth (total and children 0-18y) in the Mackay and Hervey Bay regions ................................................................. 51
Figure 3.16 Private practice activity. Number of paediatric patients seen per month - Mackay ........................................................................................................ 52
Figure 4.1 Telepaediatric intervention sites during the second phase (February 2002 – March 2003) ......................................................................................... 54
Figure 4.2  Referral methods used by clinicians during phase two (February 2002 – March 2003) ................................................................. 56
Figure 4.3  Proportion of telepaediatric consultations from November 2000 to March 2003 (n=1000). ........................................................................................................ 59
Figure 4.4  Telepaediatric activity per month – consultations (November 2000 – March 2003) ............................................................................................................. 61
Figure 4.5  Telepaediatric activity per month – videoconferencing (November 2000 – March 2003) ................................................................. 61
Figure 4.6  Telepaediatric activity – sorted by sub-specialties (November 2000 – March 2003) ................................................................. 63
Figure 4.7  Telepaediatric activity - (a) emailed image reviewed by burns team and (b) follow up consultation via videoconference................................. 63
Figure 4.8  Telepaediatric activity - (a) examination of injection sites during a consultation via videoconference and (b) education session presented by an RCH specialist to staff in Rockhampton ................................................................. 64
Figure 4.9  Telepaediatric activity - (a) discussion between staff from Mackay Hospital and RCH specialists and (b) patient from oncology unit meeting friends in Gladstone whilst an inpatient at the RCH ................................................................. 66
Figure 4.10  Telepaediatric activity - (a) case discussion before review of echocardiogram and (b) echocardiogram as seen via videoconference. .......... 67
Figure 4.11  1000 patient consultations were completed after 28 months of the telepaediatric service - (a) telepaediatric consultation in progress and (b) screen view of family and paediatrician in Mackay ................................................................. 81
Figure 5.1  Proportion of telepaediatric consultations at the five intervention sites (n = 975) ......................................................................................................................... 83
Figure 5.2  Telepaediatric equipment - (a) Centre for Online Health (Main Studio) and (b) Hervey Bay Hospital ......................................................................................................... 88
Figure 5.3  RCH Outpatients Department - (a) waiting area and (b) consultation room with doctor, patient and family ......................................................................................................... 92
Figure 5.4  Total costs for the telepaediatric service and the conventional method ($) ................................................................. 96
Figure 6.1  Proportion of patient consultations according to clinical speciality (a) patients seen at the RCH and (b) patients seen via videoconference ...... 109
Figure 7.1  A patient being reviewed - (a) by nursing staff and (b) a second patient being reviewed by Consultant A in the SPPBU ................................................................. 121
Figure 7.2  Patient being reviewed by Consultant B, in the Centre for Online Health (a) via videoconference and then (b) FTF ......................................................................................................... 121
Figure 7.4  Location of burn injuries (n=35) ................................................................................................................................. 123
Figure 8.1  Number of outpatient appointments conducted per patient during a 12 month period (March 2003 – February 2004) ................................................................. 132
Figure 8.2  Burns consultation via videoconference - (a) review of the graft site on the medial aspect of the right leg, (b) discussion with a family situated in Cairns, (c) review of a thermal burn on the palm of the hand and (d) review of a shoulder injury ................................................................................................................................. 133
Figure 8.3  Digital images could be taken and sent via email for advice - (a) image taken with a digital camera, (b) image taken with a desktop scanner, (c) extensive flame burns and (d) scald burn to face ................................................................................................................................. 134
Figure 8.4  Burns outpatient activity (2000-2003) ................................................................................................................................. 135
Figure 8.5  Telepaediatric burns services were provided to 31 sites throughout Queensland via videoconference from the specialist centre (▲) in Brisbane ................................................................................................................................. 136
Figure 9.1  Clinical updates were provided by - (a) the regional paediatrician and registrar in Mackay, and general progress was reported by (b) the patient and family in Moranbah ................................................................................................................................. 145
Figure 9.2 Injection sites were reviewed by - (a) positioning the patient in front of the main videoconference camera, and (b) using the main camera to gain a close up image of the abdomen................................................................. 146

Figure 9.3 Details of blood glucose levels from the patient record were displayed - (a) under a video-document camera and (b) viewed by the endocrinologist in Brisbane........................................................................................................... 146

Figure 9.4 Lectures were presented with - (a) PowerPoint slides being transmitted via videoconference and (b) discussions facilitated between regional clinicians and the endocrinologist in Brisbane.......................................................... 148

