Paramedic Diagnosis of Stroke
Experiencing Long-Term Use of the Melbourne Ambulance Stroke Screen (MASS) in the Field

Janet E. Bray, PhD(C); Kelly Coughlan, BS; Bill Barger, ADHS; Chris Bladin, MD

Background and Purpose—Recent evidence suggests the Cincinnati Prehospital Stroke Scale is ineffectively used and lacks sensitivity and specificity. Melbourne (Australia) paramedics have been using the Melbourne Ambulance Stroke Screen (MASS) since 2005. The aim of this study was to review the real-world use of MASS 3 years after citywide implementation.

Methods—Two groups of consecutively admitted patients to an Australian hospital between January and May 2008 were used: (1) patients for whom paramedics performed MASS; and (2) patients with a discharge diagnosis of stroke or transient ischemic attack. Use of MASS was examined for all transports and for patients diagnosed with stroke or transient ischemic attack. The sensitivity and specificity of paramedic diagnosis, MASS, and Cincinnati Prehospital Stroke Scale were calculated. Paramedic diagnosis of stroke among patients with stroke was statistically compared with those obtained immediately post-MASS implementation in 2002.

Results—For the study period, MASS was performed for 850 (16%) of 5286 emergency transports, including 199 of 207 (96%) patients with confirmed stroke and transient ischemic attack. In patients in whom MASS was performed (n=850), the sensitivity of paramedic diagnosis of stroke (93%, 95% CI: 88% to 96%) was higher than the MASS (83%, 95% CI: 77% to 88%, P=0.003) and equivalent to Cincinnati Prehospital Stroke Scale (88%, 95% CI: 83% to 92%, P=0.120), whereas the specificity of the paramedic diagnosis of stroke (87%, 95% CI: 84% to 89%) was equivalent to MASS (86%, 95% CI: 83% to 88%, P=0.687) and higher than Cincinnati Prehospital Stroke Scale (79%, 95% CI: 75% to 82%, P<0.001). The initial improvement in stroke paramedic diagnosis seen in 2002 (94%, 95% CI: 86% to 98%) was sustained in 2008 (89%, 95% CI: 84% to 94%, P=0.19).

Conclusion—In our experience, paramedics have successfully incorporated MASS into the assessment of neurologically compromised patients. The initial improvement to the paramedics’ diagnosis of stroke with MASS was sustained 3 years after citywide implementation. (Stroke. 2010;41:1363-1366.)

Key Words: ambulance ■ diagnosis ■ emergency services ■ stroke

Emergency medical services (EMS) are an integral part of the acute stroke team.1 They are fundamental in maximizing the delivery of thrombolytic therapy to patients with stroke by correctly identifying stroke in the field, transporting patients with suspected stroke to acute stroke centers, and activation of Code Stroke Teams through prehospital notification.2,3

A variety of prehospital stroke screens have been developed to assist EMS to identify patients with stroke in the field (Table 1).4-7 Our previous work confirmed the value in using these screens, showing an immediate improvement in EMS diagnosis of stroke from a baseline of 78% to 94% after education and with use of the Melbourne Ambulance Stroke Screen (MASS).8 However, recent investigations of a similar screen, the Cincinnati Prehospital Stroke Scale (CPSS), suggest poor use by paramedics and low sensitivity and specificity.9,10 Additionally, no long-term evaluations of the use of prehospital screens have been conducted.

The aim of this study was to examine the use of MASS in the field 3 years after citywide education and implementation, specifically determining the use of MASS by paramedics and to calculate and compare the sensitivity and specificity of MASS, CPSS, and paramedic diagnosis of stroke to our previous findings.

