A comparison of the performance of early warning score systems in predicting in-patient mortality in a regional hospital in Malawi.

India Wheeler

Research

Aims:

Early warning scores (EWS) are used comprehensively in developed healthcare settings to identify patients at risk of mortality. The HOTEL score (Hypotension, Oxygen saturation, low Temperature, ECG abnormality, Loss of independence) was developed and tested in a European cohort; however, its validity is unknown in resource limited settings. This study aimed to evaluate the performance of HOTEL, in comparison to the Modified Early Warning Score (MEWS), and suggested modifications to enhance performance.

Methods:

A prospective cohort study of adults (≥ 18yrs) admitted to the medical wards at a Malawian hospital. The primary outcome was mortality within two weeks. Appropriate ethical approval was obtained. Performance of MEWS and HOTEL were assessed using ROC analysis. Logistic regression analysis identified important predictors of mortality and a new score was defined.

Results:

Three-hundred-thirty-one patients were included in the study. Eighty (24.2%) died within 2-weeks of admission. The HOTEL score had sensitivity 68.8% (95% CI: 57.4-78.7) and specificity of 63.0% (95% CI: 56.65-68.94), and was superior to MEWS; sensitivity: 57.5% (95% CI: 45.9-68.5), specificity: 57.4% (95% CI: 51.0-79.8). The new score, called TOTAL (Tachypnoea, Oxygen saturation, Temperature, Alert, Loss of independence), showed slight improvement; sensitivity 68.8% (95% CI: 57.4-78.7), specificity 69.7% (95% CI: 63.6-75.3).

Conclusion:

EWS generated in developed healthcare settings do not have the same performance in settings where patient and disease profiles differ. A score based on predictors of mortality specific to the Malawian population showed enhanced accuracy but did not warrant clinical use. Further investigation into the value of additional clinical parameters is essential.
A study to determine the accuracy of the four part abbreviated mental test (AMT4) at detecting cognitive impairment in elderly acute hospital admissions

Thomas Locke

Research

AIM

Cognitive impairment is common amongst acute geriatric hospital admissions and is associated with nosocomial complications and poorer outcomes. The four-part abbreviated mental test (AMT4) has been promoted in the acute setting as a succinct cognitive assessment tool. However, there are concerns at this institution that it may be better suited to identifying dementia as opposed to delirium. This may act as an obstacle to accessing cognitive impairment care pathways. We aimed to evaluate the negative predictive value of the AMT4 within the acute setting by comparing it to three other validated tools. Specifically, could the AMT4 be improved by incorporating an additional question from these tools?

METHODS

We identified 100 acute medical admissions (>60 years old) with a negative AMT4 and administered the AMT10, six-item cognitive impairment test (6CIT) and confusion assessment method (CAM) within 24 hours of admission.

RESULTS

43.0% scored positively on at least one of the additional tests despite a negative AMT4. 42 patients had a positive 6CIT, 22 had a positive AMT10 and six had a positive CAM. 39/40 who made at least one error on the ‘months backwards’ question were positive for one or more screening tools.

CONCLUSION

Nearly half of the sample had signs of cognitive impairment despite a negative AMT4. Consequently, there is a risk of under diagnosis with potentially serious consequences for morbidity and mortality. Inattention was associated with cognitive impairment. The addition of such a test may strengthen the AMT4 without compromising its brevity and utility in the acute setting.

REFERENCES
Please note references removed as application form counting these in word total. Full references can be supplied at request.
A Survey of Recurrent Admissions: A Teaching Hospital Experience

Vicky Anne Price

Research

A Survey Of Factors Influencing Recurrent Admissions: A Teaching Hospital Experience

Aim:

Frequent users of acute services pose a significant financial pressure to the NHS trusts.

However, there is paucity of data on demographics of recurrent attenders to acute NHS services. This survey aimed to collate information about patients who recurrently attended to the acute admission unit in Aintree University Hospital NHS trust (AHT) during a 12 months period, to get an idea of the cost implication to the trust and areas in which this complex problem needs to be tackled.

Methods:

Retrospective analysis of case notes and electronic records using a standardised proforma was carried out for all recurrent attenders during 2010 (N= 258). A recurrent attender is defined as someone who was admitted to acute medical services for overnight stay for ≥ 4 times in 12 months.

