

第四代即時同步遠距照護之智慧醫療

何奕倫教授

臺大醫院內科主任

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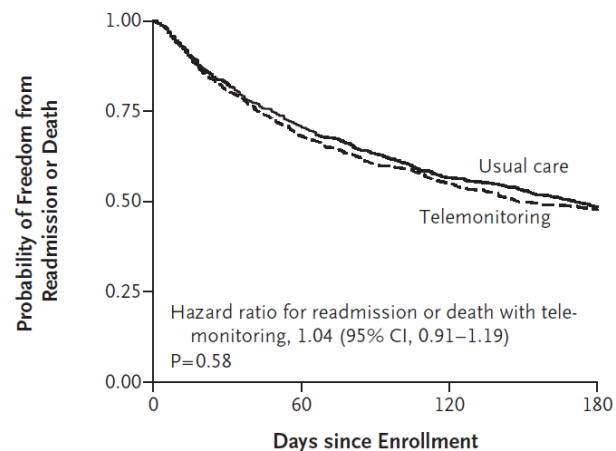


ORIGINAL ARTICLE

Telemonitoring in Patients with Heart Failure

- ◆ 1653 patients who had recently been hospitalized for heart failure to undergo either telemonitoring (826 patients) or usual care (827 patients).
- ◆ Telemonitoring was accomplished by means of a telephone-based interactive **voice response system** that collected daily information about symptoms and weight that was reviewed by the patients' clinicians.

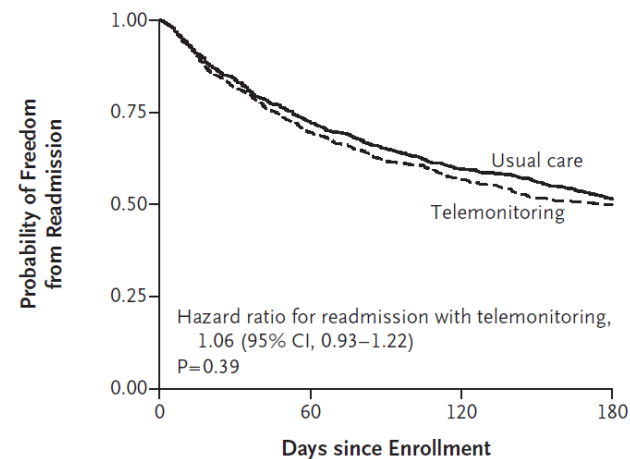
A Readmission for Any Reason or Death from Any Cause



No. at Risk

Usual care	827	587	468	402
Telemonitoring	826	564	454	395

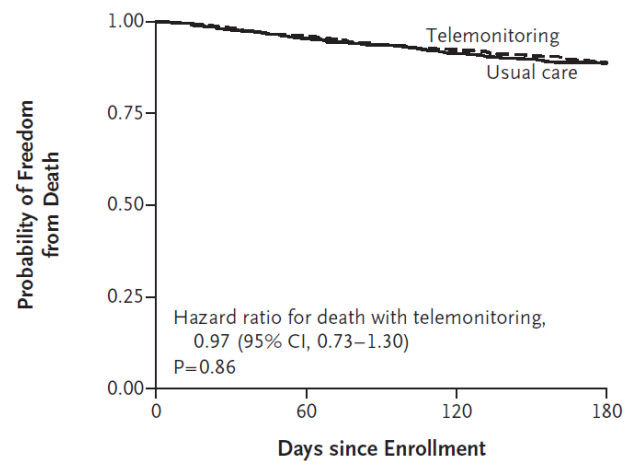
B Readmission for Any Reason



No. at Risk

Usual care	827	587	468	402
Telemonitoring	826	564	454	395

C Death from Any Cause



No. at Risk

Usual care	827	789	756	733
Telemonitoring	826	792	763	735

HEALTH CARE REFORM

A Randomized Controlled Trial of Telemonitoring in Older Adults With Multiple Health Issues to Prevent Hospitalizations and Emergency Department Visits

- ◆ We conducted a multisite randomized controlled trial at 4 sites within Mayo Clinic's Employee and Community Health program.
- ◆ Telemonitoring device (Intel Health Guide; Intel-GE) was used in the patient's home.
- ◆ The device worked **asynchronously**, and data were downloaded to a health website, which was then reviewed by the health care team daily (J.L.P., G.J.H. and others), including weekends and holidays.

住院率與急診造訪率統計上無差別

Table 2. Hospitalizations and Emergency Department (ED) Visits in the 12 Months Following Enrollment

Variable	Telemonitoring (n = 102)	Usual Care (n = 103)	P Value
Primary end point, No. (%)			
Hospitalizations and ED visits	65 (63.7)	59 (57.3)	.35
Hospitalizations	53 (52.0)	45 (43.7)	.24
ED visits	36 (35.3)	29 (28.2)	.27
Secondary end point			
Mortality, No. (%)	15 (14.7)	4 (3.9)	.008
ED visits per person, mean (SD)	0.7 (1.3)	0.5 (0.8)	.23
Total hospital days per person, mean (SD)	4.1 (8.1)	6.1 (20.1)	.61
Hospitalizations per person, mean (SD)	1.1 (1.7)	0.8 (1.2)	.28
No. of hospitalizations, No. (%)			
0	49 (48.0)	58 (56.3)	.63
1	28 (27.5)	23 (22.3)	
2	13 (12.8)	11 (10.7)	
3	4 (3.9)	5 (4.9)	
4	4 (3.9)	5 (4.9)	
≥5	4 (3.9)	1 (1.0)	

