# A Clinical Decision Support System to Prevent Aggression and Reduce Restrictive Practices in a Forensic Mental Health Service

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**Objective:** Preventing aggression and reducing restrictive practices in mental health units rely on routine, accurate risk assessment accompanied by appropriate and timely intervention. The authors studied the use of an electronic clinical decision support system that combines two elements, the Dynamic Appraisal of Situational Aggression instrument and an aggression prevention protocol (eDASA+APP), in acute forensic mental health units for men.

**Methods:** The authors conducted a cluster-randomized controlled trial incorporating a crossover design with baseline, intervention, and washout periods in a statewide, secure forensic mental health service. The study included 36 mental health nurses (13 men and 23 women, ages 20–65 years) with direct patient care responsibility and 77 male patients (ages 21–77 years) admitted to one of two acute mental health units during the baseline and intervention periods.

**Results:** eDASA+APP implementation was associated with a significant reduction in the odds of an aggressive incident (OR=0.56, 95% confidence interval [95% CI]=0.45–0.70, $p<0.001$) and a significant decrease in the odds of administration of as-needed medication (OR=0.64, 95% CI=0.50–0.83, $p<0.001$). Physical aggression was too infrequent for statistical significance of any effects of eDASA+APP to be determined; however, incidents of physical aggression tended to be fewer during the eDASA+APP phase.

**Conclusions:** These results support the use of the eDASA+APP to help reduce incidents of aggression and restrictive practices in mental health units.

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Aggression is a significant problem in general (1–3), geriatric (4), emergency (5), and acute mental health care settings (6, 7). Preventing aggression relies on accurate identification of patients at risk for becoming aggressive, followed by timely intervention. Early recognition of patients' risk for aggression is key to empowering staff to manage aggression (8). Interventions should be proportionate to the level of risk posed so that they are not unnecessarily restrictive, are assertive enough to prevent harm, and do not increase the risk for escalation. Restrictive practices carry the risk for undermining staff's physical safety and emotional well-being (9) and can result in harm to patients (10, 11). Restrictive practices also have a deleterious impact on unit atmosphere (12) and the therapeutic relationship between staff and patients (13, 14).

## DYNAMIC APPRAISAL OF SITUATIONAL AGGRESSION

Dynamic Appraisal of Situational Aggression (DASA) (15, 16) is a seven-item actuarial assessment instrument designed to appraise risk for imminent (i.e., in the next 24 hours) aggression in mental health units. The DASA has moderate to outstanding levels of predictive validity, indicated by an average area under the curve of 0.82 reported in a recent

### HIGHLIGHTS

- Use of an electronic clinical decision support system combining the Dynamic Appraisal of Situational Aggression instrument with an aggression prevention protocol (eDASA+APP) was associated with significantly reduced odds of aggressive behavior in a forensic mental health unit.
- eDASA+APP was also associated with a significant reduction in the use of more controlling interventions (e.g., administration of as-needed medication) and with a significant increase in proactive, noncoercive interventions.
- eDASA+APP use prompted a larger number of nursing interventions early during an escalation.

meta-analysis study (17), and it has been recommended by the National Institute for Health and Care Excellence (18) as best practice for preventing violence in mental health units. Although research has shown that the DASA has strong predictive validity, until recently no accompanying guidelines existed that specified interventions to prevent aggression on the basis of DASA scores. Moreover, some commentators have argued that risk assessment instruments have not been demonstrated to prevent aggressive behavior (19), highlighting a lack of integration between risk assessment and management.

## CLINICAL DECISION SUPPORT SYSTEMS AND THE EDASA+APP

Clinical decision support systems (CDSSs) have emerged to improve the uptake of evidence-based decision making by clinicians (20, 21). An innovative computerized electronic version of the DASA augmented with an aggression prevention protocol (eDASA+APP) recommends nursing interventions according to an APP (19) on the basis of DASA-estimated risk level. An initial trial of the eDASA+APP instrument resulted in reduced verbal aggression, seclusion, restraint, and administration of as-needed medication (22). This previous trial was conducted in a secure forensic women-only unit and involved a pretest-posttest design.

The present study extends this initial trial (22) by testing the eDASA+APP in two mental health units for men and by using a crossover design to allow for comparison of conditions. The aim of eDASA+APP implementation was to increase the use of routine risk assessment and proactive early intervention practices and to reduce rates of inpatient aggression and restrictive practices.

## METHODS

### Setting

The study was conducted in two secure acute units for male patients in Thomas Embling Hospital (TEH), a statewide secure forensic mental health service in Melbourne. Each unit contained 17 beds, none of which was empty for >24 hours during the study. Approval to conduct this research was obtained from the Human Research Ethics Committee of Swinburne University (ethics approval number 2017/080).