Results:

Information regarding demographics was recorded and analysed, see Table 1 for a list of some of the basic data collected.

The most common reasons for recurrent admissions are demonstrated in Figure 1.

Conclusions/Recommendations:

There is a large financial burden to the trust from recurrent attendance.

Factors contributing to recurrent attendance include multiple co morbidities, mental health problems, living in socially deprived areas, poor social support at home, smoking and dependence on alcohol. Local care commissioning should reflect these issues.

Patients who recurrently attend are poorly recognised. This often results in inappropriate repetition of investigations and prevents admitting teams addressing individual cases.
Are below knee deep vein thromboses being missed by the lack of routine distal vein ultrasonography and are they associated with the development of post thrombotic syndrome? What are the implications for treatment?

Katherine Erica Smith

Research

AIMS:

· To determine if a significant number of deep vein thrombosis’ (DVT) are being missed by not routinely scanning patients’ calf veins.

· To determine whether routine distal vein scanning in suspected DVTs would reduce the burden of undertaking second scans.

· To determine whether distal DVTs are associated with the development of post-thrombotic syndrome (PTS), and whether anticoagulation reduces this risk.

METHODS:

- Retrospective review of patients who were investigated at Haywards Heath between 2004 and 2010 for post-operative swelling in whom the diagnosis was post-operative leg swelling or distal DVT.

- Patients were contacted and diagnosed with PTS in accordance with the Villalta Scale.

RESULTS:

- 42.5% of patients with distal DVTs were diagnosed on second ultrasound. Where initial ultrasounds were negative and included the distal veins, second scans were negative in 100%.

- Rates of PTS were 47.1% in those with distal DVTs compared to 53.6% in those with post-operative swelling, p=0.7572.

- Anti-coagulation did not alter the rates of PTS, p=0.2398.
CONCLUSIONS

- Routine scanning of distal veins reliably excludes distal DVTs on imaging.
- However, high rates of PTS in patients diagnosed with post-operative swelling suggest that distal DVTs are being missed despite scanning according to current guidance and requires further investigation.
- Distal DVTs are associated with a high PTS burden, however anti-coagulation was not shown to significantly alter this burden.

REFERENCES:

Barriers to uptake of oxygen therapy in Malawi: a qualitative study

Anna Clare Stevenson

Research

Introduction and Objectives: Oxygen is a scarce resource in many developing countries and there are current efforts to increase its availability. Clinicians in Malawi often report refusal of oxygen by patients. This qualitative study explores attitudes to oxygen therapy in Malawi.

Method: Focus group discussions involving 86 participants were held in rural and urban communities in Malawi until no new ideas were found. Framework analysis of transcripts of the audio recordings was carried out by at least two researchers to identify recurring themes.

Results: We found that participants’ knowledge of oxygen was limited, although many recognised that oxygen is used for respiratory diseases in adults and children. Knowledge of oxygen arose from personal experience, observation in hospital and discussion in local communities. Participants were keen to receive further education about oxygen therapy.

Attitudes to oxygen varied. Some participants recognised that it could benefit those with respiratory and other diseases, and had positive experiences of using it. Others expressed fear or anxiety about using oxygen and cited this as a reason for refusing it. Many of the participants had witnessed a patient’s death following the use of oxygen: “they are afraid that the patient is going to die ... because they had previously seen another patient dying after being placed on the machine”. Some had heard in their local communities that oxygen was used prior to the death of a patient: “even at the funeral ceremony people are told that the deceased went to the hospital and there he was put on oxygen and he died there, so this message terrifies people”.

Participants found the appearance and noise from oxygen concentrators alarming: “that device is fearsome just by looking at it. When you think of someone inserting this device in the nose or mouth, you may think they want to finish off the life of your child”.

Conclusion: This study impacts on efforts to increase the use of oxygen in Malawi and other developing countries. We have shown a need for education at a community level and for guidance for health workers seeking to increase the uptake of oxygen.
Changes and their prognostic implications in the abbreviated Vitalpac™ Early Warning Score (ViEWS) after admission to hospital of 18,853 acutely ill medical patients

John Kellett

Research

Aim: the best performing early warning score is Vitalpac™ Early Warning Score (ViEWS). However, it is not known how often, to what extent and over what time frame any early warning scores change, and what the implications of these changes are.

