Teledermatology for Diagnosis and Management of Skin Conditions:
A Systematic Review of the Evidence

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EVIDENCE-BASED SYNTHESIS PROGRAM (ESP)

- Funded by Health Services Research and Development (HSR&D)
- Purpose: Timely, focused evidence reviews to support VA policy and practice and to set directions for future research
- Veteran and VA-system focused
- Products:
  - Evidence synthesis reports
  - Succinct briefs for managers and leadership

Web Site:
http://www.hsrdr.research.va.gov/publications/esp
OBJECTIVES

- Summarize evidence for diagnostic / management accuracy and concordance for teledermatology as compared to usual care

- Review data on clinical outcomes, costs and key implementation factors in teledermatology
TELEDERMATOLOGY

LIVE INTERACTIVE

STORE AND FORWARD

Univ of MN, Mercer Univ, US Military web sites
BACKGROUND

- Store and forward (SAF) more widely used in VA*
  - 44% (19/43) of responding VA dermatology chiefs use TD
  - Of those, 89% (17 of 19) use SAF
    - 1 live interactive (LI)
    - 1 both SAF and LI

- Despite implementation, info on diagnostic and management accuracy and concordance, cost-effectiveness, and impact on clinical management and patient outcomes are not well understood

*Informal survey of VA dermatology chiefs, December 2009
KEY QUESTIONS — DIAGNOSIS & MANAGEMENT

1. How does the **accuracy** and **concordance** of teledermatology compare to usual care (in-person dermatology) for the **diagnosis** of skin conditions?

2. How does the **accuracy** and **concordance** of teledermatology compare to usual care (in-person dermatology) for the **management** of skin conditions?
KEY QUESTIONS - OUTCOMES

- 3. How do **clinical outcomes** of teledermatology compare to usual care (in-person dermatology) for skin conditions?

- 4. How does the **cost** of teledermatology compare to usual care (in-person dermatology)?

- 5. What are the key structural and process elements associated with **successful implementation** of teledermatology and what are the barriers?
METHODS

- Topic nominated by Center for Chronic Disease Outcomes Research (CCDOR), Minneapolis VAMC
- Key questions developed with TEP
- Literature search (MEDLINE, Cochran Trials Registry, PubMed) for:
  - Clinical trials, systematic reviews, cost studies, implementation papers
  - 1990 to June 2009
  - Human subjects
  - Search terms: remote consult/consultation, electronic mail, telecommunications, telemedicine, telepathology, dermatology, teledermatology
METHODS

- **Inclusion Criteria:**
  - SAF or LI in English
  - controlled trial for Key Questions 1 and 2 (diagnosis, management)

- **Exclusion Criteria:**
  - teledermatology using mobile phones
  - non-teledermatology settings
  - dermatopathology
  - computer-aided diagnoses only
  - survey studies with outcomes not related to questions
  - teledermatology as an educational tool
  - technology assessment only
  - remote monitoring of known diagnoses
  - patient-generated photos and/or history (no provider)
  - studies with one diagnosis only or only acne or warts
  - pediatric population only
METHODS

- Data extracted by 2 research associates, verified by PI
- Quality Assessment of Diagnostic Accuracy Studies (QUADAS)* instrument used to assess study quality of studies related to diagnostic accuracy and concordance
- Results presented by outcome and method of outcome reporting
  - stratified by SAF or LI technology
  - weighted mean differences where appropriate (limited pooling due to heterogeneity)

*Whiting et al., BMC Medical Research Methodology, 2003
RESULTS

Search Result=657
References

Abstracts Excluded=473

Full Text Review=184

Full Text Excluded=100

Included Studies=85

Recent Publication=1

Diagnosis/Management Questions (1,2)=50

Outcomes Questions (3, 4, 5)=26
DEFINITION - DIAGNOSTIC ACCURACY

- Match of TD or CD diagnosis with gold standard diagnosis (histopathology or other laboratory test)
  - Aggregated
    - match of primary or differential diagnoses with gold standard diagnosis
  - Primary
    - match of primary diagnosis with gold standard diagnosis
DEFINITION - MANAGEMENT ACCURACY

- Match of TD or CD management plan with gold standard management plan
DEFINITIONS - CONCORDANCE

- **Diagnostic concordance:**
  - *Aggregated* - agreement of TD primary or differential diagnoses with CD primary or differential diagnosis
  - *Primary* - agreement of primary TD diagnosis with primary CD diagnosis

- **Management concordance:**
  - agreement of TD and CD management plans
Results – Q1,2 Diagnosis & Management

41 SAF studies (42 publications)

- 40 repeated measures studies, 1 randomized trial
- 12 U.S., 9 U.K., 6 Italy, 4 Spain, 3 Australia/New Zealand, 2 Turkey
- 5 studies - U.S. Military Personnel or Veterans
- 12-882 subjects per study
- Mean age=53 years (19 studies)
- 43% female (21 studies)
- 93% Caucasian (5 studies)
- Rashes and lesions (14 studies)
- Lesions only (22 studies)
QUADAS RESULTS SAF

The image shows a bar chart titled "QUADAS RESULTS SAF". The chart displays the number of studies across different categories: Selection, Index Test, Reference Test, and Data Analysis. Each category has three bars representing different statuses:

- **Yes** (dark gray)
- **Unclear** (light gray)
- **No** (light gray)

The numbers on the bars are:

- **Selection**:
  - Yes: 13
  - Unclear: 8
  - No: 2

- **Index Test**:
  - Yes: 38
  - Unclear: 2
  - No: 1

- **Reference Test**:
  - Yes: 36
  - Unclear: 3
  - No: 2

- **Data Analysis**:
  - Yes: 30
  - Unclear: 1
  - No: 1
RESULTS – DIAGNOSTIC ACCURACY

SAF

TD Accuracy vs. CD Accuracy, Weighted Mean Difference*

Aggregated Diagnostic Accuracy = -19%
range: -28% to 18%
6 studies

*Teledermatology minus Usual Care
Primary Diagnostic Accuracy of Store and Forward Studies

Teledermatology Study Size:
- * <75
- * 75-150
- * >150

Usual Care Study Size:
- □ <75
- ◯ 75-150
- □ >150

Warshaw(6)
Warshaw(5)
Oakley(15)
Coras(24)
Pak(26)
Jolliffe(30)
Braun(35)
Piccolo(37)
Piccolo(40)
White(41)
White(43)
RESULTS – DIAGNOSTIC ACCURACY SAF

TD Accuracy vs. CD Accuracy, Weighted Mean Difference*

Primary Diagnostic Accuracy = -11%
range: -54% to 11%
11 studies

Primary Diagnostic Accuracy, Pigmented Lesions Only = -5%
range: -9% to 11%
6 studies

*Teledermatology minus Usual Care
## OTHER RESULTS – DIAGNOSTIC ACCURACY

<table>
<thead>
<tr>
<th>Category</th>
<th>Teledermatology</th>
<th>Usual Care</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kappa Statistic SAF:</strong></td>
<td>k = 0.44 to 0.94</td>
<td>k = 0.52 to 0.70</td>
<td>(4 studies) (1 study)</td>
</tr>
<tr>
<td><strong>Sensitivity SAF</strong></td>
<td>0.91</td>
<td></td>
<td>(1 study)</td>
</tr>
<tr>
<td><strong>Specificity SAF</strong></td>
<td>0.95</td>
<td></td>
<td>(1 study)</td>
</tr>
</tbody>
</table>

**Live Interactive** (1 study)

Aggregated diagnostic accuracy

Teledermatology=73%  Usual Care=64%
<table>
<thead>
<tr>
<th>Primary Concordance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigmented skin lesions</td>
<td>91%</td>
<td>(1 study)</td>
</tr>
<tr>
<td>Skin lesions</td>
<td>53-80%</td>
<td>(5 studies)</td>
</tr>
<tr>
<td>General studies</td>
<td>46-88%</td>
<td>(14 studies)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aggregated Concordance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin lesions</td>
<td>64-100%</td>
<td>(4 studies)</td>
</tr>
<tr>
<td>General studies</td>
<td>60-100%</td>
<td>(10 studies)</td>
</tr>
</tbody>
</table>
Aggregated Diagnostic Concordance of Store and Forward Studies

Study Size:
- □ <75
- □ 75-150
- □ >150

Percent
Primary Diagnostic Concordance of Store and Forward Studies

Study Size:
- □ <75
- ■ 75-150
- □ >150

Percent

# OTHER RESULTS – DIAGNOSTIC CONCORDANCE

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappa statistic SAF</td>
<td>( k = 0.71 ) to ( 0.93 )</td>
<td>4 studies</td>
</tr>
<tr>
<td>Sensitivity SAF</td>
<td>0.88-1.00</td>
<td>3 studies</td>
</tr>
<tr>
<td>Specificity SAF</td>
<td>0.39-0.98</td>
<td>3 studies</td>
</tr>
<tr>
<td>Live Interactive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated</td>
<td>78-99%</td>
<td>5 studies</td>
</tr>
<tr>
<td>Primary</td>
<td>57-78%</td>
<td>7 studies</td>
</tr>
<tr>
<td>Kappa statistic</td>
<td>( k = 0.62 ) to ( 0.79 )</td>
<td>2 studies</td>
</tr>
</tbody>
</table>
RESULTS – MANAGEMENT SAF

**Accuracy**

Teledermatology 75.3% vs. Usual Care 75.9%

Weighted Mean Diff* = -0.6%

range: -5% to 5%

2 studies

*Teledermatology minus Usual Care
OTHER RESULTS – MANAGEMENT

**Concordance**
- Percent concordant: 55-96% (8 studies)
- Kappa statistic: $k = 0.68-0.75$ (4 studies)
- Sensitivity & Specificity: 1.0 (1 study)

**Live Interactive**
- Percent Concordant: 64-75% (3 studies)
- Kappa statistic: $k = 0.71$ (1 study)
CONCLUSIONS – DIAGNOSIS & MANAGEMENT

1. Diagnostic accuracy of in-person dermatology is better than SAF teledermatology.
2. Diagnostic concordance of SAF teledermatology with in-person dermatology is acceptable.
3. There is limited data on management accuracy; two studies show equivalence.
4. Management concordance is moderate to very good.
KEY QUESTION 3 – CLINICAL COURSE

Three studies (2 SAF, 1 LI)
- two suggested more favorable clinical course following TD compared to UC
- third study (VA/DoD n=508) reported no difference

Different methods for determining clinical course
- clinic visit, photos, questionnaire

Clinical course assessed at different time points
- first clinic visit, 4 months, 6 months
PATIENT SATISFACTION

Four SAF studies with usual care comparison group

<table>
<thead>
<tr>
<th>Teledermatology</th>
<th>Usual Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8/5 (5 point scale)*</td>
<td>3.8/5 (5 point scale)*</td>
</tr>
<tr>
<td>84% satisfied overall*</td>
<td>87% satisfied overall*</td>
</tr>
<tr>
<td>86% very satisfied**</td>
<td>98% very satisfied**</td>
</tr>
<tr>
<td>79% excellent or very good**</td>
<td>78% excellent or very good**</td>
</tr>
</tbody>
</table>

*randomized controlled trial
**VA studies
PATIENT PREFERENCE

Four SAF studies

<table>
<thead>
<tr>
<th>Teledermatology</th>
<th>Usual Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>76% preferred TD over waiting for UC*</td>
<td></td>
</tr>
<tr>
<td>42% preferred TD over UC**</td>
<td>37% preferred UC over TD**</td>
</tr>
<tr>
<td>68% TD as good as UC</td>
<td>40% prefer UC to TD</td>
</tr>
<tr>
<td>42% preferred TD over waiting for UC</td>
<td>38% prefer UC</td>
</tr>
</tbody>
</table>

*randomized controlled trial  **VA studies

Similar findings for live interactive studies
CLINIC VISITS AVOIDED

SAF: % of pts not requiring derm clinic visit (2 studies)

<table>
<thead>
<tr>
<th>Teledermatology</th>
<th>Usual Care</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>39.0%</td>
<td>18.3%</td>
<td>20.7%</td>
</tr>
<tr>
<td>66.0%</td>
<td>38.0%</td>
<td>28.0%</td>
</tr>
</tbody>
</table>

Percentage of visits avoided in studies with no comparison group: 12.8% to 53.3% (7 studies)

LI: 14% and 1% differences reported (2 studies)
72.0% did not need follow-up (1 study)
SUMMARY – CLINICAL OUTCOMES

1. There is insufficient data to determine whether clinical course is impacted by SAF teledermatology vs. in-person dermatology.

2. Waiting time for usual care (in-person dermatology) appointments was a factor in patient preference for teledermatology.

3. In-person dermatology visits can be avoided when teledermatology is used.
KEY QUESTION 4: COST

- **SAF** (3 studies)
  - 1 VA (Whited 275 pts RCT)
    - cost-effective but not cost-saving
  - 1 DoD (Pak 698 pts RCT)
    - cost savings of $32/pt accounting for lost productivity

- **LI** (6 studies)
  - 2 US (Burgiss 87 pts; Armstrong 451 TD visits)
    - cost less or was cost efficient, if pts had long travel or if met criteria for volume and usual care costs

- **LI vs. SAF** (1 study, UK; Loane 102 pts):
  - SF less expensive but less clinically efficient than LI
KEY QUESTION 4: SUMMARY - COST

- Limited by various parameters and perspectives (societal, health service or patient)
- Most found telederm to be cost effective if:
  - Far patient distance
  - High telederm volume
  - High costs of usual care
KEY QUESTION 5: BARRIERS AND KEY ELEMENTS OF SUCCESSFUL IMPLEMENTATION

- Lessons learned from mature functioning teledermatology systems
- Descriptions of programs
- Finch: longitudinal study of 12 TD services in UK
  - MDs, nurses, pts, PCPs, administrators, technologists
  - “the original...vision of how TD would be utilized, as a technological fix for long waiting lists and consultant shortages, failed to be realized.”
- General recommendations – Pak military
EVALUATE THE SETTING & DEFINE OBJECTIVES

- **Intrasite** (Site with dermatology): triage

- **Intersite** (Site with access to distant VA derm clinic): decrease travel, specialist costs

- **New Service** (Site with no VA derm access): decrease outsourcing costs, access
UNDERSTAND ORGANIZATIONAL ISSUES

- **Intrasite & Intersite**
  - Derm workload stable
  - Primary care workload increases

- **New Site**
  - Workload increases for both derm and primary care
  - Outsource costs for procedures still needed
EVALUATE & PROVIDE REQUIRED RESOURCES

- **Intrasite & Intersite:**
  - liquid nitrogen
  - ? support for minor procedures – KOH, scabies prep
  - otherwise TD simply triage, only eliminating visits for benign growths or simple rashes
  - Informal survey - 3 sites d/c’ed TD because most pts needed to come to the clinic anyway

- **New Site:**
  - NP or PA with dermatology training important
  - Biopsies, KOH, scabies prep,
  - On site surgical resources vs. outsourcing for malignancies
COST ANALYSIS, ASSESS ALTERNATIVES

- Cost of TD is mostly personnel, not equipment
  - Imager
  - Consult manager
  - Likely to fail if primary care MD serves in these roles

- Evaluate needs
  - If high volume of skin cancer, TD may not be cost-saving

- Compare TD costs to costs of consultant dermatologist, dermatology resident, transportation services
OBTAIN ORGANIZATIONAL SUPPORT

- Medical Center Leadership
- Primary Care – “market” educational benefit
- Surgical Subspecialties
- Dermatology
- Pharmacy
- Intersite and New Service
  - Add’l derm meds, CPRS quick orders
- Important to incorporate TD into normal oper
PROVIDE SPECIFIC TD TRAINING

- Imager
- Resources
  - American Telemedicine Association
  - VA intranet
  - American Academy of Dermatology Position Statement
- Hands on training, usually by dermatologist
- Periodic refresher training
IMPORTANCE OF ONGOING SUPPORT

- TD more than equipment
- Personnel
- Refresher training
- Upgrades
- Periodic evaluation
- Travel
SUMMARY – IMPLEMENTATION

1. Important

2. Identifying key factors for success and barriers are highly dependent on intended setting and specific sites
OVERALL CONCLUSIONS

1. Diagnostic accuracy of in-person dermatology is better than SAF teledermatology
2. Diagnostic concordance of SAF teledermatology with in-person dermatology is acceptable
3. Management concordance is moderate to very good
4. Limited data on management accuracy, clinical outcomes
5. Pt satisfaction/preference good; dep on distance
6. Cost-effectiveness also dep on cost usual care, distance, & volume
7. Many key factors in planning implementation
THANK YOU FOR YOUR ATTENTION!

COMMENTS, QUESTIONS WELCOME!