APPENDIX 1: PROTOCOL

A systematic review of the peer-reviewed literature on the use of store-and-forward telehealth modalities (SP-2)

This systematic review will focus on store-and-forward telehealth modalities of relevance to family physicians working in communities that lack specialist services, or to settings where there are no family physicians available.

The methodology for study selection, literature search (with the addition to Cluster 1 of the following terms: [(store and forward or store-and-forward).mp and asynchronous.mp] and data extraction will use the same approach described above. The following sections focus on issues that are specific to this sub-project.

Cluster 1 – Terms related to telehealth
Telemedicine (exp)
(telemedicine or tele-medicine).mp. or (telehealth or tele-health).mp.
Telecommunications/ or electronic mail/ or satellite communications/ or telefacsimile/ or telephone
remote consultation$.mp.
Tele$.mp.
NOT telegraph$.mp.
Cluster 2 – Terms related to the delivery of health services
"delivery of health care"/ or delegation, professional/ or "delivery of health care, integrated"/ or health services accessibility/ or uncompensated care/
Rural Health Services
Inuit or Indians, North American (expands rural health services term)
"Referral and Consultation"
consult$.mp.
Organizational Innovation
workflow.mp. or productivity.mp.
Practice Management, Medical
"Diffusion of Innovation" (exp)

Selection criteria

An article will be regarded as potentially eligible if it meets all of the following criteria:

- It evaluates one or more store-and-forward services;
- It involves the capture of digital clinical samples by family physicians, community-based nurses or trained members of the public;
- It focuses on the delivery of digital samples for assessment by specialists in remote locations, transferred electronically, with emphasis on conditions of great burden to society such as heart disease, stroke, cancer, diabetes and chronic respiratory diseases;
- It includes data on health outcomes, process of care or resource utilization; and
- It is published in English, since 1995, in a peer-reviewed journal.

With minimal support and resources for family practitioners, the authors determined that the articles for inclusion in this study should relate to technologies easily implemented in the primary care setting and requiring minimal ancillary resources for operations. The primary care setting in Canada is characterized by individual family physicians working in an independent or small group practice [National Physician Survey 2004]. Further, the articles should discuss outcomes of administrative and/or clinical benefits to provide policy makers with meaningful information.

Articles will be excluded from this study if they pertain to:

- Asynchronous telehealth used for clinical activities that generally do not require face-to-face interaction involving a primary care setting (e.g., radiological diagnostic imaging or pathology) or,
- Only focus on concordance among different methods, focusing on technical issues rather than on clinical or economic outcomes (e.g., different modalities of telehealth or telehealth vs. face-to-face consultations).

Literature search

Eligible studies will be identified through a search from 1995 to the date of the last available issue of, MEDLINE, CINAHL, HealthSTAR and The Cochrane Library using a refined search strategy, based on clusters 1 and 2 as outlined above. Additional clusters will be assembled by an information specialist with expertise in the use of ICTs within the health sector. The purpose of these clusters will be to increase the sensitivity and precision with which the search would include citations specifically devoted to asynchronous telehealth and of relevance to primary care practitioners (family physicians, nurses or trained community members).
As outlined in SP-1, the terms within each cluster will be combined with the Boolean operator "or" before being "and-ed" together across the clusters to yield the combined search results.
The references cited in eligible citations will be hand searched for additional studies. Full text versions will be obtained for each new reference and both reviewers will review them independently. Inclusion will be assessed in the same manner as the first abstracts and retrieved articles. This process will be repeated several times until no new, relevant references are identified.

Data extraction

Once all the eligible citations are identified, two reviewers will extract the following information using hard copies of the articles:

- General characteristics (e.g., name of lead author, publication title, year of publication, country of study);
- Study type (e.g., observational or experimental. If observational, it will be recorded whether it was a case series, a cross-sectional effort, a cohort or a case-control study. Whenever relevant, it will be stated if the study was retrospective or prospective);
- Clinical specialty (e.g., dermatology, cardiology, oncology, endocrinology, respirology);
- Patient population (e.g., sample size, underlying pathology; demographic characteristics);
- Setting (e.g., rural or urban, using the definitions used by the article authors, whenever possible);
- Originator of the consultation (e.g., family physician, nurse, community member, patient)
- Technology for data capture (e.g., generic [digital cameras] or specialized [spirometers, retinographs, digital ECG devices]; other information in the referral package; file type and transfer protocol for sample management);
- Modalities used for consultation (e.g., store-and-forward only, store-and-forward and live telehealth; application not specified);
- Comparison group(s) (e.g., face-to-face consultations, multiple specialists)
- Purpose of the consultation (e.g., diagnostic, therapeutic support, follow up)
- Outcomes measured and main findings (e.g., impact on health outcomes, process of care or finances).

Specific items for the assessment of the impact of each of the interventions in each of the study groups will follow the evaluation framework developed by the Ontario Telehealth Network, one of the most comprehensive set of indicators in the world.

The methodological quality of each of the studies, whenever relevant, will be assessed using validated tools. The so-called Jadad Scale will be used for randomized controlled trials [4]and the Downs and Black Checklist for observational studies [5].

Data synthesis

Evidence tables will be produced to summarize the information extracted from the articles.

Descriptive statistics will be calculated for all the fields of the database. The overall quantity and quality of the data available, and the degree of clinical heterogeneity will be used as the criteria to determine whether meta-analysis is appropriate.

If meta-analysis is deemed appropriate, typical odds ratios, risk ratios, risk differences and number-needed-to-treat would be estimated for outcomes expressed as discrete data, using both fixed- and random-effects models. For outcomes expressed using continuous data, weighted mean differences and standardized mean differences will be used depending on the similarity of the tools used to gather the data [118].

If meta-analysis is considered inappropriate, given the heterogeneity, quality and quantity of the data available, a systematic quantitative review will be done. Tables describing the eligible studies will be provided, together with description of the most salient aspects of the studies. The reasons why meta-analysis could not be performed will be explicitly stated.

A critical analysis of the practices of leading organizations and initiatives providing store-and-forward telehealth services of relevance to Canadian policy makers (SP-3)

This sub-project seeks to complement the information gathered by the systematic review of studies on store-and-forward telehealth applications. It will include the identification and critical analysis of organizations at the forefront of store-and-forward telehealth activities around the world.

Selection criteria

An organization or initiative will be selected for this sub-project if it:

- Has stated as one of its key objectives the application of store-and-forward modalities to improve access to health services;
- Provides information about its services through any means (e.g., the Web, through telephone or face-to-face);
- Has generated data on the impact of such services.

Search strategy

Eligible organizations will be identified through:

- The affiliations of authors of studies included in Sub-project 2; and
- A search of Google designed to yield links to initiatives promoting store-and-forward or asynchronous telehealth (emphasis will be placed on the top 200 hits); and
- Interactions with leading individuals from publicly funded telehealth programs and members of the Canadian Society of Telehealth (CST) suggested by them.

Data extraction

The following information will be sought for each of the identified organizations:

- Its name and contact details (e.g., postal address, telephone and fax numbers, URL);
- Contact person and organizational leader, whenever possible;
- Available telehealth services (e.g., technology, staff, geographic and clinical scope);
- Evidence of impact, as stated in publicly available documents.