### Participants

Patients present during the study period were men admitted to one of the two mental health units during the baseline and intervention periods and were 21–77 years old. Most had a psychotic illness. Thirty-six permanent, fully registered mental health nurses with direct patient care responsibility who were directly employed at TEH participated in the study; 13 men and 23 women, ages 20–65 years. All staff were fully registered nurses and had completed between 3 and 7 years of tertiary nursing education. Contract staff were excluded because of the transient nature of their employment.

### Research Design

We used a prospective randomized controlled trial (RCT) with crossover design incorporating a baseline and two intervention phases, one for each participating unit, interspersed by a washout period (see flow diagram, available as an online supplement to this article).

### Outcome Measures

We examined staff use of the clinical decision support tool, the eDASA+APP, to guide nursing interventions for aggression prevention. Outcomes included participating staff's use of nursing interventions associated with use of eDASA+APP, acts of verbal and physical aggression among patients or toward staff or objects, and staff use of other nursing interventions. Information on outcome measures was obtained through review of TEH health records and the seclusion register.

### Instrument Components

*Adapted Overt Aggression Scale.* The Adapted Overt Aggression Scale (OAS) (23) categorizes aggressive behavior into verbal aggression, aggression against objects, aggression toward self, and physical aggression toward staff or patients. Aggression toward self was excluded because the study's focus was outwardly directed aggression. When several types of aggression (e.g., verbal and physical) occurred during one incident, all types were included in the analysis of the likelihood of aggression. The Adapted OAS is incorporated into the eDASA and into the eDASA+APP clinical decision support tool.

*DASA.* The DASA (15) is an actuarial instrument designed to rate the risk for aggression in the next 24 hours. It incorporates seven items (negative attitudes, impulsivity, irritability, verbal threats, sensitive to perceived provocation, easily angered when requests are denied, and unwillingness to follow directions), scored for their presence (1) or absence (0) during the preceding 24 hours. Items are summed to produce three risk bands (24): 0, low; 1–3, moderate; and 4–6, high. The DASA was in routine use in both units before this study, so staff were familiar with it. At the commencement of the baseline phase, the eDASA was loaded onto nursing station computers. The eDASA has drop-down menus for staff to rate DASA items, and it automatically sums items before providing a risk category. The eDASA does not provide recommendations for interventions.

*eDASA+APP.* Previous research has reported that some interventions increase the risk for aggression at particular DASA risk bands (24). The APP incorporates interventions that have been found not to increase aggression risk when implemented at specific DASA risk bands (25, 26). In the low-risk band, indicated interventions include distraction

(including use of exercise, sensory modulation, or redirection) and engagement (involving direct one-to-one engagement); as-needed medication (for behavior management) and limit setting (clarification of rules and guidelines) are contraindicated for this risk band. In the moderate-risk band, engagement, deescalation (use of verbal deescalation strategies), and distraction are recommended, whereas reassurance and limit setting are contraindicated. In the high-risk band, no intervention is contraindicated (24, 27). After eDASA completion, the APP-indicated interventions are recommended. Incidents of aggression are recorded daily by nursing staff in eDASA+APP, as they are routinely in the usual DASA.

### Study Phases

*Baseline (months 1 and 2)*. Between January 4, 2018, and March 5, 2018, participating units were provided with eDASA, ensuring that the impact of eDASA+APP could be distinguished from the effect of simply providing an electronic version of the DASA.

*Staff training*. Just before each eDASA+APP implementation phase, staff from the participating units were provided with two 3-hour training sessions to introduce eDASA+APP and its associated interventions. Hard-copy training manuals and posters detailing eDASA+APP were placed in the two units' nursing offices.

*Intervention phase 1 (months 3 and 4)*. Between March 6, 2018, and May 4, 2018, the two units were randomly allocated to the control (eDASA) or experimental (eDASA+APP) conditions using an online random-number generator. Once per day, at 1:00 p.m., nursing staff in unit 1 completed eDASA+APP for all patients, and nursing staff in unit 2 completed the eDASA (without the APP) and implemented nursing interventions on the basis of clinical judgment. After the handover stage, staff on the subsequent shift referred to the recommendations when selecting interventions.

*Washout period (months 5 and 6)*. A 2-month washout period followed intervention phase 1, during which staff on both units completed the eDASA, without the associated APP. Washout periods are considered best practice in clinical trials with crossover designs (25); in this study, the washout was included to reduce carryover effects on nursing practice.