遠距照護收案後住院率反而增加

Table 4. Preenrollment vs Postenrollment Emergency Department (ED) Visits, Hospitalizations, and Total Hospital Days

Variable	Telemonitoring (n = 102)			Usual Care (n = 103)		
	Preenrollment	Postenrollment	<i>P</i> Value	Preenrollment	Postenrollment	<i>P</i> Value
ED visits						
No. (%)	34 (33.3)	36 (35.3)	.25	31 (30.1)	29 (28.2)	.28
Per person, mean (SD)	0.7 (1.5)	0.7 (1.3)	.59	0.4 (0.7)	0.5 (0.8)	.63
Hospitalizations						
No. (%)	46 (45.1)	53 (52.0)	.03	57 (55.3)	45 (43.7)	.22
Per person, mean (SD)	1.0 (1.5)	1.1 (1.7)	.93	1.1 (1.6)	0.8 (1.2)	.18
Total hospital days, mean (SD)						
Per person	3.9 (7.5)	4.1 (8.1)	.45	4.3 (7.4)	6.1 (20.1)	.39
Total	3.9 (3.4)	3.8 (3.5)	.63	4.1 (4.0)	7.4 (16.8)	.37

遠距照護組死亡率增加

- ◆ Mortality was higher in the tele-monitoring group (14.7%) than in the usual care group (3.9%) ($P=.008$).



資訊不等於知識

愛因斯坦

Information is not knowledge.

By Albert Einstein



	資料傳輸	病況判斷與分析	結合電子病歷並提供 後送醫院與聯絡原主治醫師
第一代	Asynchronous	Non-immediate	-
第二代	Synchronous	During office hours	-
第三代	Synchronous	During and outside office hours	-
第四代	Synchronous	During and outside office hours	+

Stefan D Anker et al. Lancet 2011; 378: 731–39

Telecare in NTUH

24 hrs Stand-by and Monitor Including MDs



生理資訊
量測儀器



生理資訊
傳輸儀器



遠距照護中心

77777 心衰測試(全) (登出)

首頁 新增病患 使用者管理 登入紀錄 更新資料

姓名	種類	數值	量測時間	上傳時間
0703_陳○○	血壓	86 / 55 / 93	2012/09/23 21:59:08	2012/09/23 21:59:28
0223_陳○○	血壓	117 / 52 / 66	2012/09/23 21:50:03	2012/09/23 21:50:14
0607_陳○○	血壓	101 / 65 / 50	2012/09/23 21:46:16	2012/09/23 21:46:37
0607_陳○○	心電	51 / 主線 / X	2012/09/23 21:42:43	2012/09/23 21:44:20
0423_陳○○	心電	45 / 主線 / X	2012/09/23 21:39:08	2012/09/23 21:40:15
0663_陳○○	血壓	121 / 82 / 102	2012/09/23 21:16:27	2012/09/23 21:17:23
0714_陳○○	血壓	129 / 72 / 76	2012/09/23 21:10:07	2012/09/23 21:10:29
0714_陳○○	心電	73 / 主線 / X	2012/09/23 21:07:24	2012/09/23 21:08:16
0720_陳○○	血壓	91 / 55 / 72	2012/09/23 21:04:28	2012/09/23 21:05:23
0653_陳○○	血壓	126 / 63 / 72	2012/09/23 21:03:43	2012/09/23 21:03:57
0548_陳○○	心電	86 / 主線 / X	2012/09/23 21:01:24	2012/09/23 21:02:44
0234_陳○○	脈搏血氧	196	2012/09/23 21:01:33	2012/09/23 21:01:45
0653_陳○○	血氧	99	2012/09/23 21:01:20	2012/09/23 21:01:39
0550_陳○○	心電	85 / 主線 / X	2012/09/23 20:59:42	2012/09/23 21:01:27
0720_陳○○	心電	69 / 主線 / X	2012/09/23 20:59:56	2012/09/23 21:00:48
0653_陳○○	心電	73 / 主線 / X	2012/09/23 20:59:23	2012/09/23 21:00:48
0595_陳○○	血壓	124 / 73 / 85	2012/09/23 20:59:50	2012/09/23 20:59:58
0234_陳○○	心電	60 / 主線 / X	2012/09/23 20:57:50	2012/09/23 20:59:26
0426_陳○○	心電	70 / 主線 / X	2012/09/23 20:57:39	2012/09/23 20:58:48
0595_陳○○	心電	86 / 主線 / X	2012/09/23 20:56:44	2012/09/23 20:57:48

台大遠距照護中心與遠距照護平台

遠距照護平台



Clinical Outcome and Cost-Effectiveness of a Synchronous Telehealth Service for Seniors and Nonseniors with Cardiovascular Diseases: Quasi-Experimental Study

Taiwan ELEctroHEALTH study group

Ying-Hsien Chen, Yen-Hung Lin, Chi-Sheng Hung, Ching-Chang Huang, Deng-Feng Yeih, Pao-Yu Chuang, Yi-Lwun Ho, Ming-Fong Chen

Synchronous telehealth intervention by Telehealth Center National Taiwan University Hospital may reduce costs, decrease all-cause admission rates, and decrease durations of all-cause hospital stays in cardiovascular disease patients, regardless of age.

Final measure	Nonsenior, mean (SD) n=48			Senior, mean (SD) n=93		
	Pre	Post	<i>P value</i>	Pre	Post	<i>P value</i>
Outpatient cost	127.08 (309.34)	263.51 (569.44)	.04	137.57 (253.47)	153.21 (215.45)	.08
Inpatient cost	814.93 (1000.40)	217.39 (771.01)	.001	768.27 (1148.20)	301.14 (926.92)	<.001
Emergency department cost	12.76 (26.89)	4.16 (12.76)	.01	22.35 (35.18)	40.51 (120.93)	.11
Total cost of all-cause health care	954.78 (998.70)	485.06 (952.47)	<.001	928.20 (1194.11)	494.87 (1047.08)	<.001



Original Paper

Assessment of the Cost-Effectiveness and Clinical Outcomes of a Fourth-Generation Synchronous Telehealth Program for the Management of Chronic Cardiovascular Disease

- ◆ We retrospectively analyzed 576 patients who has joined telehealth care program at cardiovascular ward and outpatient clinic of National Taiwan University Hospital, to compare with 1178 patients with matched sex, age and Charlson socre.
- ◆ Telehealth care program included synchronized daily biometric data analysis, symptom reporting, and immediate drug adjustment or medical suggestion from an attending physician.
- ◆ The data of hospitalization, ED visit and medical cost were collected from electrical database at the hospital.

Primary Endpoints

	遠距組 (n=576)		非遠距組 (N=1178)		p
f/u months	20.4	11.4	25.8	14.5	<0.001
ER visit – overall	1.03	2.06	1.38	2.68	<0.001
- adjusted by f/u mo	0.059	0.132	0.094	0.234	<0.001
Hospitalization times	0.85	1.83	1.35	2.21	<0.001
- adjusted by f/u mo	0.05	0.12	0.11	0.21	<0.001
Hospitalization days	10	27.7	15.3	32.3	<0.001
- adjusted by f/u mo	0.77	2.78	1.4	3.6	<0.001
ICU times	.18	.49	.33	.6	<0.001
- adjusted by f/u mo	.011	.067	.036	.141	<0.001
OPD times	33	33.7	43.7	48.5	0.003
- adjusted by f/u mo	1.57	1.12	1.66	1.78	0.75

Medical cost (US\$, per patient-month)

Medical cost, mean (SD)	Case	Control	p value
Emergency department costs	20.9(66.6)	37.3(126.2)	<.001
Hospitalization costs	386.3(1424.3)	878.2(2697.2)	<.001
Outpatient clinic visit costs	180.4(278.6)	248.2(984.6)	.06
Total medical costs	587.6(1497.8)	1163.6(3036.6)	<.001
Total healthcare costs	812.4(1497.8)	1163(3036.6)	<.001

2013/11/19 Dallas American Heart Association Annual Meeting
Journal of Medical Internet Resesearch 2014; 16:e145

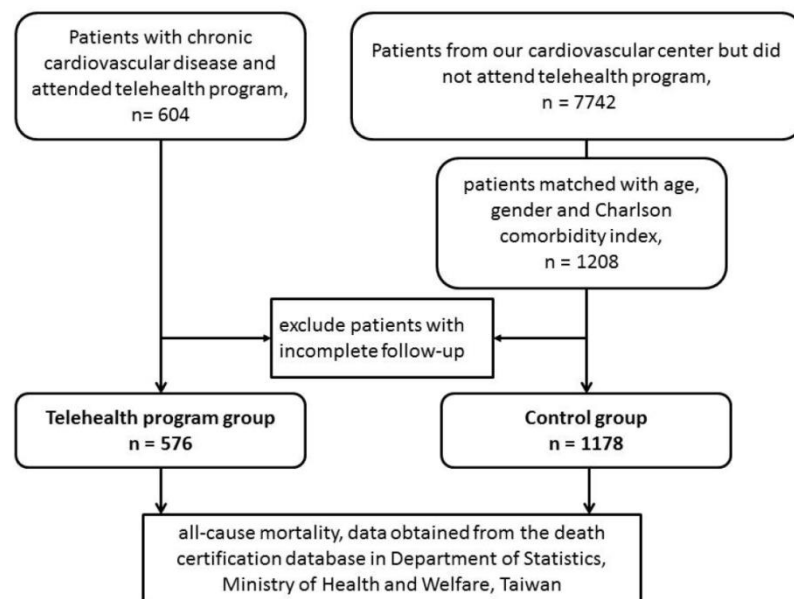
■ 接受遠距照護服務，可顯著降低個案死亡率。

Mortality Benefit of a Fourth-Generation Synchronous Telehealth Program for the Management of Chronic Cardiovascular Disease: A Longitudinal Study

Chi-Sheng Hung¹, MD, PhD; Jiun-Yu Yu², PhD; Yen-Hung Lin³, MD, PhD; Ying-Hsien Chen¹, MD; Ching-Chang Huang¹, MD; Jen-Kuang Lee¹, MD; Pao-Yu Chuang⁴; Yi-Lwun Ho¹, MD, PhD; Ming-Fong Chen³, MD, PhD

慢性心血管疾病的病患進行世代研究，在遠距照護組有 53 人 (9.3%) 死亡，而在對照組有 136 人 (11.5%) 死亡。

結果發現遠距照護對於整體死亡率的風險比 (hazard ratio) 為 0.866。顯示第四代遠距照護在考慮所有慢性共病症之下，比對照組仍有較少的死亡率。






Hazard Ratio of All-cause Mortality (N=1754)

Clinical predictors	Hazard ratio (95% Confidence interval)	<i>p</i> -value
Age (years)	1.019 (1.018 – 1.021)	<.001
Age > 69.809 (years)	1.890 (1.810 – 1.974)	<.001
Age > 69.809 (years) × Telehealth	0.837 (0.788 – 0.889)	<.001
Male	1.152 (1.125 – 1.179)	<.001
Telehealth	0.866 (0.810 – 0.926)	<.001
Telehealth × Time-to-mortality (days)	0.9997 (0.9996 – 0.9998)	<.001
Myocardial infarction	1.097 (1.051 – 1.146)	<.001

Effect of Contract Compliance Rate to a Fourth-Generation Telehealth Program on the Risk of Hospitalization in Patients With Chronic Kidney Disease: Retrospective Cohort Study

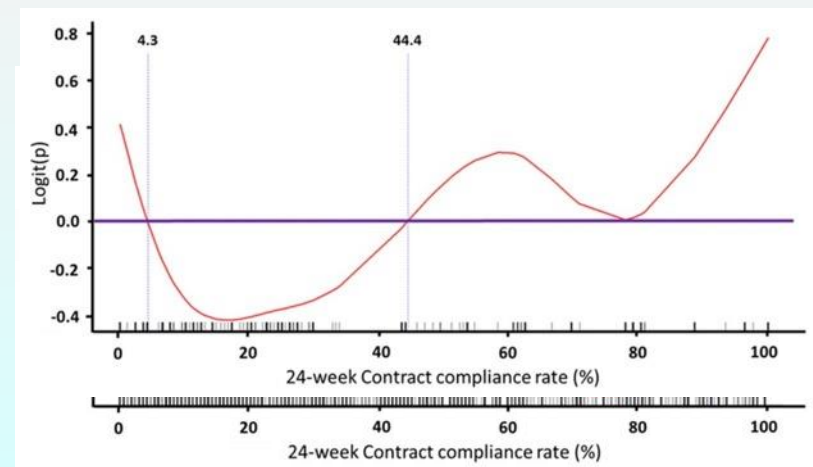
Chi-Sheng Hung¹, MD, PhD  ; Jenkuang Lee¹, MD, PhD  ; Ying-Hsien Chen¹, MD  ;

Ching-Chang Huang¹, MD  ; Vin-Cent Wu², MD, PhD  ; Hui-Wen Wu¹, RN  ; Pao-Yu Chuang¹  ;

Yi-Lwun Ho¹, MD, PhD 

Triphasic relationship between contract compliance rate to the telehealth program and risk of hospitalization
ESRD was associated with risk of hospitalization

End stage renal disease

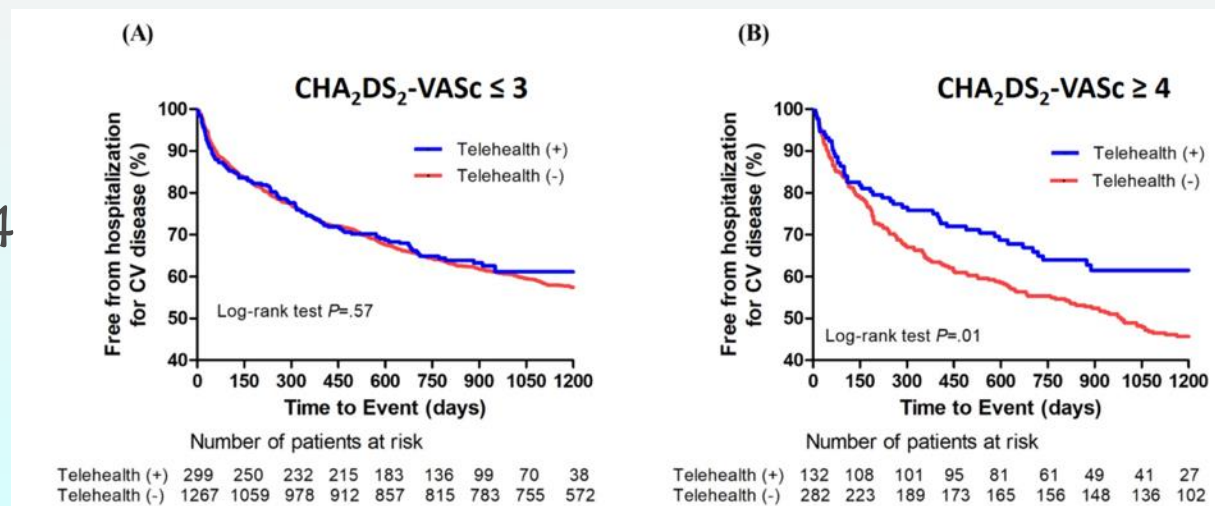


Use of the CHA₂DS₂-VASc Score for Risk Stratification of Hospital Admissions Among Patients With Cardiovascular Diseases Receiving a Fourth-Generation Synchronous Telehealth Program: Retrospective Cohort Study

Jen-Kuang Lee^{1,2,3}, MD, PhD  ; Chi-Sheng Hung^{1,2}, MD, PhD  ; Ching-Chang Huang^{1,2}, MD  ;

Ying-Hsien Chen^{1,2}, MD  ; Pao-Yu Chuang^{1,4}, MSN  ; Jiun-Yu Yu^{1,5}, PhD  ; Yi-Lwun Ho^{1,2}, MD, PhD 

Patients accepting the fourth-generation telehealth program with CHA₂DS₂-VASc scores ≥ 4 benefit most by remaining free from cardiovascular hospitalization



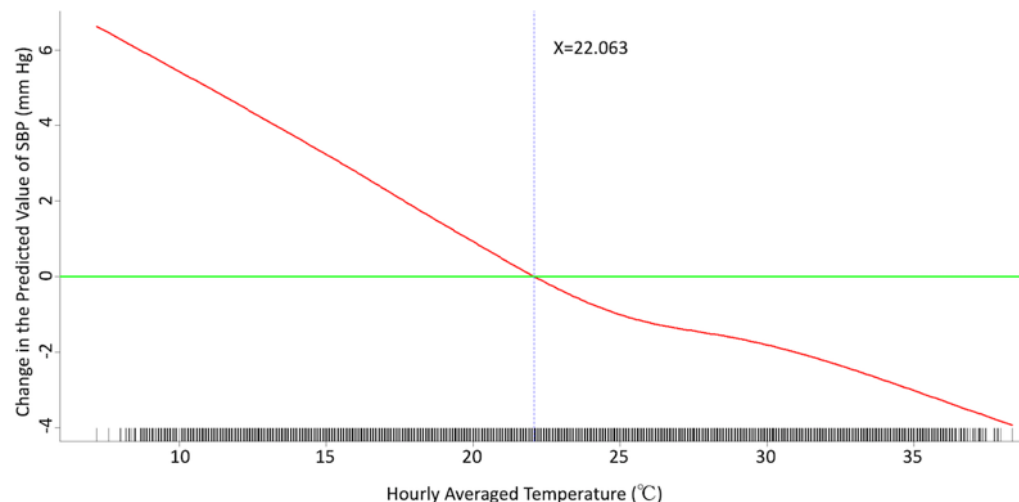


Assessment of the Relationship Between Ambient Temperature and Home Blood Pressure in Patients From a Web-Based Synchronous Telehealth Care Program: Retrospective Study

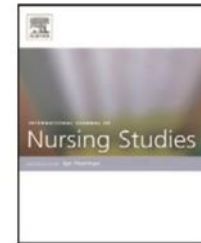
Ching-Chang Huang^{1,2}, MD ; Ying-Hsien Chen^{1,2}, MD ; Chi-Sheng Hung^{1,2}, MD, PhD ;

Jen-Kuang Lee^{1,2}, MD, PhD ; Tse-Pin Hsu^{1,3}, MSN ; Hui-Wen Wu^{1,3}, MSN ; Pao-Yu Chuang^{1,3}, MSN ;

Ming-Fong Chen^{1,2}, MD, PhD ; Yi-Lwun Ho⁴, MD, PhD

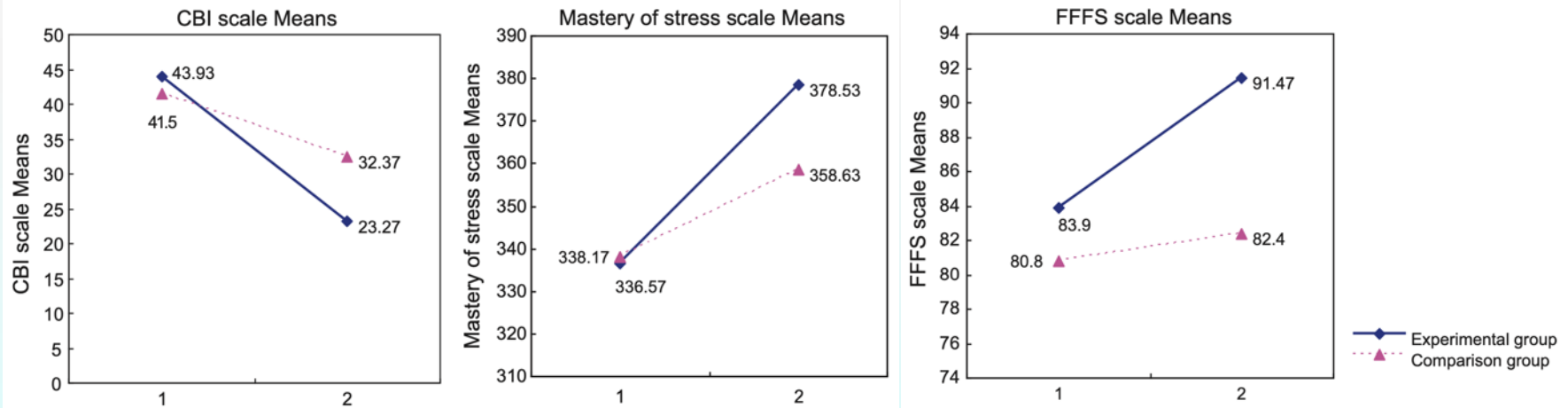


- Short-term exposure to low ambient temperature significantly increased home blood pressure in patients with chronic cardiovascular diseases.
- Antihypertensive agents may modify this effect.







The effectiveness of telehealth care on caregiver burden, mastery of stress, and family function among family caregivers of heart failure patients: A quasi-experimental study

Li-Chi Chiang^a, Wan-Chou Chen^b, Yu-Tzu Dai^{b,c}, Yi-Lwun Ho^{d,*}



The results provide evidence that telehealth care combined with discharge planning could reduce family caregiver burden, improve stress mastery, and improve family function during the first 30 days at home after heart failure patients are discharged from the hospital.

Patient willingness to undergo a two-week free trial of a telemedicine service for coronary artery disease after coronary intervention: A mixed-methods study

Yueh-Hsiu Lin RN, MSN, Doctoral student¹  |
Guey-Shiun Huang RN, PhD, Assistant Professor¹  | Yi-Lwun Ho MD, PhD, Professor²  |
Meei-Fang Lou RN, PhD, Professor¹ 

Conclusion: Staff support through telephonic tracking and real-time feedback can increase willingness to use telemedicine.

Implications for Nursing Management: Case managers can collect necessary personal information and offer the patients 24-hr services as a monitor, an instructor and a companion, thereby accommodating more patients, building value and strengthening telemedicine services.

with experience using technology, perceived ease of use or computer self-efficacy; instead, it was based on trust in the hospital staff, opinions of the staff and ongoing support from the case manager. Reasons for their lack of willingness to use the service were mainly related to diseases, technology/equipment and environmental factors.

Conclusion: Staff support through telephonic tracking and real-time feedback can increase willingness to use telemedicine.

Implications for Nursing Management: Case managers can collect necessary personal information and offer the patients 24-hr services as a monitor, an instructor and a companion, thereby accommodating more patients, building value and strengthening telemedicine services.

KEYWORDS

computer self-efficacy, coronary artery disease, telemedicine

Application Telehealth Service

- ◆ Atrial fibrillation screening
 - ◆ Mobile ECG recorder
 - ◆ Application Programming Interface
 - ◆ Telehealth Surveillance System
 - ◆ Embedded Cloud-Computing Algorithm

Assessment of Remote ECG Sampling with a Handheld Device for Atrial Fibrillation Screening: The REHEAT Study

AliveCor Kardia S (Apple Inc, Cupertino, CA)

Clinical Perspective

What Is New?

- This is the first prospective randomized trial evaluating the ability of remote ECG acquisition and transmission with a handheld device with remote interpretation to screen for atrial fibrillation (AF) in at-risk people >65 years of age over an extended period of time (1 year).
- This approach is at least 3 times more likely to identify incident AF than routine care at a cost of just over \$10 000 per case identified and is a highly acceptable approach in this group of patients. A CHADS-VASc score of ≥ 4 was the strongest predictor of incident AF.

What Are the Clinical Implications?

- Our findings suggest that this approach could be considered for AF screening in routine practice, particularly in the highest-risk patients.
- Although strokes and transient ischemic attacks were numerically fewer in monitored patients, the study was not statistically powered to evaluate hard clinical outcomes, and this difference was not statistically significant.
- These results support consideration of evaluation in an appropriately powered, event-driven randomized trial to confirm clinical and cost-effectiveness of such an approach to stroke prevention in AF.



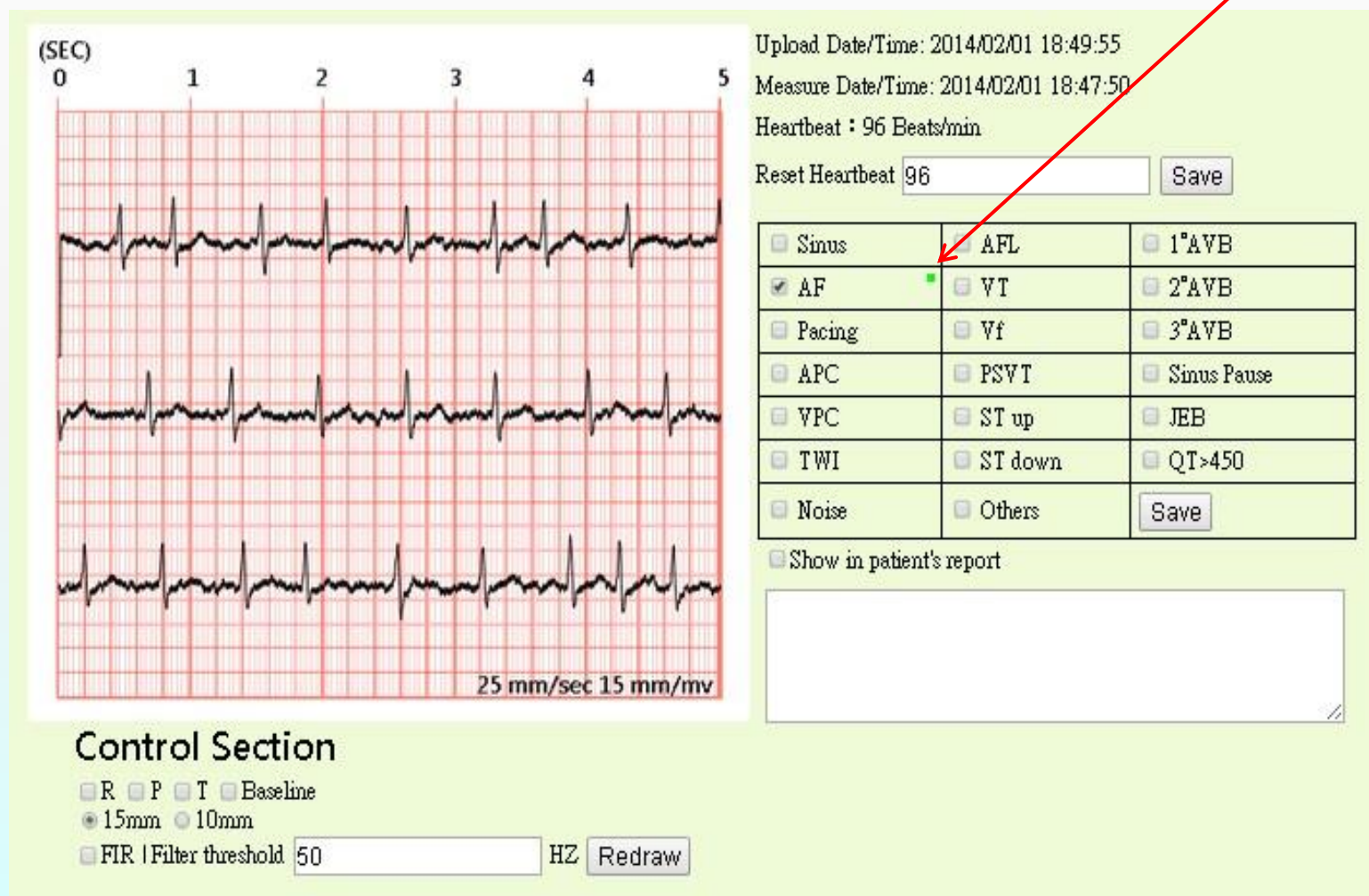
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心電圖自動判讀系統

■ 心電圖自動判讀結果呈現方式

心電圖自動判讀程式建議



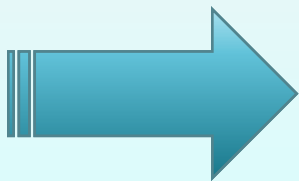
心房顫動篩檢成果

Atrial fibrillation screening using ambulatory ECG Recorder

Under trial measurement 967 ECGs from 922 participants

Screening result, n=967	
Sinus	942 (97.41%)
Af	22 (2.28%)
Pacing	1 (0.1%)
APC	16 (1.65%)
VPC	22 (2.28%)
Junctional escape	3 (0.31%)
No interpretation	2 (0.21%)

ECG auto-interpretation, n=967	
Sinus	918
Af	42
Sinus+Af	3
No interpretation	4



Statistic	Value
Sensitivity	95.45%
Specificity	97.67%
Positive Predictive Value	48.84%
Negative Predictive Value	99.89%
Disease prevalence	2.28%

雲端心房顫動篩檢準確度

	年齡 ≤ 65 N = 526	年齡 > 65 N = 439	總計 N = 965
敏感度	100.00% (39.76%–100.00%)	94.44% (72.71%–99.86%)	95.45% (77.16%–99.88%)
特異度	98.66% (97.26%–99.46%)	96.44% (94.19%–97.99%)	97.67% (96.49%–98.53%)
陽性預測值	36.36% (21.49%–54.39%)	53.12% (40.51%–65.35%)	48.84% (38.47%–59.30%)
陰性預測值	100.00%	99.75% (98.37%–99.96%)	99.89% (99.27%–99.98%)
疾病盛行率	0.68% (4/590)	5.42 % (18/332)	2.39% (22/922)

AF screening in nonmetropolitan areas using a telehealth surveillance system with an embedded cloud-computing algorithm is feasible.