Data synthesis

The information extracted will be summarized in a report that will:

- Be easily posted and searched on the Web;
- Outline best practices; and

Identify individuals who could play an advisory role to policy makers in terms of decisions about the role that store-and-forward telehealth could play as a means to promote optimal access to health services to Canadians

APPENDIX 2: MEDLINE SEARCH STRATEGY FOR ASYNCHRONOUS/STORE-AND-FORWARD

Ovid MEDLINE(R) 1966 to November Week 3 2006		
#	**Search History**	**Results**
1	exp Primary Health Care/	47070
2	exp Physicians, Family/	11027
3	exp Family Practice/	49769
4	exp Community medicine/	1655
5	exp Group practice/	21139
6	exp Physician's Practice Patterns/	22015
7	exp Physicians' Offices/	1153
8	exp Practice management, medical/	6650
9	exp Regional medical programs/	3134
10	exp ambulatory care/	37589
11	exp outpatient clinics/	32264
12	exp homes for the aged/	8057
13	house calls/	1574
14	Private practice/	5815
15	Rural Health Services/	5036
16	Hospitals, Rural/	3197
17	Rural Health/	17048
18	Rural Population/	26192
19	northwest territories/ or nunavut/ or yukon territory/	293
20	Arctic Regions/	2493
21	**northern territory/**	**595**
22	Indians, north american/ or inuits/	10304
23	**Health services, indigenous/**	**1207**
24	outpatient:.mp.	75951
25	out-patient:.mp.	9626
26	(free-standing adj2 clinic?).mp.	57
27	(free-standing adj2 facilit:).mp.	39
28	ambulatory care facilities/ or community health centers/ or substance abuse treatment centers/ or community mental health centers/ or child guidance clinics/ or maternal-child health centers/ or outpatient clinics, hospital/ or pain clinics/ or surgicenters/	32264

Ovid MEDLINE(R) 1966 to November Week 3 2006		
#	Search History	Results
29	**general practitioner:.mp.**	**23064**
30	**exp medicine/**	**505183**
31	or/1-30	767111
32	(online or on-line).tw.	20338
33	(remote: adj2 consult:).tw.	148
34	(web page: or webpage:).tw.	620
35	(web-site: or website:).tw.	5119
36	Answering Services/	15
37	cellular phone/	759
38	comput:.tw.	290233
39	cyber:.tw.	1549
40	digital:.tw.	49073
41	discussion list:.tw.	68
42	e-bulletin board:.tw.	0
43	electron: bulletin board:.tw.	52
44	electron: discuss: board:.tw.	5
45	electron: mail:.tw.	498
46	electronic mail/	681
47	electronic:.tw.	36300
48	e-mail:.tw.	1821
49	email:.tw.	502
50	exp computer communication networks/	32709
51	exp online systems/	8319
52	exp computer-assisted instruction/	5693
53	exp diagnosis, computer-assisted/	24386
54	exp therapy, computer-assisted/	14543
55	exp computers, handheld/	767
56	exp decision making, computer-assisted/	39205
57	exp electronics, medical/	5624
58	exp internet/	22134
59	exp microcomputers/	14067
60	exp telecommunications/	31758
61	exp user-computer interface/	12397
62	(handheld adj2 computer:).tw.	219

Ovid MEDLINE(R) 1966 to November Week 3 2006		
#	Search History	Results
63	(hand held adj2 computer:).tw.	201
64	information highway:.tw.	72
65	information superhighway:.tw.	128
66	information super highway:.tw.	11
67	Instant messag:.tw.	20
68	text messag:.tw.	47
69	internet:.tw.	11655
70	(irc and (internet: or online or on-line or chat: or relay)).tw.	11
71	list serv:.tw.	44
72	Listserv:.tw.	120
73	mail: list:.tw.	326
74	messaging:.tw.	217
75	Microscopy, Video/	3465
76	modems/	220
77	Mobile phone:.tw.	563
78	mobilephone:.tw.	0
79	Mobile telephone:.tw.	152
80	Mobile telecom:.tw.	41
81	Mobile communic:.tw.	150
82	newsgroup:.tw.	105
83	((pda or pdas) and (comput: or internet: or wireless:)).tw.	223
84	personal digital assistant:.tw.	375
85	Pocket pc:.tw.	21
86	pocketpc:.tw.	5
87	Radar/	379
88	Radio/	1658
89	Remote Consultation/	2239
90	Satellite Communications/	472
91	short messag:.tw.	37
92	(sms and (internet: or online or on-line or chat: or relay: or wireless:)).tw.	19
93	exp Software/	59775
94	tele:.tw.	61774
95	exp Telecommunications/	31758
96	teleconfer:.tw.	377

Ovid MEDLINE(R) 1966 to November Week 3 2006		
#	Search History	Results
97	tele-confer:.tw.	8
98	teleconsult:.tw.	451
99	tele-consult:.tw.	15
100	Telefacsimile/	177
101	(tele-home: or telehome:).tw.	57
102	telemed:.tw.	3494
103	tele-med:.tw.	37
104	Telemedicine/	5442
105	Telepathology/	454
106	exp Telephone/	7499
107	usenet:.tw.	20
108	videoconfer:.tw.	616
109	video-confer:.tw.	201
110	Videoconferencing/	123
111	videophone:.tw.	53
112	virtual.tw.	10512
113	web based:.tw.	3484
114	webbased:.tw.	4
115	world wide web:.tw.	2208
116	www.tw.	1078
117	telestroke.mp.	12
118	tele-stroke:.mp.	0
119	teleneurology.mp.	13
120	tele-neurology.mp.	2
121	telehealth:.mp.	590
122	tele-health:.mp.	14
123	telerehab:.mp.	58
124	tele-rehab:.mp.	7
125	teleservic:.mp.	10
126	tele-servic:.mp.	0
127	or/32-126	539384
128	31 and 127	44778
129	asynchrono:.mp.	4852
130	**unsynchron:.mp.**	**257**

Ovid MEDLINE(R) 1966 to November Week 3 2006		
#	**Search History**	**Results**
131	"store and forward:".mp.	181
132	**"store forward:".mp.**	**5**
133	or/129-132	5284
134	128 and 133	264
135	limit 134 to english language	251

*The “Stroke” components of this strategy are drawn from the Cochrane Stroke Group Medline search strategy.

APPENDIX 3: DATA EXTRACTION FORM

Store and Forward Data Extraction (v1)

General Characteristics of the Studies

Article Screening

1. Does this study include asynchronous telemedicine applications?

   Yes No

2. Are outcome measures related to health outcomes, process of care or resource utilization?

   Yes No

General systematic review characteristics:

1. Reference ID:
2. Surname of first author:
3. Year of publication:
4. Source publication:
5. Country where review was conducted: Unclear Not reported
6. What organization was involved in delivering the telelmedicine service? [This is to ensure that we include both the publishing and telemedicine organization if these are not the same]
7. Country of origin for remote asynchronous site: :
8. Country of origin for host (consulting) asynchronous site:
9. Funding source for study: Unclear
10. Sample size (number of patients enrolled in the study):

    Total Interventional group: Control group:

11. What was the comparison group for asynchronous telemedicine (if applicable)?

    Face to face Live telemedicne Other

12. What type of study design was used?
13. What was the objective: Poorly stated

Experimental	**Observational**	**Other Studies**	
RCT	Case Series	Qualitative	Prospective
CCTs	Cohort	Mixed methods	Retrospective
	Case Control		Can’t tell

QUALITY ASSESSMENT TOOLS (see Appendix 4)

Population Information

1. Age of patient population? (From inclusion criteria or results section):

   Child Adult (>18 y.o) Exclusively senior (>65 y.o) All
   Unclear/Not reported

2. What level of acuity of medical care was being delivered?

   Preventive care Acute Chronic Long term Can't tell

3. Clinical specialty:

4. Disease profile (e.g. asthma, diabetes, hypertension other):

5. Setting of remote (requesting) asynchronous telemedicine site as defined by author: Rural
   Urban

6. Location of transmission for remote (requesting) asynchronous telemedicine site??

   Patient home Physician office Hospital setting Nursing home Other

7. What type of health providers were involved in delivering the service? (Please indicate all provider types mentioned in the direct delivery of care):