Methods: the changes in the first three recordings of an abbreviated version of ViEWS (that did not include mental status) after admission to hospital of 18,853 acutely ill medical patients, and their relationship to subsequent in-hospital mortality were examined.

Results: the 7717 (40.9%) patients with incomplete records were more likely to die in hospital (odds ratio 1.16, 95% CI 1.04 to 1.29, Chi-square 7.1, p 0.008). In the 10.4 SD 20.1 (median 5.0) hours between admission and the second recording the score changed in only 5.9% of patients and these changes were of no prognostic value. By the time of the third recording 34.9 SD 21.7 (median 30.0) hours after admission a change in score was clearly associated with a corresponding change in in-hospital mortality (i.e. an increase between the first and third recording of >=4 points increases mortality nearly five fold while a reduction of <=-4 points almost halves mortality).

Conclusion: after a median interval of 30 hours both the initial abbreviated ViEWS recording and subsequent changes in it are powerful predictors of clinical outcome. These findings support the concept of acute medical units that carefully assess and promptly treat patients, and then monitor their response over 48 hours in order to determine the appropriate level of care to which they should be then transferred.
Deprivation indices and mortality in the AMAU - St James's Hospital 2002-2011.

Richard Conway

Research

Aim

The hospital service patterns vs clinical outcomes report of the RCP(2012) suggested that hospitals in areas with higher deprivation had a lower adjusted case fatality rate\(^1\). Little data exists in a broader context on this deprivation-outcome relationship; we assessed its influence on 30-day in-hospital mortality for all emergency medical admissions between 2002 and 2011.

Methods

St James's AMAU has a database of over 62,000 patient episodes, with full demographic, biochemical and mortality data. We studied unique patients; last attendance was used if >1. We used the SAHRU small areas national classification system for Ireland\(^2\). Patient addresses were geocoded to assign spatial coordinates; these co-ordinates were allocated to the appropriate small area, each with known deprivation value. Quintiles of deprivation were calculated and entered into a logistic regression of known risk predictors of 30-day in-hospital mortality including illness severity, co-morbidity\(^3\) and troponin at presentation.

Outcomes/Results

31057 patients were included, average annual mortality was 8.7\%(95% CI 8.4 – 9.0) over the 10 years. Mortality increased by deprivation quintile from 7.0\%, to 8.4\%, 9.6\%, 9.6\% and 8.9\% respectively. Multiple logistic regression, adjusted for age, comorbidity and illness severity confirmed deprivation as an independent predictor of 30-day mortality with OR’s(compared with group 1) of 1.25, 1.42, 1.65 and 1.59 respectively(p<0.01). 87\% of patients were from the top half of deprivation risk; these had an adjusted mortality risk of 1.32(95% CI 1.20 – 1.44).

Conclusion

Mortality following an emergency medical admission is not alone determined by illness severity and co-morbidity; deprivation independently predicts and influences outcome.

References


How long does it take to get the right prescription on admission to hospital?

Jan Basey

Background

A recent study has shown that prescribing errors are most likely to occur on admission to hospital and that the most common type of error is omission of one or more of the patients’ usual medicines.(1) Delays in patients receiving appropriate medication may have both clinical and financial consequences.(2)

Aim

This study investigated the accuracy of prescribing and the delay in rectifying any errors following admission to hospital via the Acute Medical Unit (AMU).

Methods

NHS ethical approval was granted. Data were collected over four periods; November 2009, January 2010, April 2010 and April 2011. Patients case notes and corresponding medication charts were reviewed to identify the date and time of admission, whether a pharmacist had confirmed the patients medication history, whether any prescribing errors had been identified and if so the type of error and the time taken for these to be resolved.

Results

810 case notes and corresponding medication charts were reviewed; a medication history was completed by a pharmacist for 685 patients (84.6%). 851 prescribing errors were identified involving 319/685 (46.6%) patients; 737/851 (86.6%) were omissions. The delays in rectifying these errors are shown in the table; 64 patients, 20% of those affected, experienced a delay of more than 24 hours.

Conclusion

There may be significant delays in an accurate prescription being written when medical patients are admitted to hospital; the causes, possible adverse consequences and potential solutions require further investigation to minimise the risk to patients.

References

Hydration and Nutrition on the AMU - Can We Do Better?