Subjects and Methods
This study was a cross-sectional design of consecutive patients transported by EMS to an Australian hospital between January and May 2008. Methods are summarized in the Figure. Institutional ethical approval was received before the start of data collection.
Emergency Medical System
The Victorian EMS is described in detail elsewhere. In brief, Ambulance Victoria services 5 million people in the state of Victoria, Australia. Ambulance Victoria uses the Advanced Medical Priority Dispatch System with a 2-tiered response: Advanced Life Support paramedics and Mobile Intensive Care paramedics and takes approximately 387,000 emergency calls per year. The training of Advanced Life Support paramedics required 3 years of university study and a 1-year graduate program. Mobile Intensive Care paramedics have additional education and operate at an independent practitioner level. All paramedics received a 1-hour stroke education program and instruction on the use of MASS in 2004 to 2005. Paramedics perform the 3 MASS physical assessments (facial droop, hand grip, and speech) in conscious but neurologically compromised patients of no obvious cause such as drug overdose or trauma. If these assessments are positive for stroke, they obtain the remaining MASS history items and perform a blood sugar level to rule out stroke mimics and suitability for thrombolysis. If the MASS is still positive and the stroke is acute, paramedics transport the patient with suspected stroke to the nearest acute stroke center and activate the hospitals “Code Stroke Team” by calling the emergency department en route.

Hospital Setting
Box Hill Hospital (BHH), located in the eastern suburbs of Melbourne, admits approximately 500 patients with stroke per year. All patients with a confirmed diagnosis of stroke by neuroimaging or with a discharge diagnosis of transient ischemic attack (TIA) admitted to the hospital are entered into the Stroke/TIA registry.

Data Collected
Data were accessed through the Victorian Ambulance Clinical Information System and BHH Stroke/TIA registry. The Victorian Ambulance Clinical Information System allows paramedics to electronically record patient information and to access protocols and prompts for additional assessments that may be completed at the scene. The patient’s name, MASS assessments, and paramedic diagnosis were retrieved. This data were cross-referenced against the BHH Stroke/TIA registry (name, date, gender, and age) to determine if the discharge diagnosis was stroke or TIA. For patients with stroke and TIA with no MASS documentation (n = 8), MASS and CPSS were retrospectively applied based on the paramedic assessment.

Statistical Analysis
The sensitivity, specificity, positive and negative predictive values, and 95% CIs were calculated for MASS (positive or negative), CPSS (positive or negative), and paramedic diagnosis of stroke/TIA (yes or no) using the discharge diagnosis of stroke/TIA (yes or no). These were statistically compared in SPSS (Version 17.0) using the χ² test. A probability value <0.05 was considered statistically significant.

Results
Use of MASS
Of the 5286 emergency transports to BHH, 1004 (18%) were conscious but neurologically compromised with no immedi-

Table 1. Comparison of Validated Prehospital Stroke Screens

<table>
<thead>
<tr>
<th>Assessment</th>
<th>LAPSS</th>
<th>CPSS</th>
<th>MASS</th>
<th>OPSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessments suggesting stroke</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilateral facial droop or weakness</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unilateral arm drift or weakness</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Unilateral hand grip weakness</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Unilateral leg weakness</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Slurred or abnormal speech or mute</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Assessments ruling out stroke mimics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &lt;45 years</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>History of seizure or epilepsy</td>
<td></td>
<td></td>
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<tr>
<td>Abnormal blood glucose level</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Symptoms have resolved</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Additional criteria for thrombolysis ineligibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be transported within 2 hours of onset</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At baseline, wheelchair or bedridden</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glasgow coma Scale &lt;10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminally ill or palliative care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triage Level 1 and/or uncorrected airway, breathing or circulation problem</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LAPSS indicates Los Angeles Prehospital Stroke Screen; OPSS, Ontario Prehospital Stroke Scale.

1. Extract from the Victorian Ambulance Clinical Information System all patients transported to BHH between January and May 2008 with documentation in MASS fields – facial droop, hand grip, and speech

2. Determine whether MASS and CPSS were positive or negative for identification of stroke and document paramedic diagnosis.

3. Cross-match patients against Stroke/TIA registry and calculate sensitivity and specificity for MASS, CPSS and paramedic diagnosis and statistically compare.

4. Examine the paramedic diagnosis of stroke for Stroke/TIA patients and statistically compare to the 94% improvement in paramedic diagnosis seen immediately post-MASS implementation.

Figure. Flow chart of methods.
ately obvious cause. MASS was documented for 850: 16% of all transports and 85% of conscious neurologically compromised patients.

For the same period, 199 (96%) of 207 confirmed stroke or TIA admissions transported by EMS had MASS documentation. Patients with no MASS documentation (n = 8) were posterior ischemic strokes (n = 4), parietal intracerebral hemorrhages (n = 3), and a TIA (n = 1; Table 2); 4 of these patients had documentation of confusion and 2 were non-English-speaking.

Sensitivity and Specificity Analysis for Patients With Documented MASS

For patients with documented MASS, the sensitivity of the paramedic diagnosis of stroke was higher than MASS (93% versus 83%, P = 0.003) and equivalent to CPSS (93% versus 88%, P = 0.120; Table 3). In contrast, the specificity of the paramedic diagnosis of stroke was equivalent to MASS (87% versus 85%, P = 0.687) and higher than CPSS (87% versus 79%, P < 0.001). The MASS demonstrated equivalent sensitivity to the CPSS (P = 0.149) and higher specificity (P = 0.001).

Paramedic Diagnosis in Patients With Stroke and TIA

The improvement seen in stroke paramedic diagnosis after the introduction of MASS in a pilot group in 2002 (n = 78 of 83 [94%], 95% CI: 86% to 98%) was sustained in 2008 (n = 184 of 207 [89%], 95% CI: 84% to 94%, P = 0.19). Of the 22 cases in which EMS did not diagnose stroke, 63% (n = 14) did not meet MASS criteria for stroke, 14% (n = 3) were MASS-positive, and 23% (n = 5) did not have MASS documented.

Discussion

Our large study demonstrated high use of MASS in the field by paramedics and confirms the value of such screens in the identification of stroke. The excellent initial improvement in the diagnosis of stroke by paramedics after the pilot study of MASS\(^8\) was sustained 3 years after citywide education and MASS implementation.

The strengths of this study are that it examined the “real-world” use of prehospital stroke screens as used by paramedics and is 1 of a few studies to examine these screening tools outside of screening tool validation studies.

| Table 2. Patients With Stroke and TIA With No MASS Documentation (n = 8) |
|---|---|---|---|---|---|
| Age | Gender | Resides | Stroke Subtype | Symptoms | Paramedic Diagnosis | MASS Symptom |
| 1 | 74 | F | Nursing home | Ischemic—cerebella | Dizziness, unsteady gait, vomiting (non-English-speaking) | Vertigo | No |
| 2 | 87 | F | Nursing home | Ischemic—posterior | Fever, drowsy, nausea, confused speech | Confusion | Yes—speech |
| 3 | 86 | M | Retirement village | ICH—frontoparietal | Confusion, incontinence | UTI/confusion | Yes—speech |
| 4 | 68 | M | Home | ICH—parietal | Repetitive questioning, incontinence, fall with forehead hematoma | Altered conscious state posthead strike | Yes—speech |
| 5 | 74 | F | Home | Ischemic—cerebella | Nausea | Nausea | No |
| 6 | 86 | M | Nursing home | Ischemic—cerebella | Fall (non-English-speaking) | Collapse | No |
| 7 | 67 | F | Home | TIA | Dizziness, headache | Migraine | No |
| 8 | 70 | M | Nursing home | ICH—parietal–temporal | Confused, unsteady gait (Alzheimer) | Confusion | Yes—speech |

F indicates female; M, male; ICH, intracerebral hemorrhage; UTI, urinary tract infection.

Table 3. The Raw Data and Sensitivity Analysis of Paramedic Stroke/TIA Diagnosis, MASS and CPSS

<table>
<thead>
<tr>
<th>Paramedic Diagnosis</th>
<th>MASS</th>
<th>CPSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>185/199</td>
<td>166/199</td>
</tr>
<tr>
<td>93% (88–96)</td>
<td>83% (77–88)</td>
<td>88% (83–92)</td>
</tr>
<tr>
<td>Specificity</td>
<td>564/651</td>
<td>559/651</td>
</tr>
<tr>
<td>87% (84–89)</td>
<td>85% (83–88)</td>
<td>79% (75–82)</td>
</tr>
<tr>
<td>PPV</td>
<td>185/272</td>
<td>166/258</td>
</tr>
<tr>
<td>68% (62–73)</td>
<td>64% (58–67)</td>
<td>56% (50–62)</td>
</tr>
<tr>
<td>NPV</td>
<td>564/578</td>
<td>559/592</td>
</tr>
<tr>
<td>98% (96–99)</td>
<td>94% (92–96)</td>
<td>96% (94–97)</td>
</tr>
</tbody>
</table>

PPV indicates positive predictive value; NPV, negative predictive value.
However, the findings of this study must be considered in light of its weaknesses. First, the final diagnosis of TIA relied on a discharge diagnosis of TIA, and not all patients with true TIA may have been correctly diagnosed at discharge. Second, positive and negative predictive values are influenced by the prevalence of disease. Because only 23% of all patients with documented MASS were diagnosed as having stroke or TIA, these figures may not reflect true values. Lastly, it is possible that MASS was only performed in patients paramedics strongly suspected had experienced a stroke. This may have artificially inflated the specificity of the screen tools by excluding false-positives and explain the better performance of CPSS compared with previous reports.9,10

Another finding that conflicts with recently published studies in this area9,10 is the improvement in paramedics’ diagnosis of stroke. This disparity may be explained by differences in the samples studied. The previous studies reporting lower paramedic identification of stroke only examined patients with a paramedic diagnosis of stroke or a positive stroke screen, whereas we extended this to include all patients with documented MASS (positive and negative stroke screen). An additional explanation could be differences in paramedic training between Australia and the United States, which may also explain differences found in the use of stroke screens.

Recent work by Frendl et al reported poor use (37.5%) of the CPSS by paramedics in patients with stroke with no improvement after paramedic education.10 However, use of the MASS in our study was high (85% of conscious neurologically impaired patients transported and 96% of patients with stroke). A review of the patients with MASS showed the majority presented with neurological problems and explained falls. As discussed in a previous report,11 we attribute some of our success to our feedback system. For the first 18 months after education, we provided the transporting paramedics with the outcome of patients receiving thrombolytic therapy. This allowed us the opportunity to provide a reminder about MASS and to give feedback to paramedics about their contribution to successful patient outcomes.

Previous work has demonstrated that paramedic diagnosis of stroke results in faster in-hospital times12 and improving paramedic diagnosis of stroke with the use of paramedic stroke screening tools has been linked to increasing thrombolytic therapy rates to as high as 21%.13 In our hospital, thrombolytic therapy rates improved from 5%8 to 11%14 after the combined implementation of MASS and an in-hospital code stroke system.

In summary, our large study indicates that paramedics have successfully incorporated MASS into their assessment of neurologically compromised patients and that correct paramedic diagnosis of stroke remained consistently high 3 years after citywide implementation of MASS. Paramedic diagno-

Acknowledgments

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Disclosures

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References

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Paramedic Diagnosis of Stroke:
Examining Long-Term Use of the Melbourne Ambulance Stroke Screen (MASS) in the Field
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背景及目的：近期有证据提示辛辛那提院前卒中评估量表 (Cincinnati Prehospital Stroke Scale, CPSS) 未得到有效使用，且敏感性及特异性不高。墨尔本（澳大利亚）院前急救人员自 2005 年起一直使用“墨尔本急救卒中筛查” (Melbourne Ambulance Stroke Screen, MASS) 量表。本研究在 MASS 全市应用三年后进行，旨在对该量表的实际应用情况进行评估。

方法：研究对象纳入 2008 年 1-5 月连续收住澳大利亚医院的患者，分为两组：(1) 接受 MASS 院前评估的患者；(2) 出院诊断为卒中或短暂性脑缺血发作 (Transient Ischemic Attack, TIA) 患者，对所有针对急诊转运及诊断为卒中或 TIA 患者的 MASS 评估进行检验。分别计算出院前诊断、MASS 及 CPSS 的敏感性和特异性，并将卒中患者的院前诊断数据与 2002 年前版 MASS 刚实施时的数据进行统计学比较。

结果：研究期间共有 5286 名急诊转运病人，有 850 人 (16%) 接受了 MASS 评估，其中确诊为卒中和 TIA 者 199 人，占所有确诊为卒中和 TIA 的患者 (n=207) 的 96%。在接收 MASS 评估的患者中 (n=850)，卒中院前诊断的敏感性为 93%(95% CI：88%-96%)，显著高于 MASS 的敏感性（83%，95% CI：77%-88%，P=0.003），与 CPSS 敏感性相当（88%，95% CI：83%-92%，P=0.120），卒中院前诊断的特异性为 87%(95% CI：84%-89%)，与 MASS 特异性无显著差异（86%，95% CI：83%-88%，P=0.687），但显著高于 CPSS 特异性 (79%，95% CI：75%-82%，P<0.001)。2002 年 MASS 初步实施后卒中院前诊断率得到的改善 (94%，95% CI：86%-98%)，在 2008 年仍得以保持 (89%，95% CI：84%-94%，P=0.19)。

结论：本研究提示，MASS 已被成功地运用于神经功能缺损患者的院前急救评估，其对卒中院前诊断率的改善在全市应用三年仍得以维持。

关键词：急救，诊断，急诊服务，卒中

(Stroke. 2010;41:1363-1366. 安冉 黄纯臣 译 董强 校)
比较 MASS、CPSS 和院前诊断的敏感性、特异性，并与我们之前的卒中院前诊断研究结果进行比较。

研究对象与方法
本研究为横断面研究，研究对象为 2008 年 1-5 月期间经 EMS 连续收入澳大利亚医院的患者。方法如流程图所示。本研究在开始数据收集之前已通过伦理认证。

急诊医疗系统
关于维多利亚 EMS 的介绍在其它研究中已有详述 [8]。简言之，维多利亚急诊系统为澳大利亚维多利亚州的 5 000 000 人群提供服务，它采用高级医疗优先调度系统 (Advanced Medical Priority Dispatch System)，每年接受约 387 000 个急诊呼叫，它有两个应答级别：高级生命支持院前救护及移动重症监护救护。高级生命支持院前救护的培训包括三年大学课程及一年研究生项目。移动重症监护救护则需要在独立行医的水平上接受额外的培训和操作锻炼。

所有的院前急救人员皆于 2004-2005 年接受过一小时卒中培训项目以及 MASS 的使用指导。接受 MASS 评估的患者需符合有意识且存在神经功能受损，同时排除药物过量、外伤等明确病因。首先进行 MASS 体检评估，包括三个方面（面部检查、握力检查及言语检查）。如这些评估结果支持卒中诊断，则接下来进行 MASS 相关病史项目的询问及血糖水平检查，以排除卒中样发作，并进行统计学比较。统计学差异分析使用 SPSS11 软件进行，采用 Wilcoxon 列群秩和检验，检验水平为 0.05。

研究对象
有两组收入 BHH 的患者纳入本研究：(1) 通过 EMS 转运至 BHH 的患者; (2) 在卒中/TIA 登记系统中出院诊断为卒中或 TIA 患者。排除在院前评估时昏迷及无症状患者 49 人。

数据收集
所有数据通过维多利亚急诊临床信息系统及 BHH 卒中/TIA 登记系统获得。通过维多利亚急诊临床信息系统，院前急救人员可记录患者的电子信息，并获得有助于完成其它现场评估的流程提示，患者姓名、MASS 评估结果及院前诊断可在此系统中进行检索。其与 BHH 卒中/TIA 登记系统的相关数据（姓名、日期、性别和年龄）可交叉引用，从
而确定患者的出院诊断是否为卒中或 TIA。在诊断为卒中和 TIA 患者中，有 8 人无 MASS 评估记录，则通过院前评估记录对其进行回顾性的 MASS 及 CPSS 评估。

### 统计分析
本研究以出院诊断是否为卒中 / TIA (是 / 否) 为临床诊断标准，计算 MASS（阳性 / 阴性）、CPSS（阳性 / 阴性），及院前诊断为卒中或 TIA（是 / 否）的敏感性、特异性、阳性预测值、阴性预测值及 95% 可信区间 (95% CIs)。采用 SPSS (17.0 版本) 软件中 χ² 检验进行数据分析，P<0.05 被认为有统计学意义。 

### 结果

#### MASS 的应用

在急诊转运至 BHH 的 5286 名患者中，有 1004人 (18%) 符合有意识且存在神经功能受损，并且无明确病因的纳入标准，其中 850 人有 MASS 评估记录，占所有转运患者 16%，占所有有意识且存在神经功能受损患者的 85%。

在相同时间段内，有 207 名患者经 EMS 转运入院并确诊为卒中或 TIA，其中 199 (96%) 人有 MASS 记录。无 MASS 记录者有 8 人，包括后循环缺血性卒中 4 人，合并颅骨内出血 3 人，TIA 1 人 (见表 2)；4 人记录不详，2 人语言为非英语语种。

#### 经 MASS 评估的患者中敏感性和特异性分析

在有 MASS 评估记录的患者中，卒中院前诊断的敏感性高于 MASS (93% vs. 83%，P=0.003)，与 CPSS 敏感性相当 (93% vs. 88%，P=0.120，见表 3)。

而卒中院前诊断的特异性与 MASS 相比无统计学差异 (87% vs. 85%，P=0.687)，但显著高于 CPSS 特异性 (87% vs. 79%，P<0.001)。MAS 与 CPSS 敏感度相当 (P=0.149)，但特异性较 CPSS 高 (P=0.001)。

卒中和 TIA 患者的院前诊断

在 2002 年初步应用 MASS 的研究群体中，卒中院前诊断的识别率达到 94% (n=78/83, 95% CI: 86%-98%)，2008 年则为 89% (n=184/207, 95% CI: 84%-94%)，与之前 MASS 对院前诊断水平相当 (P=0.19)。在 22 例 EMS 未诊断出卒中的患者中，63% (n=14) 未达到 MASS 的卒中诊断标准，14% (n=3) 无 MASS 评估记录。

### 讨论

本项大样本研究提示了 MASS 在院前急救中的高利用率，并明确了其对卒中识别的价值。MASS 于全市推行应用三年之后，其在前期研究中对院前
卒中诊断的显著改善仍得以维持。

本研究的优势在于，能够对院前卒中筛查工具在实践应用中的情况进行检验，超出对筛查工具本身有效性的评估。但是，本研究结果也必然存在缺陷。首先，TIA 的最终诊断依赖于出院诊断，而并非所有真正的 TIA 患者的出院诊断都正确。第二，阳性及阴性预测值的评价受患病率的影响。因为仅有 23% 的有 MASS 记录的患者诊断为卒中或 TIA，所以这些数据可能并不影响真实的评价。最后，MASS 可能只在急救人员强烈怀疑其为卒中者中进行，因排除了部分假阳性数据，就造成了对筛查工具特异性的人为夸大，这也可以解释为何本研究结果相较于之前报道 CPSS 的效用得到明显改善 [9,10]。另一个与近期发表结果不一致的方面 [9,10] 为卒中院前诊断率的显著提高。此差异可能是由于样本范围不同造成，过去的研究只对院前诊断为卒中或卒中筛查阳性的患者进行检验，而本研究将范围扩大到所有有 MASS 记录的患者。另一个原因可能由于院前急救人员的培训在澳大利亚与美国之间有所不同，这也可用以解释筛查工具的使用率的差异。

近期 Frendl 等报道了 CPSS 在院前卒中患者中使用不佳 (仅为 37.5%)，且院前诊断率为卒中后无明显改善 [10]。但在本次研究中，MASS 的使用度很高 (在有意识的神经功能缺损患者中达 85%，在卒中患者中高达 96%)。经 MASS 评估的多数患者均存在神经系统症状，并有无法解释的跌倒。正如之前报道中讨论所得 [11]，我们将一部分成功原因归功于良好的回馈系统。在接受培训前的前 18 个月内，我们将患者接受溶栓治疗的结果提供给急救人员，这使我们有机会提醒他们进行 MASS 评估，并向其反馈他们的努力给患者带来的益处。

之前的研究所显示卒中诊断可缩短入院时间 [12]，并且利用筛查工具改善卒中院前诊断与溶栓率的提高有关，可使溶栓率升至 21% [13]，在本院联合使用 MASS 和入院卒中急救系统后，溶栓率从 5% [8] 提高至 11% [14]。

综上所述，此项大样本研究显示 MASS 与院前诊断相结合，可成功地应用于对神经功能缺损的患者评估。MASS 在全市范围内应用三年后，卒中院前诊断仍保持高水平。卒中院前诊断的敏感性较 MASS 高，提示卒中的培训项目很成功。

参考文献