   Family physician Nurse Medical consultant Community member Patient

8. Comparison group (if any): Face to face Live telemedicine Other

   None

Type Of Intervention

1. What was the specific purpose of the intervention? (Choose all that apply)

   Diagnostic Therapeutic Educational/non-acute Follow-up Rehabilitation
   Other_____

2. Was other data (e.g. history, lab results, past pertinent information) available to the consultant in a 'standard' pre-formatted package?
   Yes [available and standardized] No [Available but non-standardised]
   Unavailable Can't tell

3. Were there remote monitoring devices to record and transmit physiological parameters?

   Yes (specify below) No

   WeightBP Glucose ECG Oxygen saturation/spirometer

   Digital camera Other

4. What type of connection was being used to transmit the asynchronous interaction/data?

   Mobile Dial-up Broadband Satellite Other Unknown

5. What platform was being used for the asynchronous interaction?

   Proprietary software Open-source TCP/IP

6. Other comments about intervention:

Outcomes

7. What outcomes were measured?

   Health (clinical) outcomes (e.g. control of disease, medication compliance, improved diagnosis)

   Process of care (e.g. wait times, increased access,

   Resource utilization (e.g. cost effectiveness)

   Patient satisfaction

8. How were the outcomes measured? (check all that apply)

   Health Type of instrument:
   Resource utilization Type of instrument:
   Process of care Type of instrument:
   Patient satisfaction Type of instrument:

9. What were the outcomes (if meta-analysis)? N/A

Outcome	Control group	Intervention group	Statistical significance

10. Observational outcomes (please describe if not clearly measured):

11. What are the conclusions (as documented in the full text of the article--in the words of the authors)?

General comments on article/conclusions

Internal Quality Assessment Of The Study

Should we follow up this article any further (e..g with deficiencies that need clarification or references that ma be useful)? *Yes* *No*

APPENDIX 4: QUALITY ASSESSMENT TOOLS

A. **RCT** : Jadad Scale

Was the trial described as 'randomized' in the text of the study? (Yes=1, No=0) Yes No

Was the randomisation sequence generated described and appropriate? (Yes=1, No=0)

Yes No

Was the study described as double-blinded? (Yes=1, No=0) Yes No

Was the method of double-blinding described and appropriate? (Yes=1, No=0) YesNo

Were the withdrawals documented and detailed? (The number of withdrawals and dropouts in each group and the reasons must be stated in the report. Yes=1, No=0)
Yes No

Total score:

B. **Non-randomized control trials and observational studies:** Downs and Black Checklist

Reporting

1. *Is the hypothesis/aim/objective of the study clearly described?*
Yes *No*

2. *Are the main outcomes to be measured clearly described in the Introduction or Methods section?*
If the main outcomes are first mentioned in the Results section, the question should be answered no.
Yes *No*

3. *Are the characteristics of the patients included in the study clearly described ?*
In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case-control studies, a case-definition and the source for controls should be given.
Yes *No*

4. *Are the interventions of interest clearly described?*
Treatments and placebo (where relevant) that are to be compared should be clearly described.
Yes *No*

5. *Are the distributions of principal confounders in each group of subjects to be compared clearly described?*
A list of principal confounders is provided.

Yes *Partially* *No*

6. *Are the main findings of the study clearly described?*
Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions. (This question does not cover statistical tests which are considered below).
Yes *No*

7. *Does the study provide estimates of the random variability in the data for the main outcomes?*
In non normally distributed data the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that he estimates used were appropriate and the question should be answered yes.
Yes *No*

8. *Have all important adverse events that may be a consequence of the intervention been reported?*
This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided).
Yes *No*

9. *Have the characteristics of patients lost to follow-up been described?*
This should be answered yes where there were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no where a study does not report the number of patients lost to follow-up.
Yes *No*

10. *Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the mainoutcomes except where the probability value is less than 0.001?*
Yes *No*

External validity

All the following criteria attempt to address the representativeness of the findings of the study and whether they may be generalised to the population from which the study subjects were derived.

11. *Were the subjects asked to participate in the study representative of the entire population from which they were recruited?*
The study must identify the source population for patients and describe how the patients were selected. Patients would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant population exists. Where a study does not report the proportion of the source population from which the patients are derived, the question should be answered as unable to determine.

Yes *No* *Unable to determine*

12. *Were those subjects who were prepared to participate representative of the entire population from which they were recruited?*
The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.
Yes *No* *Unable to determine*

13. *Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?*
For the question to be answered yes the study should demonstrate that the intervention was representative of that in use in the source population. The question should be answered no if, for example, the intervention was undertaken in a specialist centre representative of the hospitals most of the source population would attend.
Yes *No* *Unable to determine*

Internal validity - bias

14. *Was an attempt made to blind study subjects to the intervention they have received ?*
For studies where the patients would have no way of knowing which intervention they received, this should be answered yes.
Yes *No* *Unable to determine*

15. *Was an attempt made to blind those measuring the main outcomes of the intervention?*
Yes *No* *Unable to determine*

16. *If any of the results of the study were based on "data dredging", was this made clear?*
Any analyses that had not been planned at the outset of the study should be clearly indicated. If no retrospective unplanned subgroup analyses were reported, then answer yes.
Yes *No* *Unable to determine*

17. *In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls?*
Where follow-up was the same for all study patients the answer should yes. If different lengths of follow-up were adjusted for by, for example, survival analysis the answer should be yes. Studies where differences in follow-up are ignored should be answered no.
Yes *No* *Unable to determine*

18. *Were the statistical tests used to assess the main outcomes appropriate?*
The statistical techniques used must be appropriate to the data. For example nonparametric methods should be used for small sample sizes. Where little statistical

analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.
Yes No Unable to determine

19. *Was compliance with the intervention/s reliable?*
Where there was non compliance with the allocated treatment or where there was contamination of one group, the question should be answered no. For studies where the effect of any misclassification was likely to bias any association to the null, the question should be answered yes.
Yes No Unable to determine

20. *Were the main outcome measures used accurate (valid and reliable)?*
For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.
Yes No Unable to determine

Internal validity - confounding (selection bias)
21. *Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?*
For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case-control studies where there is no information concerning the source of patients included in the study.
Yes No Unable to determine

22. *Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?*
For a study which does not specify the time period over which patients were recruited, the question should be answered as unable to determine.
Yes No Unable to determine

23. *Were study subjects randomized to intervention groups?*
Studies which state that subjects were randomized should be answered yes except where method of randomisation would not ensure random allocation. For example alternate allocation would score no because it is predictable.
Yes No Unable to determine

24. *Was the randomized intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable?*
All non-randomized studies should be answered no. If assignment was concealed from patients but not from staff, it should be answered no.
Yes No Unable to determine

25. *Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?*
This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In nonrandomized studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.
Yes *No* *Unable to determine*

26. *Were losses of patients to follow-up taken into account?*
If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.
Yes *No* *Unable to determine*

Power

27. *Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%?* Sample sizes have been calculated to detect a difference of x% and y%.

Was this stated clearly by the author in the study? Yes No

APPENDIX 5: GENERAL CHARACTERISTICS OF STUDIES FOR RADIOLOGY AND PATHOLOGY (ASYNCHRONOUS TELEHEALTH)

Author	Year of publication	Source of publication	Country	Funding source	Type of study	Quality score (DB)
Desai [45]	2004	Indian Journal of Pathology and Microbiology	India	Not reported	Case series	16
Dunn [47]	1997	Telemedicine Journal	USA	Not reported	Case series	12
Dunn [46]	1999	Telemedicine Journal	USA	Hybrid open system technology program of Department of veterans affair	Case series	17
Gomez [51]	2001	Computer Methods & Programs in Biomedicine	Spain	EU Advanced Communication Technologies and Services	Case series	4
Hussain [52]	1999	Journal of Telemedicine & Telecare	UK	Not reported-- (British Telecom for support)	Case series	10
Johnson [53]	1998	Telemedicine Journal	Canada	Not reported	Cohort (prospective)	16
Lanschuetzer [48]	2004	Journal of Telemedicine & Telecare	Austria	Not reported	Case series	10
Lewis [54]	2005	Journal of Telemedicine and Telecare	Australia	Not reported	Survey	12
Marcelo [49]	2000	Archives of pathology & laboratory medicine	USA	Not reported	RCT	5(JS)
Settakorn [50]	2002	Telemedicine Journal & E-Health	Thailand	Nara Medical University Scholarship	Cohort (prospective)	12

RCT=Randomized control trial
JS=Jadad scale
DB=Downs and Black checklist

APPENDIX 6: COMPONENTS AND OUTCOMES OF STUDIES FOR RADIOLOGY AND PATHOLOGY

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
Desai 2004[11]	102 teleconsultations between a tertiary cancer centre and a rural area	Digital images captured and sent by email via POTS	Pathology	Diagnostic	H	P			Diagnosis offered in 99 (99%) cases; deferred in only I (1%). Clinically important or relevant diagnosis achieved in 93/ 99 (93.93%) of cases. Major discrepancies were encountered in 6/99 (6.06%) of cases. A total of 79% of cases were reported within 3 days, of which 32% were reported within 8 hours (a single working day) and 47% within 1-3 days.
Dunn 1999[46]	2000 consecutive surgical pathology cases	Hybrid store and forward system with video microscopy and video conferencing transmitted over ISDN	Pathology	Diagnostic			R		2134 of 2200 consecutive case diagnoses (97.0%) rendered at same level of diagnostic accuracy and in the same turnaround time. 3.0% of cases final diagnosis was inaccurate (0.3% of cases) or were turnaround times prolonged (2.7% of cases)
Dunn 1997[47]	200 cases in total assessed by 2 pathologists	Digital microscope with transmission over ISDN	Pathology	Diagnostic	H	P			Clinically important and overall concordance were 99.0% and 97.4%, respectively by telepathology Examining glass slides by HDSF telepathology took an average of 4.43 minutes per slide and 12.09 minutes per case.
Lanschuetzer 2004[48]	17 patients with images of skin conditions	Digital microscopic images of skin lesions sent via email	Pathology	Diagnostic					Agreement on diagnoses made by the local and both remote centres by physicians experienced in 14 of 17 cases (82%).
Marcelo 2000[49]	10 pathologists examined 10 cases (biopsy samples) each for a total of 100 samples	Digital image capture with compression served on the World Wide Web	Pathology	Diagnostic				S	No statistically significant difference in diagnostic accuracy between non-compressed (bit map) and compressed (JPEG) images. No differences in acceptability, confidence level, and perception of image quality.

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
Settakorn 2002[50]	39 biopsies presented as 100 individual cases comparing telepathology vs. microscopy	Digital image capture with microscope and submission by email	Pathology	Diagnostic		P			Average total turnaround time spent on each case was 215 minutes (less than required by conventional post); 2 clinically significant errors.
Gomez 2001[51]	Not specified	Presents the experience on exploiting the possibilities offered by broadband and multimedia technologies in teleradiology and co-operative diagnosis.	Radiology	Digital imaging (including DICOM, workstation and VC) transmitted over ATM broadband		P		S	The average time of system usage during the collaborative sessions was 60 min, with an average number of 5 patient cases per session. The system learnability time was quite short (2 h). Most users (75%) rated the system pleasurable to use.
Hussain 1999[52]	64 patients undergoing ultrasound scan by GP	Ultrasound images transmitted over ISDN	Radiology	Diagnostic	H			S	85% of images were diagnostic while other 15% were considered non-diagnostic. Early results showed acceptance by GPs and allowed access to experts.
Johnson 1998[53]	146 patients requiring ultrasound evaluation in rural community	Ultrasound linked to teleradiology system	Radiology	Diagnostic	H		R		Teleultrasound made transfer unnecessary in 42% and results of ultrasound assessment influenced management in 59%; Second-look scanning by the on-site radiologist or videoconferencing by the remote radiologist provided a major new diagnosis in only 1% of patients.
Lewis 2005[54]	Survey responses from physicians and sonographers in 22/27 centres in Queensland	Not reported	Radiology	Diagnostic				S	Strong preference (70%) for store-and-forward transmission of static images; 19% preferred real time transmission and 11% preferred store-and-forward transmission of video clips.

ISDN=Integrated services digital network
POTS=Plain old telephone system
DICOM=Diagnostic imaging and communications system
ATM=Asynchronous transfer mode
JPG=Joint Photographic Experts Group
VC=Videoconference/video teleconference
SF=Store and forward
S=Patient/provider satisfaction
P=Process of care
H=Health outcomes
R=Resource utilization

APPENDIX 7: GENERAL CHARACTERISTICS FOR STUDIES INCLUDED IN REVIEW (ASYNCHRONOUS TELEHEALTH)

Author	Year of publication	Source of publication	Country	Funding source	Type of study	Quality score (DB)
Abboud [62]	2005	Clinical Orthopaedics & Related Research	USA	Not reported	Case series	19
Archbold [79]	2005	Injury	UK-Ireland	Vodaphone	Case series	16
Baba [99]	2005	Journal of Telemedicine & Telecare	Turkey	Not reported	Case series	18
Barnard [63]	2000	Telemedicine Journal & E-Health	USA	Not reported	Case series	15
Baruffaldi [91]	2002	Journal of Telemedicine & Telecare	Italy	Not reported	Case series	10
Beach [80]	2000	Journal of Telemedicine & Telecare	UK	NHS Executive, (telemedicine equipment loaned by ADV Communications and software by Telemarque Ltd	Case series	6
Brandling-Bennett [64]	2005	Telemedicine Journal & E-Health	USA	Not reported	Case series (retrospective)	13
Callahan [65]	2005	Archives of Pediatrics & Adolescent Medicine	USA	US Army Medical Research Acquisition	Case series	12
Chan [66]	2003	American journal of Health-Syst Pharm	USA	US Army research acquisition activity	Case series	17
Chen [98]	2004	Journal of Telemedicine & Telecare	Taiwan	Not reported	Case series	14
Collins [83]	2004	Journal of Telemedicine & Telecare	UK	NHS R&D Health Technology Assessment Programme	Survey	15
Collins [82]	2004	Journal of Telemedicine & Telecare	UK	UK NHS R&D Health Technology Assessment Programme	Survey	17
Collins [81]	2000	Journal of Telemedicine & Telecare	UK	NHS R&D Health Technology Assessment Programme	Survey	12
Eminovic[94]	2003	Journal of Telemedicine & Telecare	The Netherlands	KYOS Research foundation (non-profit organization based at the dermatology	Cohort (prospective)	19