Anjali Balasanthiran

Research

Aim

Nutritional and hydration assessment are important aspects of care for acutely unwell patients. Standardised nutritional assessments are common in clinical practice (e.g. MUST), but less so hydration(1). Bioelectrical Impedance Vector Analysis (BIVA) is an emerging technology to assess nutritional and hydration states(2). We measured the levels of hydration and nutrition of patients presenting to AMU by BIVA and Adult Nutritional Assessment Score (ANA)

Method

102 patients were assessed on admission to the AMU on unselected medical and surgical takes at Chelsea and Westminster Hospital between 0800am-1800pm (3rd–26th of July). Data was collected from patient notes, electronic records and review on admission.

Results

- 7/92 (7.6%) and 5/43 (11.6%) of patients were defined as at risk of malnourishment by BIVA and ANA respectively
- 10/100 (10%) and 20/100 (20%) of patients were defined as dehydrated and fluid overloaded by BIVA respectively.
- ANA and BIVA scores do not correlate ($r_s$ -0.23, N= 32, P = 0.902)
- ANA correlates well with the Waterlow Score ($r_s$ 0.515, N = 34, P = 0.003)
- BIVA correlated with BMI ($r_s$ 0.274, N = 69, P = 0.025 NB outliers removed)
- BIVA hydration scores displayed significant distribution over age bands (Fishers exact 34.352 P = 0.01)\textsuperscript{Figure 1}, as did BIVA nutrition scores (Fishers exact 23.166 P = 0.033)\textsuperscript{FIGURE 2}

CONCLUSION
A significant proportion of patients are dehydrated and malnourished prior to admission. ANA and Waterlow scores may have better discriminatory power over BIVA and BMI. BIVA’s utility and ease in assessing hydration deserves further study.

REFERENCES


Is mis-diagnosis and over treatment of hypothyroidism in the elderly contributing to increased medical admissions?

Emily Falconer

Research

Aim: To investigate whether mis-diagnosis and over treatment of hypothyroidism in the elderly (>65 years) is contributing to increased medical admissions.

Method: Data was collected over a period of two months from elderly patients on thyroxine therapy, admitted to the Acute Medical Unit (AMU) of Ninewells Hospital. Electronically available medical records and thyroid function tests over the past 10 years were reviewed to determine whether every patient had a biochemical requirement for levothyroxine initiation and to look for evidence of subclinical hyperthyroidism, resulting from inappropriate levothyroxine supplementation.

Results: Data from 35 patients (9 male, 26 female) was analysed. 80% of all patients were initiated on levothyroxine in the last 10 years. Of these only 21% showed a biochemical requirement (low T4 & high TSH) for levothyroxine initiation. 40% of all patients showed TSH readings below the lower limit of normal (<0.04μIU/L) on at least one occasion in the past 4 checks, suggesting inappropriate titration of levothyroxine. Of these, 35% were admitted to AMU with a presenting complaint which could be attributed to thyroxine therapy.

Conclusion: Our data suggests that elderly patients may be mis-diagnosed with hypothyroidism and inappropriately titrated with levothyroxine. Deranged thyroid function in the elderly may be due to altered thyroid physiology during acute illness and does not require treatment. Thyroxine is a catabolic hormone, leading to poor nutritional status, increased anginal pain and atrial fibrillation. Our data supports this view. We suggest caution when diagnosing hypothyroidism in the elderly and careful titration of levothyroxine in appropriate cases.
Mode of Transportation and Mortality in the AMAU - St James' Hospital 2002-2012

Rebecca Wu

Research

Aims:

There are some data suggesting that the mode of arrival at hospital influences the outcome; we have assessed any relationship with 30-day in-hospital mortality for emergency medical admissions over the last 10 years.

Methods:

St James's AMAU has a database of 62,000 patient episodes, with full demographic, biochemical and hospital mortality data. We studied unique patients; their arrival at hospital was classified as EMS (emergency medical services – ambulance), car/taxi, bus/tram or ‘walk-in’. We determined the significance of mode of arrival on 30-day in-hospital mortality in a univariate and multivariate logistic regression model (Stata 12.2) adjusting for know risk predictors including illness severity, co-morbidity, deprivation status and troponin status at presentation.