*Intervention phase 2 (months 7 and 8)*. Between July 16, 2018, and September 18, 2018, the intervention and control conditions were reversed. Staff in unit 1 completed the eDASA without the APP and implemented nursing interventions on the basis of clinical judgment, and staff in unit 2 completed eDASA+APP for all patients, choosing interventions after viewing those suggested by the CDSS instrument.

### Data Analyses

*Multilevel analysis*. Aggression, seclusion, and nursing interventions for each patient were recorded as present or absent for each day. The analysis was conducted with a two-level hierarchical linear model (HLM). HLMs were produced with HLM 7.03 (student version) (26) for individuals for whom we estimated the effect of the eDASA+APP. The estimates obtained from each individual provided a random sample of values that enabled acquisition of a population estimate for the eDASA+APP effect. This method automatically allows for variation in the number of observations obtained for each individual and enabled controlling for the impact of individual characteristics, including age and psychiatric diagnosis, on rates of aggression. Age was the only significant predictor of aggression and was therefore controlled for in all analyses of aggression.

The multilevel data structure involved repeated measurements on persons, with measurements clustered within persons and predictors available at the measurement or person level. For example, for person $j$ on day $t$, the probability of aggression is

$$\Pr(y_{jt}=1)=\text{logit}^{-1}(\beta_0+\beta_1\text{age}_j+\beta_2\text{eDASA}_{jt})$$

where $\text{eDASA}_{jt}$ is a binary variable set to 1 when patient $j$ is in a ward with eDASA on day $t$ or 0 when the patient is not present on the participating ward. The intraclass correlation coefficient (ICC) is calculated by determining the percentage of the variation that can be attributed to participant differences as opposed to differences over time. The ICC also measures the correlation between the observations for any individual across days.

*Baseline analysis*. Aggression, seclusion, and nursing interventions were examined for both units at baseline to identify preexisting differences. We analyzed use of indicated strategies by risk level with IBM SPSS Statistics, version 25, to identify the proportion of interventions that were indicated by eDASA-estimated risk level, according to the APP. Baseline comparison of the units was conducted with a two-level HLM analysis, as explained above, assuming a binary logistic regression model in the case of incidents of aggression and seclusion, and with a Poisson model, allowing for overdispersion, in the case of the number of indicated nursing interventions.

*Intervention analysis*. We examined the effect of eDASA+APP relative to eDASA only for the daily incidence of nursing interventions, aggression, and seclusion. The overdispersion statistic was calculated for the Poisson distribution, allowing for the fact that variances exceeded means, and the model standard errors were then multiplied by the square root of this overdispersion statistic to preclude standard error underestimation.

## RESULTS

### Baseline Comparison of Units

The patients' demographic characteristics and psychiatric diagnoses are shown in Table 1. Nursing interventions, routinely recorded in the medical record, were extracted from

**TABLE 1. Demographic and mental health characteristics of patients admitted to two acute mental health units during the baseline and intervention periods**

| Characteristic | N | % |
|---|---|---|
| Age (M±SD) | 39.6±10.9 | |
| No. of patients | 77 | 100 |
| Total occupied-bed days | 5,724 | 100 |
| Unit 1 | 2,994 | |
| Unit 2 | 2,730 | |
| Male gender | 77 | 100 |
| *DSM-5* diagnosis[a] | | |
| Delusional disorder | 4 | 5 |
| Bipolar disorder | 2 | 3 |
| Schizophrenia | 55 | 71 |
| Schizoaffective disorder | 11 | 14 |
| Personality disorder | 12 | 15 |
| Unspecified or drug-induced psychosis | 12 | 15 |

[a] Patients could have more than one diagnosis.

daily medical records and analyzed. The frequency and type of aggressive incidents were similar for the two units at baseline, except for verbal aggression among patients, which was statistically significantly more common in unit 2 (odds ratio [OR]=1.58, 95% confidence interval [95% CI]=1.20–2.03, t=3.7, df=45, p<0.001). Odds of staff use of nursing interventions were also similar between the two units at baseline. Staff use of reassurance, distraction, talk-down or deescalation, and limit setting did not differ significantly between the units at baseline. We did, however, observe differences in the use of some interventions between the units. Administration of as-needed medication was significantly more frequent in unit 2 (OR=1.98, 95% CI=1.36–2.89, t=3.7, df=45, p<0.001), and we noted significantly higher odds of use of interventions in unit 2 during the baseline phase that would have been contraindicated by the APP (OR=1.94, 95% CI=1.38–2.74, t=4.0, df=45, p<0.001). The two units were selected to ensure similarity and did not differ in terms of patient characteristics, procedures, or protocols. Staff were generally assigned to only one unit; therefore, the observed differences in medical practice may have reflected staff differences but were unlikely to represent unit differences.

### Effects of eDASA+APP on Aggression

When eDASA+APP was used, the units had a significant reduction in the odds of an aggressive incident (verbal, physical, and property damage combined) (OR=0.56, 95% CI=0.45–0.70, t=−5.0, df=75, p<0.001). The odds of verbal aggression were significantly reduced in the eDASA+APP condition compared with the baseline phase, in which only eDASA was used (OR=0.56, 95% CI=0.44–0.70, t=−5.1, df=75, p<0.001). Too few instances of physical aggression occurred in either condition to allow meaningful statistical analyses; however, the total number of physical incidents was lower during the eDASA implementation. See Table 2 for statistical analyses of differences in aggression and Table 3 for descriptive statistics for all forms of aggression.

**TABLE 2. Odds ratios for aggression after implementation of the eDASA+APP instrument, compared with baseline[a]**

| Variable | OR | 95% CI | t | p |
|---|---|---|---|---|
| Verbal toward any target | .56 | .44–.70 | −5.1 | <.001 |
| Verbal toward staff | .51 | .40–.65 | −5.7 | <.001 |
| Verbal toward patients | .51 | .44–.60 | −9.7 | <.001 |
| All forms together | .56 | .45–.70 | −5.0 | <.001 |

[a] eDASA+APP, electronic Dynamic Appraisal of Situational Aggression+ aggression prevention protocol. df=75 for all t values.

### Effects of eDASA+APP on Nursing Interventions

In both units, interventions appropriate to risk level according to the APP significantly increased during the use of eDASA+APP (OR=2.36, 95% CI=1.87–2.99, t=−7.3, df=75, p<0.001), compared with baseline, whereas contraindicated interventions exhibited no significant change. We observed significant differences in the use of several nursing interventions, with a particularly large increase in noncoercive interventions; during the eDASA+APP use, the odds of one-to-one nursing and the use of reassurance and distraction techniques significantly increased. The odds of nurses reporting the use of deescalation increased significantly (OR=1.50, 95% CI=1.22–1.83, p<0.001) and odds of the use of limit setting also increased significantly (OR=1.37, 95% CI=1.23–1.83, p=0.01). The odds of nurses reporting the use of as-needed medication administration decreased significantly (OR=0.64, 95% CI=0.50–0.83, p<0.001). Table 4 summarizes the results of the changes in nursing interventions.

### Seclusion

Seclusion was examined in terms of the total number of discrete seclusion episodes per patient, in addition to the total number of days involving any degree of seclusion per 1,000 occupied-bed days (OBDs). At baseline, the units did not significantly differ in the total number of seclusion days; however, seclusion was used more frequently but for briefer periods in unit 2 (OR=2.87, 95% CI=1.43–5.69, t=3.1, df=43, p<0.001). Compared with baseline, there were fewer seclusion episodes per 1,000 OBDs during eDASA+APP use. Overall, 22.3 seclusion episodes per 1,000 OBDs occurred during baseline, and 16.2 seclusion episodes per 1,000 OBDs occurred during eDASA+APP use.

### Uptake of eDASA and eDASA+APP

Earlier iterations of the DASA used in the same hospital had only a 60% uptake rate, despite DASA use being hospital policy (24). We found improved completion rates for both the eDASA and the eDASA+APP, with daily eDASA or eDASA+APP use occurring in >85% of OBDs for all phases of the study regardless of the instrument version used. Staff surveys indicated that most staff found the instrument useful.

## DISCUSSION

Introduction of the eDASA+APP instrument was associated with increased use of indicated nursing interventions,

**TABLE 3. Aggression at baseline and during use of the eDASA+APP instrument[a]**

| | Condition | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | | | | | eDASA+APP | | | | |
| Characteristic | M[b] | SD | Max[c] | N[d] | OBD | M[b] | SD | Max[c] | N[d] | OBD |
| Incidents of physical aggression | | | | 82 | | | | | 17 | |
| Unit 1 | .077 | .298 | 2 | 60 | 784 | .011 | .106 | 1 | 8 | 707 |
| Unit 2 | .032 | .191 | 2 | 22 | 696 | .014 | .116 | 1 | 9 | 664 |
| Incidents of verbal aggression | | | | 222 | | | | | 58 | |
| Unit 1 | .153 | .419 | 2 | 120 | 784 | .024 | .162 | 2 | 17 | 707 |
| Unit 2 | .147 | .385 | 2 | 102 | 696 | .062 | .259 | 2 | 41 | 664 |
| All incidents | | | | 304 | | | | | 75 | |
| Unit 1 | .230 | .624 | 4 | 180 | 784 | .035 | .213 | 2 | 25 | 707 |
| Unit 2 | .178 | .489 | 3 | 124 | 696 | .075 | .306 | 2 | 50 | 664 |

[a] eDASA+APP, electronic Dynamic Appraisal of Situational Aggression+aggression prevention protocol.
[b] Means were calculated as incidents per occupied-bed day (OBD).
[c] Max refers to maximum number of incidents on any given day. Median values for both conditions were 0.00.
[d] N refers to the total number of incidents.

reductions in all forms of aggression, and reduced use of restrictive interventions. The high rate of completion during both the baseline and the eDASA+APP phases indicates that staff were willing and able to use the eDASA and eDASA+APP instruments, which was confirmed by staff surveys indicating that staff found the instrument helpful. Although eDASA+APP use was associated with a significant increase in nursing interventions indicated by the APP, staff did not decrease the use of interventions contraindicated by the APP. The eDASA+APP instrument does not warn staff not to use contraindicated interventions. Previous studies have found that staff are resistant to CDSS technology that instructs them not to carry out contraindicated interventions (27); however, an alert that is provided when the APP contraindicates an intervention may prove useful in reducing clinical override.

Two RCTs have examined structured interventions that assist in the management of patient aggression, the Safewards trial (12) and the early recognition method (8). In both trials, early detection and noncoercive interventions were provided, which significantly reduced patient aggression. However, neither intervention provided prompts for empirically derived interventions targeted to specific risk levels. The current study builds on this work by incorporating systematic selection of interventions on the basis of previous analysis of the effectiveness of interventions at each risk band and automating these suggestions within a CDSS.

**TABLE 4. Effects of the electronic Dynamic Appraisal of Situational Aggression+aggression prevention protocol instrument on nursing interventions, compared with baseline**

| Variable | OR | 95% CI | t | df | p |
|---|---|---|---|---|---|
| One-to-one nursing | 2.61 | 1.98–3.45 | 6.9 | 75 | <.001 |
| Reassurance | 4.05 | 3.09–5.29 | 10.4 | 75 | <.001 |
| Distraction | 3.41 | 2.64–4.42 | 9.5 | 75 | <.001 |
| Deescalation | 1.50 | 1.22–1.83 | 4.0 | 75 | <.001 |
| PRN medication | .64 | .50–.83 | 3.6 | 75 | <.001 |
| Limit setting | 1.37 | 1.23–1.83 | 2.7 | 75 | .010 |

### Study Limitations

Low statistical power to detect changes in physical aggression rates was a limitation of this study. A small number of patients was physically aggressive. After removal of outlier data from two patients with more than 3 SDs greater assaultiveness throughout the study phases during which they were participants, the remaining data were insufficient to conduct a detailed statistical analysis of physical aggression. The very low rate of aggression allowed only for reporting of raw descriptive data (Table 3).

An additional limitation was the lack of blinding, which would have been extremely challenging to accomplish in a small forensic hospital such as ours. Therefore, some carryover effects that affected staff behavior may have occurred between the participating units. Such effects might have included staff discussion of the use of selected interventions, heightened awareness of early proactive interventions, or communicated perceptions of the effectiveness of particular approaches, such as increased use of engagement strategies early in an escalation.

### Practical Implications and Future Research

The findings of this study show that it is possible to apply CDSS technology to select timely and appropriate interventions to prevent aggression and simultaneously reduce restrictive interventions in acute mental health settings. This approach may be applied to other settings (e.g., emergency departments and civil mental health hospitals) and populations (e.g., general medical, civil mental health, cognitively impaired, and elderly patients and patients with disability), but DASA will require validation in these settings, and the most effective and contraindicated interventions require elucidation.

Future research might also consider tailoring risk-related recommendations of eDASA+APP by using consumer input and increasing choice and control. Of the range of interventions indicated at the different risk bands, patients may be encouraged to suggest their preferred strategies in advance,

and staff could use these strategies when a patient is in that risk band.

## CONCLUSIONS

The results of this study indicate that implementation of the eDASA+APP instrument reduces aggressive behaviors while simultaneously reducing restrictive practices in acute mental health settings. This observation suggests an opportunity to expand on this research to further refine the eDASA+APP tool for efficiency, ease and speed of use, personalization, patient involvement, and staff satisfaction.

### AUTHOR AND ARTICLE INFORMATION

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