Author	Year of publication	Source of publication	Country	Funding source	Type of study	Quality score (DB)
				department of the AMC)		
Fortin [96]	2003	Journal of Telemedicine & Telecare	Canada	Health Canada Transition Fund	Case series and semi-structured interview	13
Gomez [61]	1996	Telemedicine Journal	USA	Not reported	Cohort (retrospective)	10
Heautot[56]	1999	Medical Informatics & the Internet in Medicine	France	Ministry of Industry, the Region of Brittany	Case series	8
Helveston [67]	2001	Journal of American Association for Pediatric Ophthalmology & Strabismus	USA	Equipment sponsored by Education and Research Foundation for Children's Eyes, Indianapolis, Indiana, and Clody and Riley's "One-Eyed Golf."	Case series (before and after)	8
Hersh [68]	2002	AMIA Annual Symposium Proceedings	USA	Eugene Garfield Foundation, OHSU Hospital, OHSU Medical Group, and Asante Health System	Survey	12
Hockey [102]	2004	Journal of Telemedicine & Telecare	Australia	Commonwealth Department of Health and Ageing (Medical Specialist Outreach Assistance Programme)	Case series	11
Klaz [100]	2005	Israel Medical Association Journal	Israel	Israel Defense Forces Medical Corps.	Multicenter uncontrolled cohort (prospective)	18
Knol [95]	2006	Journal of Telemedicine and Telecare	The Netherlands	Not reported	Cohort (prospective)	13
Kokesh [69]	2004	International Journal of Circumpolar Health	USA	Not reported	Case series (descriptive)	2
Krupinski [57]	1999	Telemedicine Journal	USA	US Department of Agriculture Rural Utilities Service Distance Learning, U.S Department of Commerce, National telecommunications and	Case series	12

Author	Year of publication	Source of publication	Country	Funding source	Type of study	Quality score (DB)
				Information Administration, Office of Rural Health Policy, Department of Health and Human Services Rural		
Krupinski[70]	2004	Journal of Telemedicine & Telecare	USA	Not reported	Cohort (retrospective)	12
Larcher [92]	2003	Medical Informatics & the Internet in Medicine	Italy	Public Health Institute of the Government of Italy	Survey	13
Lau [71]	2002	IEEE Transactions on Biomedical Engineering	USA	Not reported	Case series (descriptive)	9
Loane [84]	2000	Journal of Telemedicine & Telecare	UK	NHS R&D	RCT	2(JS)
Mahendran[85]	2005	Clinical &Experimental Dermatology	UK	Not reported	Case series	13
Malacarne[93]	2004	Telemedicine Journal & E-Health	Italy	Not reported	Case series	11
Mallett[86]	2003	Clinical & Experimental Dermatology Clinical and experimental dermatology	UK	Not reported	Case series	6
Malone[72]	2004	Telemedicine Journal & E-Health	USA	Pacific Telehealth and Technology Hui and Medical Health care facilities	Case series	12
Mandall [87]	2005	British Dental Journal	UK	Not clearly stated	RCT	3(JS)
Massone[103]	2006	Journal of Telemedicine and Telecare	Austria	Not reported	Case series (descriptive)	7
McConnochie [73]	2005	Pediatrics	USA	US Department of Commerce Technology Opportunities Program, Robert Wood Johnson Foundation Local Initiative Funding	Case series (before and after)	15
Moreno-Ramirez [101]	2006	Clinical & Experimental Dermatology	Spain	'Instituto Carlos III' of the Spanish Health Ministry	Case series	14
Mukundan[74]	2003	Acad Radiol Academic Radiology	USA	Swifen Charitable Trust, Cantebury, England Not reported	Case series	11
Pak [60]	1999	Studies in Health Technology and Information	USA	Walter Reed Army Medical Cente	Cohort (retrospective)	10

Author	Year of publication	Source of publication	Country	Funding source	Type of study	Quality score (DB)
Pap[75]	2002	Plastic & Reconstructive Surgery	USA	Not reported	Case series	11
Patterson [88]	2001	Journal of Telemedicine & Telecare	UK	Not reported	Case series	12
Person [76]	2003	Telemedicine Journal & E-Health	USA	THE PACIFIC ISLAND HEALTH CARE PROJECT (PIHCP)	Case reports	6
Person[77]	2000	Pacific Health Dialog	USA	Not reported	Case series	6
Rodas [117]	2005	Journal of Telemedicine & Telecare	Ecuador	NASA and Instituto de Investigacionesde la Universidad de Cuenca (IDIUC).	Case series	11
Sibson [58]	1999	Medical Informatics & the Internet in Medicine	UK	NHS Research and Development Waiting List Taskforce fund.	Case series and survey	15
Taylor [89]	2001	British Journal of Dermatology	UK	Not reported	Case series	17
Vassallo [90]	2001	Journal of Telemedicine & Telecare	UK	The Swinfen Charitable Trust (SCT)	Case series	12
Vladzymyrskyy [97]	2005	Journal of Telemedicine & Telecare	Ukraine	Not reported	Case series	8
Weinstock [38]	2002	Journal of the American Academy of Dermatology	USA	Cooperative Studies Program, Office of Research and Development, Department of Veterans Affairs	Survey	14
White[59]	1999	Journal of Telemedicine & Telecare	UK	Not reported	Case series	7
Whited[78]	2002	Telemedicine Journal and e-Health	USA	VA Health Services Research and Development Service.	RCT	2(JS)
Williams [31]	2001	Journal of Telemedicine & Telecare	UK	Not reported	Survey	10
Zelickson [55]	1997	Archives of Dermatology	USA	Not reported	Case series	13

DB=Downs and Black
JS=Jadad Scale

APPENDIX 8: COMPONENTS AND OUTCOMES OF STUDIES INCLUDED IN REVIEW (ASYNCHRONOUS TELEHEALTH)

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
Abboud 2005[62]	100 patients age range 8–79 years with disorders of upper extremity	Use of electronic history and digital image capture of radiological films and affected extremity with consumer quality camera and storage on PC	Orthopaedic	Diagnostic	H				5.0% intra-observer differences and 5.5% inter-observer in diagnoses or treatment when comparing the face-to-face and electronic evaluations (none life/limb threatening). Established intra-observer agreement of diagnosis and treatment plan (kappa=0.92 and 0.90, respectively) and inter-observer agreement of diagnosis and treatment plan (kappa=0.86 and 0.90, respectively)
Archbold 2005[79]	46 consecutive trauma consultations age range 4 to 90 years	Multi-media cell phone to capture images (mobile platform) including plain films and wound	Orthopaedic	Diagnostic	H		R	S	8 of 46 consults felt to have changed the initial management and 10 referrals avoided forwarding plain films by taxi (cost savings), patient care improved in 34 out of the 46 cases (trauma surgeon) and 36 out of 46 cases (emergency physician). Ease of use acceptable 70% of the time.
Baba 2005[99]	242 skin lesions on 228 patients age range 2-82	PC based Web camera videoconferencing compared with electronic transfer of history and images obtained with digital camera	Dermatology	Diagnostic	H			S	Conventional SF method diagnostic accuracy of 2 teledermatologist was 81% and 75% but with combined method, the corresponding values were 90% and 82% (P<0.001 for both). No significant difference in inter-observer agreement Use of Web camera videoconferencing improved

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									patient satisfaction with teledermatology. 85% of subjects would accept teledermatology in the future, of which, 82% thought that teleconsultation should include videoconferencing with Web cameras.
Barnard 2000[63]	8 teledermatologists evaluated 50 cases submitted by other dermatologists with various skin conditions	Digital images of lesions taken with camera followed by brief electronic history	Dermatology	Diagnostic	H				Diagnostic accuracy for skin cancers was 88% versus 90% (range, 75–100%) for the in person and teleconsultants, respectively. For all confirmed cases the accuracy was 84% (in-person) compared to 73% (range, 65–88%). Teleconsultants changed their primary diagnosis in 11% of cases (range, 2–22%). Biopsy rates were not significantly different between teleconsultants (45%) and in-person dermatologists (40%).
Baruffaldi 2002[91]	65 teleconsultations for second opinion on work-related injuries	Real-time VC (PC with document camera) or asynchronous with transfer of files across ISDN	Orthopaedic	Diagnostic		P			Average time spent was slightly longer in videoconferences (21 min, SD 8) than in asynchronous teleconsultations (19 min, SD 8). The clinicians' confidence in diagnosis was lower in asynchronous consultations. Clinical complexity of the case and the organizational requirements were declared to be the main factors affecting the choice of consulting procedure. Asynchronous method was preferred in the majority of cases although some concerns about the diagnostic quality of the

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									information transmitted.
Beach 2000[80]	71 patients entering minor injury units	Low cost VC and asynchronous telemedicine transmitted over ISDN (no detail data provided)	Orthopaedic	Diagnostic			R		Data obtained in some cases avoided transfer or referral. Some changes in diagnosis and treatment for remote physician (no detail data provided)
Brandling-Bennett 2005[63]	264 general clinic visits on 214 patients (age range 3 months to 80 years) in rural Cambodia.	Electronic history and digital images sent by email via satellite connection	Multiple	Diagnostic				S	All patients surveyed either "very satisfied" (46%) or "satisfied" (54%) with their care, and most patients were willing to pay for a visit, with a median amount of USD 0.63.
Callahan 2005	267 paediatric consultations from 16 different sites mean age 5+/-5 years	Web-based, store and forward, asynchronous, provider-provider teleconsultation with image capture device (digital camera, scanner, and video camera)	Paediatrics	Diagnostic	H	P	R		Mean ± SD response time by a consultant was 32 ± 14 hours. Initial diagnosis was changed or modified in 15% (39/267) of cases, the diagnostic plan was changed or modified in 21% (57/267), and the treatment plan was changed or modified in 24% (64/267) (P .01 for all). Routine air evacuations were avoided in 32 cases (12%).
Chan 2003 [66]	10 children (age range 6-17 years) with asthma submitting 321 videos of inhaler use and 309 peak flow meter videos undergoing virtual versus office based education	Home-based computer and video camera with Internet access	Paediatrics (asthma)	Therapeutic	H			S	Inhaler technique scores improved significantly (87% in periodd1) compared with period2 (94%). Less controller medication period 1, mean+/-SD (0.8+/-0.6), compared with 0.5+/-0.3. Peak flow values increased significantly. Overall, no change in quality of life but caregivers in virtual-education group reported increase in patients' quality-of-life survey scores. Emergency department visits and hospital admissions were avoided. High rate of satisfaction

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									with home telemonitoring
Chen 2004[98]	113 patients (mean age 53 years) screening for ocular disorders in Tungyin, China	Digital ophthalmoscopy with image capture and transmission over ADSL	Ophthalmology	Diagnostic (screening)	H				Screening for retinopathy, the detection rate for digital imaging (8.8%) was two times higher than indirect ophthalmoscopy (4.4%). Community-based screening for four categories of eye disease successfully demonstrated.
Collins 2004 [82]	148 responses from 208 dermatology patients enrolled in RCT comparing traditional in-person care to teleconsultation	Asynchronous telemedicine (not specified)	Dermatology	Diagnostic				S	No statistical difference in satisfaction of care between 2 groups. 85% of teleconsultation group happy to use this system, 38% *prefer* to discuss their skin problem with dermatologist in person. 40% feel that something important was missing if they did not see the dermatologist in person. 76% would rather have their skin problem managed via telemedicine than have to wait.
Collins 2000[81]	26 responses from a total of 35 GPs who agreed to participate in RCT	Asynchronous telemedicine (not specified)	Dermatology	Diagnostic				S	(81%, n=21; 95% CI 55–91%) anticipated problems with implementing the system. 15%(n=4; 95%CI 5–36%) respondents said their expectations of teledermatology were high. One in four respondents (27%, n=7; 95% CI 9–45%) felt confident or very confident about teledermatology diagnosis and management of care
Collins 2004 [83]	36/42 GPs enrolled in an RCT responded to a before and after questionnaire	Asynchronous telemedicine (not specified)	Dermatology	Diagnostic				S	86% enthusiastic about teledermatology in contrast to 21% at end of study who felt all expectations had been met; 21% satisfied, 47% dissatisfied and 32% unsure; 31% confident in diagnosis

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									and management, 28% unconfident and 41% unsure; high expectations pre-trial were more likely to be satisfied (Kendall's tau-b=0.51, p=0.023); 12/26 felt positive about improved access; 11/33 felt referral process complex while 18/33 reported increased workload
Eminovic 2003[96]	96 of 105 patients recruited (age range 4 months to 72 years) various skin lesions	Submission of electronic form and 4 digital images taken by patient	Dermatology	Diagnostic	H		R		71% of cases further investigation proposed. 58% of cases needed (less frequent) in person consultation. 23% of patients no kind of hospital visit required.
Fortin 2003[96]	118 transmissions involving 101 patients in Quebec various clinical domains	Store and forward imaging along with videoconferencing for other areas	Multiple	Diagnostic (19 patients received follow-up)	H		R	S	8 emergency transfers avoided and 15 patients requiring elective transfer were managed locally. 3 unanticipated transfers carried out 13/15 patients satisfied while 25 health professionals interviewed and 'majority' perceived as beneficial
Gomez 1996 [61]	240 consults from 12 remote telemedicine sites across multiple clinical domains	Various digital image capture devices and transmission via satellite or commercial telephone lines	Multiple	Diagnostic		P			Most consults were routine (88%); 94% of consults were completed within the predefined telemedicine response criteria (24 hours for routine consults and 3 hours for emergencies).
Heautot 1999 [56]	Patients presenting for emergency neurosurgical consults at distant hospital. 3 phases (I)-11 patients (no asynchronous), (II)-51cases (image transfer ISDN) and (III)-unknown	Proprietary software and DICOM to submit radiological images over ISDN/ATM	Neurosurgery	Diagnostic	H		R	S	Phase I-10/11 patients transferred 4 could have been avoided with images, Phase II 34/48 (71%) actual patient transfers with 8/48 transfers avoided, Phase III-62% transferred with image helpful in 50% of cases Up to 50 % unnecessary patient transfers avoided. non-urgent advice requests increased from 0 to 21 %.

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									ATM network, the service gave satisfaction to all the physicians.
Helveston 2001[67]	Total of 50 patients with strabismus in various countries with 30 in Cuba	Digital image with PC storage on disk and transmission as attachment to email	Ophthalmology	Diagnostic			R		The transmission of text and images by e-mail was trouble-free, and communication in English was effective. The store-and-forward technique is a relatively simple, inexpensive, and versatile method of telemedicine.
Hersh 2002[68]	31 clinicians in Oregon given access to a system to pose clinical questions	Web-based asynchronous application	Non-specific	Support (physician)				S	Clinicians displayed modest but enthusiastic use
Hockey 2004[102]	15 GPs in Australia submitting 63 email consultation requests where no dermatologist access was available locally	Submission via email of electronic copy of history and digital image using consumer based camera	Dermatology	Diagnostic	H	P			Majority (53/63) of cases management plan developed based on email; 10 cases (16%) additional images or biopsy results requested (image quality inadequate) Average time between receiving referral and clinical advice being provided was 46 hours. GPs made more referrals the longer they stayed in study.
Klaz 2005[100]	18 physicians in military units recruiting 435 patients (age range 18-39 years) from rural and urban centres with non-pigmented skin lesions. No comparison group.	Digital images uploaded from camera and sent along with electronic questionnaire via email	Dermatology	Diagnostic		P	R	S	Tele-diagnosis possible for 95% of 435. 22% of referrals required face-to-face consultation. Satisfaction high/very high among 89% patients in rural and urban clinics-significantly higher in rural units. Average wait time 50% less than face-to-face appointment. 87% PCPs were satisfied with the quality of the service and its contribution to their knowledge. Rural physicians rated level of service and overall satisfaction higher.
Knol	505 consultations in 503	Electronic form and	Dermatology	Diagnostic	H	P	R		No difference between initial

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
2006 [95]	patients (age range 0-96 years) with skin lesions. Face-to-face comparison only for those requiring follow-up.	digital image transmission by email							diagnosis and face-to-face in those requiring further follow-up. 163 patients were not referred because of teledermatology--a reduction of 53% (163/306); 17% of cases required traditional consultation when none was intended by GP
Kokesh 2004 [69]	91 patients provided store and forward services from rural communities with ear, nose and throat conditions	Video-otoscopy, digital surgical microscopy and other digital image capture devices for otolaryngology (details unspecified)	Otolaryngology	Diagnostic and Therapeutic		P	R		Analysis of the first 91 store-and-forward cases reimbursed by Medicaid revealed significant. Of 91 cases, 79 saved transport for the patient and escort at an average cost of $307.57/person round-trip. For every $1 spent on reimbursement for telemedicine, almost $8 of travel cost was avoided. Wait times from 4-15months were reduced "significantly"
Krupinski 2004[70]	Comparison of 50 teledermatology patients to convenience sample of 50 assessed face to face for skin lesions	Digital image captured with camera and uploaded to proprietary software	Dermatology	Diagnostic			R		In-person group had fewer records about actions taken as a result of the consultation (e.g. performed a biopsy, prescribed a medication)--12% of the in-person records compared with 43% in teledermatology (z = 3.14, P<0.01). Both groups had similar follow-up rate with 8% vs. 10% (z=.094, p>0.05).
Krupinski 1999[57]	Unknown sample size. Based on review of program workload of 35 cases/month across 39 subspecialties	Multiple types of data/image capture and transfer to proprietary software via ATM	Multiple	Diagnostic		P			Majority of store-and-forward cases (67%) have a total turn-around time of <72 hours (mean 93.01h, SD142.43) compared with real-time cases (72%) with a total turnaround time of .>72 hours. (mean=242.71h, SD271.63). SS:

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									(t=8.051, df=498, p=0.0001). Main difference occurred in time from notification of consultant until consultation (RT-mean=175.05h vs. SF-36.62h) SS: (t=8.52, df=498, p=0.0001)
Larcher 2003[92]	Two questionnaires with responses of 33/35 and 22/38 physicians before and after performing 98 asynchronous teleconsultations with cancer patients	Web-based telehealth (no details provided)	Oncology	Diagnostic /Therapeutic /Support				S	Both modalities of teleconsultation useful in enhancing communication with colleagues (86% synchronous, 80% asynchronous). Major difficulties encountered were in the introduction of the system into the daily routine. user satisfaction:78% of sessions set goal was reached
Lau 2002[71]	6 patients (average age 59 years) followed post-operatively after shoulder surgery	Web-based messaging system to send multimedia information and implement web-forms	Orthopaedic	Rehabilitative/ Follow-up (post-operatively)				S	User satisfaction between neutral and satisfied with overall mean rating 3.4 out of 5 (SD=0.85)
Loane 2000[84]	204 patients (age range 4 months to 89 years) randomized into 2 groups of 102 patients each with various skin lesions	Real-time teledermatology (VC across ISDN) compared with still images from instant camera sent by post and face to face intervention	Dermatology	Diagnostic	H		R		46% real-time teledermatology required at least one other hospital appointment compared with 45% of conventional outpatients and 69% of store-and-forward. Store-and-forward consultation was less expensive (€22.11 vs. €61.03)but clinical usefulness was limited. With sensitivity analysis real-time teledermatology as economical as conventional care when less artificial assumptions applied.
Mahendran 2005[85]	163 patients presenting with one dermatological lesion compared with FTF	Electronic history and image capture with digital camera transmitted via email	Dermatology	Diagnostic	H		R		Management plan appropriate in 55% of consultants teledermatology cases (22% could have avoided face-to-face and 33% sent directly to minor surgery).

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									45% could not be managed by SF
Malacarne 2004[93]	25 consecutive patients across 9 different specialty areas transmitted between Africa and Italy	Multiple types of data capture (patient history, ECG, radiology etc.) with transmission over ISDN	Multiple	Diagnostic			R		In 60% of cases, just one consultation was sufficient. Choosing the right specialist was the most critical phase of the operation.
Mallett 2003[86]	727 images on 325 referrals (age range 4 months-94 years) with variety of skin lesions. Face-to-face comparison.	Digital image capture with camera and transmission via email over ISDN	Dermatology	Diagnostic	H		R		95% concordance with teledermatology. An 'advice only' service was requested and given for only 26 patients (8%) while 256 patients required outpatient visit. (i.e. majority of patients still need to be seen in the outpatient clinic). Teledermatology unlikely to have significant impact on patient workload or solve waiting list problems
Malone 2004[72]	7 patients (mean age 11.9 +/-3.7 years) with asthma	Web-based asthma pathway with MPEG video and spirometry	Paediatrics (asthma)	Therapeutic Support	H		R		Fewer ED visits for asthma (3.85+/-5.14, range 0–15 vs. 0 visits, $p<0.05$) ; Fewer unscheduled acute clinic visits (1.57+/-1.27, range 0–4 vs. 0.286+/-0.48, $p<0.05$) in study year versus preceding year. 2 hospitalizations in year prior to and no patients hospitalized during the study; provider use of asthma action plan increased from 24% to 73% ($p<0.01$) and provision of asthma education increased from 18% to 73%, ($p<0.01$). Providers not more likely to order spirometry (12% vs. 18%)
Mandall 2005[87]	2 groups with 80 patients (mean age 13.1 years) for intervention and 247 controls (mean age 13.8	Electronic history and digital images taken with camera and sent via email	Dentistry	Screening	H			S	Sensitivity=0.80, and specificity=0.73 suggesting good screening test. However, low negative predictive value at 0.50.

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
	years) for orthodontic screening								No difference between attendance for first appointment. 131/200 providers responded to survey and 70% felt teledentistry good idea.
Massone 2006[103]	Physician request for 783 requests for consultations with 285 for pigmented lesions and 440 non-specific and 58 non-melanoma skin cancer	Website allowing uploading of 3 digital images and form for patient clinical data	Dermatology	Diagnostic		P			Of a total 133 requests analysed, 80 (60%) were answered within one day, 47 (35%) within one week, five (4%) within two weeks and one (1%) consultation was answered in more than two weeks.
McConnochie 2005[73]	5 inner city child care centers with avg. 138 children/centre presenting with acute illness	Computer with teleconferencing camera, digital camera and electronic stethoscope submitted by broadband	Paediatrics (acute illness)	Diagnostic and treatment	H		R		Absence due to illness (ADI) was 4.07/100 child days with telemedicine compared with 8.78/100 child-days without. 63% reduction in ADI due to telemedicine telemedicine intervention resulted in 7.0% exclusion from child care and in-person visits for 2.8%; Surveys of parents indicated 91.2% of telemedicine contacts allowed them to stay at work; 93.8% of problems managed by telemedicine would otherwise have led to an office or emergency department visit.
Moreno-Ramirez 2006[101]	63 patients with skin lesions enrolled with 61 cases evaluated. No comparison group.	Digital clinical images and dermatoscopic images taken and submitted via intranet	Dermatology	Diagnostic	H	P	R		Agreement with gold standard 0.91 (95% CI 0.82–1.00) for clinical teleconsultation and 0.94 (95% CI 0.88–1.00) for teledermatoscopy ($p > 0.05$). Teledermatoscopy increased economic investment of teledermatology facility by 2.4 times. GP spent 1.5 times longer on dermatoscopic teleconsultations.

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									Teledermatoscopy improved the teledermatology-based screening system for pigmented lesions.
Mukundan 2003[74]	8 patients from Solomon Islands referred by medical student for variety of conditions	Digital image capture of clinical lesions and patient data and submission via email	Multiple	Diagnostic		P			7/8 replies received <1d and 8/8 <3d; 50 additional referrals with >2/3 responded to <24h and 80% <3d
Pak 1999[60]	100 cases with skin lesions from referral sites including 8 primary care clinics and hospitals without dermatologists. No comparison group.	Digital image capture with camera and transmission over the Internet	Dermatology	Diagnostic		P	R	S	45% of patients avoided dermatologist visit resulting in 15-20% decline in workload; 17% required follow-up with dermatologist. Most patients felt teledermatology met their healthcare needs; 27% of follow-up cases required in person visit and 73% could be followed telephonically. Consultants took 7.7 minutes (teleconsult) vs. 20 minutes (in-person) with 70% comfortable with the diagnostic impression. Patient satisfaction during follow-up much lower due to wait for real-time appointment or lack of follow-up from primary care physician.
Pap 2002[75]	20 patients evaluated at random referred to plastic surgery service	Digital image capture of clinical lesion and radiographs with camera and transmission via email	Plastic surgery	Diagnostic		P		S	e-mail generated <10 minutes and received by attending physician <5 minutes; attending physicians reported thorough satisfaction with picture quality, the speed of transmission, and screen resolution.
Patterson 2001[88]	12 patients (age range 15–57 years) with various neurological conditions	Digital image capture with camera and transmission via email	Neurology	Diagnostic	H		R		8 cases considered complicated by the neurologist (preferred video-link consultation); advice beneficial in 75% of complex and in all straightforward cases; 50%

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									patients had care changed from specialist advice and one patient transfer out of country was avoided.
Person 2000[77]	Over 200 patients with multiple conditions in first 6 months of program in Micronesia	Digital image capture with upload to Web-based system	Multiple	Diagnostic			R	S	Cost savings direct and long distance telephone charges; every patient treated at home represents savings $10-20k; "…acceptance by the referring and consulting physicians alike has been overwhelming"
Person 2003[76]	2 girls with traumatic injuries	Not specified	Orthopaedic	Therapeutic			R		2 cases illustrate cost savings and avoidance of transfer (no details provided)
Rodas 2005[117]	144 pre-operative and 50 post-operative patients in Cuenca	Real-time and SF using digital image capture and transmission via email over POTS	Pre and post operative assessment	Therapeutic	H	P			In 101 preoperative evaluations, agreement in 78 cases (77%); in 37 postoperative evaluations agreement in 36 cases (97%). "Telemedicine may reduce the time required on site for preoperative planning, and may provide reliable postoperative surveillance, improving the efficiency of mobile surgery services. "
Sibson 1999[58]	23 patients (age range 9-74 years) presenting with suspicious skin lesions	Digital image of clinical lesion and relevant history and submission via email (over ISDN) compared with face to face intervention	Dermatology	Diagnostic	H			S	75% of patient 'agreed' or 'strongly agreed' with remote expert opinion; 77 % (n=14) of respondents either `very comfort able' or `comfortable 'with having their lesion photographed. No respondent reported any concerns regarding the electronic transfer of their clinical information using telemedicine; 100 % clinician agreement between the diagnostic opinions from both plastic

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									surgeons from the virtual and real mole clinics.
Taylor 2001[89]	194 patients presenting with skin lesions	Video camera to record still images and electronic recording of patient data	Dermatology	Diagnostic	H	P	R		77% agreement between diagnoses of the dermatologists using the system to inspect images and face-to-face dermatologist; fewer urgent appointments (32% compared with 64%); 31% of cases patient did not need to be seen-15% of these cases (5% of the total), however, their diagnosis differed significantly from that of the consultant who saw the patient; 14% of patients conventionally assigned a non-urgent appointment would have been seen urgently.
Vassallo 2001[90]	27 patients across five different specialties	Digital camera to capture images and transfer via email	Multiple			P	R		Initial email replies were received <1d of referral in 70% of cases and <3d in 100%; consultation complete <3d in 14 cases (52%) and <3 weeks in 24 cases (89%); referral judged beneficial in 24 cases (89%); 4 patients (15% of the total) and their families were spared the considerable expense and unnecessary stress of traveling abroad for a second opinion
Vladzymyrskyy 2005[97]	210 patients across multiple clinical domains but most related to trauma (age range from one month to 85 years)	Telemedical workstation with computer, digital camera, Web camera, email and videoconferencing	Multiple	Diagnostic		P			Median interval between request for a teleconsultation and it being carried out was <1d; majority of cases required single adviser; 11% of cases, more >3 advisers were required; treatment suggested by consultant accepted in 88% of cases.
Weinstock 2002[97]	100 of 112 eligible patients with skin lesions	Store and forward (unspecified)	Dermatology	N/A				S	42% of patients thought program excellent/good and 37% fair; 75%

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
	and 19/22 primary care providers. No comparison group.								patients would recommend program; 87% reported teledermatologist was excellent/good--greatest concern was their lack of direct contact with their dermatologist 63% of providers rated clinic excellent/good and 21% as average; 74% rated usefulness of the program as excellent/good and would recommend the program to another provider; other concerns were wait time and follow-up--privacy concerns were not commonly mentioned.
White 1999[59]	40 patients with skin lesions referral info vs. referral info and images. No comparison group.	Digital image captured with camera and sent with electronic patient data using wide area network over ISDN	Dermatology	Diagnostic		P	R	S	Patients more accurately triaged in at least 50%of cases (with image) and 25%of patients did not require outpatient dermatological appointment. Dermatologists rated image quality at 7.5 on a 10-point scale.
Whited 2002[78]	275 patients with skin lesions with 135 randomized to intervention	Digital image capture with standardized history and electronic consult request compared with face to face	Dermatology	Diagnostic		P			Teledermatology arm reached a time to initial definitive intervention significantly sooner than did usual care (median 41 days versus 127 days, $p<0.0001$, log-rank test); 18.5% of patients in the teledermatology arm avoided need for clinic-based visit compared to zero patients in the usual care arm of the study ($p=0.001$, z-test). Teledermatology not cost-savings per patient ($34.60 vs. $21.40) but found to be cost-effective based on faster time to definitive treatment

Publication	Sample	Intervention	Clinical Domain	Level of care	Outcome category				Results
					H	P	R	S	
									with teledermatology.
Williams 2001[31]	141/195 patients with teledermatology appointments (age range 18–90 years)	Not specified	Dermatology	Diagnostic				S	93% reported they were happy with the teleconsultation; 86% reported that it was more convenient than going to the outpatient clinic. 40% agreed that they would feel more comfortable seeing the dermatologist in person while only 58% were comfortable with not speaking to the dermatologist about their skin condition; absence of interaction with dermatologist and delay in receiving management advice may contribute to somewhat low satisfaction rates.
Zelickson 1997[55]	29 nursing home residents with skin lesions compared with FTF	Video camera for image capture of lesion and still-image telephone	Dermatology	Diagnostic	H			S	88% of cases with the history and image given correct diagnoses; no incorrect diagnoses or treatment plans would have given rise to substantial morbidity; dermatologists comfortable in making diagnosis and treatment plan in all cases with both image and patient history.

H=Health outcomes
P=Process of care
R=Resource utilization
S=Patient and provider satisfaction