Results:

31059 patients were included, with an average annual mortality of 8.7% (95% CI 8.4 – 9.0) over the 10 years studied. EMS arrivals were more likely to die by day 30 (14.8%) compared with arrivals by car/taxi (2.9%), bus/taxi (1.1%) or ‘walk-ins’ (2.1%). Multiple logistic regression, adjusted for age, comorbidity and risk group confirmed EMS as an independent predictor of 30-day mortality with OR’s (compared with group 4) of 2.46 (95% CI 2.03 – 2.99: (p<0.01).

Conclusion:

The mode of arrival at hospital (especially EMS), independently of co-morbidity, illness severity and deprivation, is an independent predictor of the 30-day hospital mortality.

References:

Multisite studies on AMUs – Lessons from a regional AKI study

Christopher Gibbins

Research

Early detection of AKI can improve outcomes. The aim of this project was to use AAUs at different hospital sites across the North East England to develop interventions that are practical and effective and will improve the AKI management.

Methods: All sites in the Northern Deanery area were invited to participate. Registrars and consultants within each unit were tasked with leading the project locally with a registrar and consultant overseeing the project regionally. A data collection tool was developed by IT to collect data in a pilot study that would provide a picture of current practice. The aim was to recruit 50 patients at each site. Each site would then develop and implement its own intervention and re-audit a further 50 patients. Quantitative data on outcomes would be collected from the data collection tool and qualitative data would be collected via questionnaires.

Results: 8 of 12 sites in the North East were involved in the study. Reasons for non-participation were lack of acute physicians. By June 2012, the pilot study was nearing completion at 6 sites. Each site collected data on between 35 and 45 patients. There was considerable variation between sites in support for the project from clinical audit departments. Limited access to medical records and a time consuming data entry process were the most common reason for failure to reach the target of 50 patients. Interventions at participating sites included pharmacy reviews, 24 hour access to USS, education, sticker prompts and improved fluid management. The re-audit using the same data collection tool will indicate whether these interventions improved care of patients with AKI.

Conclusions: By coordinating attempts to improve care of AKI regionally, we have been able to establish a picture of current AKI practice across the North East and develop and implement interventions that may improve the outcome for patients.
Predictors for hospital admissions associated with Adverse Drug Events: A prospective analysis of 3,904 patients

Jaydeep Mandal

Research

Aim: Preventable Adverse Drug Events (ADEs) are known to be a significant cause of hospital admission. [1-4] The aim of this study was to identify predictors for hospital admissions associated with preventable ADEs in the general population.

Methods: Data for this study were from a prospective observational study, in which the contribution of ADEs to hospital admission, and the causality, severity and preventability of the event were independently assessed by a multidisciplinary clinical team. Multivariate logistic regression was used to identify predictors for hospital admissions associated with ADEs and maximum-likelihood multinomial model used to examine predictors for preventability of ADEs.

Results: 439 patients [11.24 %, (95% C.I. 10.27-12.27)] were judged by the review panel to have experienced causal ADEs. Of these, 209 patients (47.61%) experienced preventable ADEs. Four independent variables: patient age; length of time since initiating new drugs; total number of prescription drugs; and the proportion of patients admitted to each hospital site were found to have significant relationships with ADE admissions and preventability of ADEs. Drug classes most involved in preventable ADEs were antiplatelet drugs, anticoagulants, diuretics (loop and thiazides diuretics), ACE inhibitors, and antiepileptic drugs.

Conclusion: Better systems for Doctors and Pharmacists, to identify patients at high risk of preventable hospital admissions associated with ADEs (i.e. >65 years old, on more than 5 drugs; and when starting new high risk medications) should be put in place in order to minimise the risks to patients and the burden on the healthcare system, in particular acute medical units.
The Efficacy of the Novel Heart Attack Centre Extension Pathway (HACX)

Dhanuka Perera

Research

AIM: Barts and the London’s novel Heart Attack Centre Extension (HACX) programme was introduced to provide a direct pathway for Non-ST elevation myocardial infarction (NSTEMI) patients from A&E to a tertiary intervention centre. Subsequently, patients have earlier access to angiography and consequent treatment including percutaneous coronary intervention (PCI), coronary artery bypass grafting (CABG), and non-surgical interventions. There is no research on the benefit of this programme.

METHODS: Over three months, 33 patients transferred via the HACX pathway and 37 patients transferred via the conventional inter-hospital transfer pathway (IHT) were followed up. All patients fulfilled the HACX criteria and were discussed with cardiology prior to transfer. Patient suitability for angiography, post-angiography procedures, and 3-month mortality were analysed. Data was obtained from the SYMPHONY and PAS computer system.