Original Paper

Atrial Fibrillation Screening in Nonmetropolitan Areas Using a Telehealth Surveillance System With an Embedded Cloud-Computing Algorithm: Prospective Pilot Study

Ying-Hsien Chen¹, MD; Chi-Sheng Hung¹, MD, PhD; Ching-Chang Huang¹, MD; Yu-Chien Hung², MD; Juey-Jen Hwang^{1,3*}, MD, PhD; Yi-Lwun Ho^{1*}, MD, PhD

¹Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan

²Department of Medicine, National Taiwan University Hospital JinShan Branch, New Taipei, Taiwan

³Department of Internal Medicine, National Taiwan University Hospital Yun-Lin Branch, Yun-Lin, Taiwan

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通訊診察門診

通訊診療門診 醫師端



通訊診察門診

通訊診療門診

病患端流程

Tablet, smartphone, PC



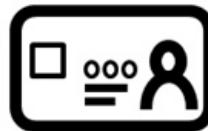
聯絡遠距中心：預約掛號



事前下載通訊軟體



當天給予通訊頻道密碼



連線後身份辨識，同意錄影

獲獎記錄

1. 2009年榮獲「教育部98年度政府服務品質獎」
2. 2009年遠距照護中心主任何奕倫醫師獲頒「第一屆遠距照護聯盟傑出貢獻獎」
3. 2010年榮獲「第二屆政府服務品質獎」
4. 2012年獲得國家生技醫療品質獎特色醫療組「SNQ國家品質標章認證」
5. 2013年獲得國家生技醫療品質獎護理組「SNQ國家品質標章認證」
6. 2013年獲得國家生技醫療品質獎醫療院所類/醫院特色組「SNQ國家品質標章認證」
7. 2013年獲得醫策會「智慧醫院資訊整合專案獎座」第一名之最高殊榮
8. 2013年獲得醫策會「智慧醫院資訊整合專案」認證標章
9. 2013年榮獲經濟部「第三屆產業創新學術獎」
10. 2013年遠距照護中心主任何奕倫醫師榮獲經理人雜誌第六屆「100MVP經理人」
11. 2014年榮獲第十一屆國家生技醫療產業策進會「國家新創獎」
12. 2014年獲得國家生技醫療品質獎護理組「SNQ國家品質標章認證」
13. 2014年獲得國家生技醫療品質獎醫療院所類/醫院特色組「SNQ國家品質標章認證」
14. 2015年榮獲經濟部第四屆「國家產業創新獎-創新菁英獎」
15. 2016年榮獲第19屆國家生技醫療品質獎-銀獎
16. 2016年榮獲第13屆國家新創獎--學研新創獎
17. 2016年獲得國家生技醫療品質獎護理組「SNQ國家品質標章認證」
18. 2016年獲得國家生技醫療品質獎醫療院所類/醫院特色組「SNQ國家品質標章認證」
19. 2017年榮獲財團法人醫院評鑑暨醫療品質策進會第18屆醫療品質獎(HQIC)競賽-佳作
20. 2017年獲得財團法人醫院評鑑暨醫療品質策進會第18屆醫療品質獎(HQIC)標章
21. 2017年獲得國家生技醫療品質獎醫療院所類/醫院特色組「SNQ國家品質標章認證」
22. 2017年獲得國家生技醫療品質獎護理照護服務類/護理特色專科組「SNQ國家品質標章認證」
23. 2018年獲得國家生技醫療品質獎醫療院所類/醫院特色組「SNQ國家品質標章認證」
24. 2019年獲得國家生技醫療品質獎醫療院所類/醫院特色組「SNQ國家品質標章認證」
25. 2019年獲得第十六屆國家生技醫療產業策進會續獎通過-「創新型遠距照護服務啟動未來健康促進新模式」



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for patient care in National Taiwan University
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– A 10-year experience**

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3. Oxana S. (2016). Investigation on Information Seeking Behavior and Information Needs of Head and Neck Cancer Patients. Master thesis. Department of Business Administration, National Taiwan University.

4. Stanton, A.L., Rowland, J.H., Ganz, P.A. (2015). Life after diagnosis and treatment of cancer in adulthood: contributions from psychoso-

cial oncology research. *American Psychologist*. 70(2), 159–174.

5. Yu, J.-Y. (2017) Improving Care with Learning through Patients Experiences: A Perspective of Facilitated Networks for Cancer, working paper.

6. Zuboff, S., Maxmin, J. (2002). *The support economy: Why corporations are failing individuals and the next*

episode of capitalism. New York, NY: Viking Penguin.

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Telehealth management program for patient care in NTUH

– A 10-year experience



The Telehealth Center of National Taiwan University Hospital was established in 2009 (Figure 1). Our center provides the fourth generation of a synchronized, integrated, remote management program for patients with multiple chronic diseases. The goal of our telehealth management program is to reduce the number of unplanned hospitalizations and improve overall health outcomes with the assistance of advanced monitoring and communication technologies. This telehealth management program provides the following services: (1) Re-

remote monitoring of biological data, including single-lead electrocardiography, blood pressure, heart rate, and pulse oximetry, which are transferred from the patients' homes to our center on a daily basis and on-demand; (2) comprehensive case management, for which purpose nurse case managers communicate with patients daily and on-demand by telephone to improve patient adherence to medication regimens and to provide personalized medical instruction; (3) continuous support from the medical team, which includes full-

time nurse case managers and cardiologists who are in charge of the telehealth management program 24 hours a day; and (4) integrated long-term care, with discussions conducted regarding long-term medications and management with the patients' primary-care physicians if acute conditions occur. Our telehealth program emphasizes the prevention and early detection of clinical deterioration as well as continuous, evidence-based medical care.