Figure 9.5 Diabetes education sessions were delivered by the diabetes educator at the RCH and included - (a) interactive discussion between the distant sites and (b) a PowerPoint lecture presented via videoconference................. 149

Figure 9.6 Diabetes education was useful for - (a) the presentation of information relevant to the recent diagnosis of diabetes and (b) demonstration of devices such as an insulin syringe....................................................... 149

Figure 10.1 Western Australia is the largest of all states and territories in Australia and has an area of over 2.5 million square kilometres, compared with 1.7 million square kilometres in Queensland................................................................. 167
List of tables

Table 1.1  Telemedicine examples: pre-recorded and real-time ........................................... 5
Table 1.2  Number of articles located in the MEDLINE database using various search terms ............................................................................................................. 7
Table 1.3  Articles related to paediatrics and telemedicine (n=129), categorised according to topic ........................................................................................................................................... 8
Table 2.1  Number of telepaediatric requests and patient consultations (November 2000 - January 2002) ................................................................................................................. 22
Table 2.2  Number of patient transfers prevented, according to independent and COH review ........................................................................................................................................... 27
Table 2.3  Number of patient transfers prevented and the number of traditional outreach visits replaced by telehealth outreach programmes ................. 28
Table 2.4  Phase 1 estimated savings associated with patient travel and outreach clinics .......................................................................................................................... 29
Table 2.5  Parent satisfaction of telepaediatric consultations .................................................. 31
Table 2.6  Summary of economic survey findings ..................................................................... 32
Table 3.1  Number of children admitted to the RCH from selected Queensland sites (1998-2003) ......................................................................................................................... 38
Table 3.2  Number of children attending the outpatient department at the RCH from selected Queensland regions (2000-2003) ................. 41
Table 4.1  Number of consultations per site. First 1000 telepaediatric patient consultations .......................................................... 57
Table 4.2  Number of telepaediatric consultations by sub-specialty (n=1000) ............... 62
Table 4.3  Changes to oncology outreach services – outreach and videoconference (VC) clinics .................................................................................................................. 65
Table 4.4  Parent satisfaction of telepaediatric consultations .................................................. 69
Table 4.5  Staff satisfaction – service provision ..................................................................... 72
Table 4.6  Staff satisfaction – technical and administrative support ..................................... 73
Table 4.7  Staff satisfaction – use of the toll-free 1800 number .................................................. 74
Table 5.1  Summary of actual costs associated with telepaediatrics and estimated costs for RCH outpatient consultations (975 patients) from November 2000 – October 2003 .................................................................................................................. 86
Table 5.2  Average and variable costs per patient consultation for telepaediatrics and RCH outpatient consultations (975 patients) from November 2000 – October 2003 .................................................................................................................. 87
Table 5.3  Calculation of interest costs on the purchase of telepaediatric equipment .................................................................................................................. 88
Table 5.4  Clinical and administrative staff employment costs per h, including all on-costs (telepaediatrics) .................................................................................................................. 90
Table 5.5  Miscellaneous project costs ...................................................................................... 91
Table 5.6  Average time (min) spent per patient consultation – telepaediatrics and RCH outpatients .................................................................................................................. 91
Table 5.7  Clinical and administrative staff employment costs per h, including all on-costs (RCH outpatients) .................................................................................................................. 92
Table 5.8  Patient travel information – method and cost of return fares per person ....... 93
Table 5.9  Patient travel costs calculated according to the amount of telepaediatric activity in each intervention area .................................................................................................................. 93
Table 5.10  Patient accommodation costs for children travelling to Brisbane ............... 94
Table 5.11  Change in threshold point caused by changes in equipment cost ........... 97
Table 5.12  Change in threshold point caused by changes in ISDN line rental costs .... 97
Table 5.13 Change in threshold point caused by changes in adjusted ISDN call costs
........................................................................................................................................ 97
Table 5.14 Change in threshold point caused by changes in adjusted costs of patient travel .................................................................................................................. 98
Table 5.15 Change in threshold point caused by changes in the employment costs .................................................................................................................. 98
Table 5.16 Change in threshold point caused by changes in interest rates associated with capital investment ........................................................................... 99
Table 5.17 Change in threshold point related to change in the percentage of patients that would have been transferred if the telepaediatric service was not available .................................................................................................................. 99
Table 5.18 Changes to threshold (expressed as a ratio) when individual cost elements are adjusted by 1% ........................................................................................................ 100
Table 5.19 Costs listed in order of effect on threshold (rated high, moderate or low) .................................................................................................................. 101
Table 6.1 Numbers of patients studied in comparisons of family costs .................................................................................................................. 108
Table 6.2 Time reported (min) by families when attending specialist outpatient appointments .................................................................................................................. 110
Table 6.3 Distance travelled (km) by families attending specialist outpatient appointments .................................................................................................................. 110
Table 6.4 Family costs ($) associated with attending the specialist outpatient appointment .................................................................................................................. 111
Table 6.5 Time off work (h) reported by family members who attended a specialist outpatient appointment .................................................................................................................. 112
Table 6.6 Time reported (min) by families when attending burns outpatient appointments .................................................................................................................. 113
Table 6.7 Distance travelled (km) by families attending burns outpatient appointments .................................................................................................................. 113
Table 6.8 Family costs ($) associated with attending the burns outpatient appointment .................................................................................................................. 114
Table 6.9 Time off work (h) reported by family members resulting from attendance at a burns outpatient appointment (h) .................................................................................................................. 115
Table 7.1 Consultation process. Each patient participated in a series of three consecutive appointments. (1) patients were reviewed by Consultant A in the outpatient department (FTF), then (2) patients were seen by Consultant B via videoconference and then (3) patients were reviewed FTF by Consultant B .................................................................................................................. 121
Table 7.2 Consultation process. Patients were reviewed twice by Consultant B. The first assessment was conducted FTF in the SPPBU and the second via videoconference .................................................................................................................. 122
Table 7.3 Measure of agreement between two independent consultants – (1) same interview technique (FTF) and (2) different interview technique (FTF and videoconference) .................................................................................................................. 124
Table 7.4 Examination of the possible order effect, when the same consultant reviewed each patient in person and then via videoconference, and vice versa .................................................................................................................. 126
Table 7.5 Parent satisfaction of consultations conducted via videoconference .................................................................................................................. 127
Table 8.1 Number of consultations conducted between November 2000 and October 2003 .................................................................................................................. 137
Table 8.2 Telepaediatric burns activity (November 2000 – October 2003) .................................................................................................................. 138
Table 8.3 Parent satisfaction of consultations conducted via videoconference .................................................................................................................. 139
Table 9.1 Changes in the delivery of diabetes/endocrine outreach services – FTF and videoconference clinics .................................................................................................................. 145
Table 9.2 Telepaediatric diabetes sessions during the three year study period .................................................................................................................. 147
Table 9.3 Videoconference usage (time spent per session) during the three year study period .................................................................................................................. 147
Table 10.1 Keywords and number of articles located in the MEDLINE database .......... 154
Table 10.2  Articles (n=22) related to [telemedicine or telehealth] and [success and factors] were categorised according to theme (some articles described more than one theme).......................................................................................... 154

Table 10.3  Articles (n=121) related to [telemedicine or telehealth] and [barriers or failures] were categorised according to theme. Some articles described more than one theme................................................................................ 155

Table 10.4  Test calls - showing the number of technical faults and successful connections........................................................................................................................................... 162
## Glossary and abbreviations

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ATSP</td>
<td>Association of Telehealth Service Providers (Portland, OR, USA)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>The capacity of an electronic transmission medium to transmit data per unit of time. The higher the bandwidth, the more data can be transmitted. Typically measured in kilobits or megabits per second (Mbit/s). Standard telephones are low bandwidth devices (maximum bandwidth = 33.6 kbit/s). Cable television uses high bandwidth (up to 140 Mbit/s).</td>
</tr>
<tr>
<td>CNC</td>
<td>Clinical Nurse Consultant</td>
</tr>
<tr>
<td>CODEC</td>
<td>COder/DECoder (also COMpression/DECompression) device. This is hardware and/or software used with interactive video systems that converts an analogue signal to digital, then compresses it so that lower bandwidth telecommunications lines can be used. The signal is decompressed and converted back to analogue output by a compatible CODEC at the receiving end. The compression method (algorithm) may be proprietary or (much preferred) standards-based.</td>
</tr>
<tr>
<td>COH</td>
<td>Centre for Online Health (University of Queensland)</td>
</tr>
<tr>
<td>Cost-benefit analysis</td>
<td>Determines how much more or less of society’s resource should be allocated to achieve a defined goal. Compares input and output in monetary units.</td>
</tr>
<tr>
<td>Cost-effectiveness analysis</td>
<td>Determines how a given goal is achieved most efficiently. Relates costs to some measures of outcome.</td>
</tr>
<tr>
<td>Cost-minimisation analysis</td>
<td>Determines which of two options with equal benefits has the lowest costs. Compares costs between different options thought to be equally effective.</td>
</tr>
<tr>
<td>Cost-utility analysis</td>
<td>Determines the best way of spending a given health care budget. Relates cost to healthy years gained.</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>Efficacy</td>
<td>The ability to achieve a desired effect under artificial, laboratory conditions.</td>
</tr>
<tr>
<td>Efficiency</td>
<td>The allocation of goods to their uses of highest relative value. The ratio of the output to the input of any system.</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>The ability to produce a desired health outcome (cure, alleviation of pain, return of functional abilities), under real-life conditions.</td>
</tr>
<tr>
<td>ENT</td>
<td>Ear, nose and throat</td>
</tr>
<tr>
<td>FTF</td>
<td>Face-to-face; conducted in person</td>
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<tr>
<td>IDDM</td>
<td>Insulin Dependent Diabetes Mellitus</td>
</tr>
<tr>
<td>Incidence</td>
<td>The rate of occurrence of some event, i.e. the number of occurrences per unit of time.</td>
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<tr>
<td>IP</td>
<td>Internet protocol</td>
</tr>
<tr>
<td>IQR</td>
<td>Inter-quartile range</td>
</tr>
<tr>
<td>ISDN</td>
<td>Integrated Services Digital Network</td>
</tr>
<tr>
<td>Kbit/s</td>
<td>Measurement of bandwidth (kilobits per second)</td>
</tr>
<tr>
<td>LAN</td>
<td>Local Area Network</td>
</tr>
<tr>
<td>MSOAP</td>
<td>Medical Specialist Outreach Assistance Programme is a funding programme of the Commonwealth Department of Health and Ageing, Australia. <a href="http://www.ruralhealth.gov.au/services/msoap.htm">http://www.ruralhealth.gov.au/services/msoap.htm</a></td>
</tr>
<tr>
<td>Multipoint meeting</td>
<td>Videoconference involving more than two sites simultaneously.</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NSW</td>
<td>New South Wales</td>
</tr>
<tr>
<td>PC</td>
<td>Personal computer</td>
</tr>
<tr>
<td>Peripheral devices</td>
<td>Attachments to videoconferencing systems to augment their communications or medical capabilities. Examples include: electronic stethoscopes, ophthalmoscopes, dermascopes, document cameras and scanners.</td>
</tr>
<tr>
<td>Point to point meeting</td>
<td>Videoconference involving two sites.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>PIP</td>
<td>Picture in Picture</td>
</tr>
<tr>
<td>Prevalence</td>
<td>The number of cases or events in a given population, usually expressed as a ratio.</td>
</tr>
<tr>
<td>PTSS</td>
<td>Patient Travel Subsidy Scheme</td>
</tr>
<tr>
<td>QLD</td>
<td>Queensland</td>
</tr>
<tr>
<td>QH</td>
<td>Queensland Health</td>
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<tr>
<td>QTN</td>
<td>Queensland Telemedicine Network</td>
</tr>
<tr>
<td>RCH</td>
<td>Royal Children’s Hospital, Brisbane</td>
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<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
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<tr>
<td>Real-time</td>
<td>Sends and receives audio / video / data simultaneously, without more than a fraction of a second delay. Applications that are transmitted within a few seconds are sometimes called near real-time. Compare store-and-forward.</td>
</tr>
<tr>
<td>RN</td>
<td>Registered Nurse</td>
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<tr>
<td>SD</td>
<td>Standard deviation</td>
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<tr>
<td>SPPBU</td>
<td>Stuart Pegg Paediatric Burns Unit</td>
</tr>
<tr>
<td>Store-and-forward</td>
<td>Captured audio clips, video clips, still images, or data that are transmitted or received at a later time (sometimes no more than a minute). Email is a store-and-forward system. Enables asynchronous communication, with the advantage of not needing concurrent participant involvement. Compare to real-time.</td>
</tr>
<tr>
<td>Telehealth</td>
<td>General term relating to the delivery of health services over a distance using a communication technique.</td>
</tr>
<tr>
<td>Telepaediatrics</td>
<td>The delivery of paediatric and child health services to regional and remote sites using a range of online communication techniques including email, videoconferencing and telephony.</td>
</tr>
<tr>
<td>Telstra</td>
<td>Telecommunications provider (Australia)</td>
</tr>
<tr>
<td>TV</td>
<td>Television</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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</table>
| UQ           | University of Queensland  
| URL          | Uniform Resource Locator (World Wide Web address) |
| US           | United States |
| WA           | Western Australia |
| WHO          | World Health Organisation |
| WWW          | World Wide Web |