RESULTS: Of 33 patients (mean age 61 +/- 15.2 SD) transferred via HACX, 30 patients (91%) were appropriately identified for an angiogram. Seventeen patients (52%) required PCI, 5 patients (15%) required CABG, 4 patients (12%) non-surgical intervention, and 4 patients (12%) no treatment. Controls included 37 patients (mean age 71 +/- 12.6 SD). Seventeen patients (46%) required PCI, 6 patients (16%) required CABG, 8 patients (22%) non-surgical intervention and 6 (16%) no treatment. At 3-month follow-up, 32 patients (97%) of HACX and 36 patients (97%) of the IHT cohort were alive.

CONCLUSION: HACX accurately identifies and rapidly transfers appropriate NSTEMI patients requiring early coronary revascularisation. There was no mortality benefit at 3 months. Further studies with larger patient cohort and longer follow-up are required to consider nationwide implementation.
Understanding of recruitment, retention and career progression for Nurses in acute medicine

Liz Lees

Research

Aim

To explore the reasons what attracts nurses to work in acute medicine; what factors positively influence their reasons to stay in acute medicine and why some choose to leave. This national research expands upon a two centre pilot study and provides in-depth analysis in the areas of expectations, opportunities and motivations (1). It is hoped that this work will enable a deeper understanding of the nursing workforce characteristics in acute medicine (2).

Methods

Survey designed using on-line technology with 27 questions via 'survey monkey application'. Both quantitative and qualitative data were extracted, after which a whole content thematic analysis was conducted. Respondent data was coded, displayed and manipulated to allow for the creation of themes in matrices to evaluate for associations and divergences. Validation was achieved through a panel of experts in acute medicine.

Results

Nurses were primarily attracted to work in acute medicine due to the acuity of patient conditions, the fast pace and diversity of workload. Actual student experience on AMU attracts junior staff to work in AMU. Experience however, in other clinical areas helps nurses to deal with diversity of situations experienced and the stamina to stay in AMU. Lack of a clear career pathway or specialism; specific nursing courses for development; and burnout through poor staffing levels were commonly cited as reasons to leave.

Conclusions

Workforce tools which reflect the diversity of workload in AMU to enable appropriate staff ratios per patient versus dependency need to be developed; equally, support to develop nationally recognised acute medicine nursing courses - similar to those available in emergency medicine, is needed to afford acute medicine nursing the status it deserves and retain experienced clinical nurses in acute medicine.

References:


(2) Fletcher, R., Advancing nursing skills on the medical admissions unit (2007) Vol 103, Issue 24, 33 - 33
Who wants to be an Acute Medic? A Survey of Junior Doctors attitudes towards and beliefs surrounding a career in Acute Medicine.

Gary Misselbrook

Research

AIM: Survival of Acute Medicine (AM) depends on successful recruitment of enthusiastic and able juniors to the specialty. Locally, juniors appeared unaware of routes into Acute Medicine, opportunities available during training, and expressed low levels of confidence in managing medical emergencies. We conducted a survey to ascertain whether attitudes were similar nationwide.

METHODS: A survey for Foundation, Acute Care Common Stem (ACCS) and Core Medical (CMT) doctors was distributed to all deaneries in England. Anonymous participants answered statements on a Likert Scale (1-10) under four headings: confidence in AM, perceptions of AM, routes into AM, and interest in AM.

RESULTS: Four deaneries participated in the project. 397 responses were received (18.6% response rate). Confidence in AM increased with training level (Figure 1) but was low overall (mean score 6.76). Junior doctors had poor perceptions of possible training opportunities in AM (Table 1). 20% of juniors did not know the routes into AM. On average, juniors agreed that becoming a medical registrar would discourage them from careers in AM (mean score 6.10) but training including ACCS, CMT or MRCP exams did not deter them.

DISCUSSION: This study reveals a lack of awareness of training opportunities available in AM amongst junior doctors. There was a perceived lack of confidence in managing acutely unwell patients and a reluctance to pursue the medical registrar role, which may be linked. Access to, and opportunities in AM should be highlighted at career events. Further promotional work regarding training opportunities will be invaluable in future workforce planning.

References: