

# Interventions designed to improve the safety and quality of therapeutic anticoagulation in an inpatient electronic medical record

Mrs Jodie Austin<sup>1,2</sup>, A/Prof Michael Barras<sup>3,4</sup>, A/Prof Clair Sullivan<sup>1,5</sup>

<sup>1</sup>Faculty of Medicine, University of Queensland, Brisbane, <sup>2</sup>eHealth Queensland, Queensland Health, Brisbane,

<sup>3</sup>The School of Pharmacy, The University of Queensland, Brisbane,

<sup>4</sup>Princess Alexandra Hospital, Brisbane, <sup>5</sup>Metro North Hospital and Health Service, Brisbane

## Background

Anticoagulation is complex. Digital transformation is rapidly evolving. Computerised physician order entry (CPOE) and clinical decision support systems (CDSS) help guide best practice. What strategies best manage anticoagulants in an electronic medical record (EMR)?

## Objective

To systematically review the literature to determine the evidence for EMR interventions designed to improve the safety and quality of therapeutic anticoagulation in a hospital setting.

## Methods

The search strategy is shown in Figure 1.

Covidence® was used for screening and data extraction. Studies were grouped according to the type of intervention and the outcomes measured.

## Results

From 2,624 articles, 27 met inclusion criteria - 3 RCTs, 4 cohort studies and 20 pre/post observational studies. Figure 2 = number of studies per EMR intervention. Figure 3 = number of studies researching the different anticoagulant types.

27 articles met inclusion criteria	
<b>CPOE (n=4)</b>	<b>CDSS (n=21)</b>
Discharge Medication Reconciliation	Heparin Induced Thrombocytopenia Alerts
Medication CPOE	Drug Interaction Alerts
Pathology CPOE	Epidural Alerts
	Other Alerts
	UFH Weight-Based Nomograms
	General Order Sets/Order Forms
	Multiple CPOE/CDSS
	Dashboard (n=1)
	EMR in general (n=1)

CPOE = computerised physician order entry, CDSS = clinical decision support systems, n= number of studies, UFH = unfractionated heparin, EMR = electronic medical record

Figure 2: Type of EMR intervention studied

Table 1: Effects of EMR interventions on study outcomes

'+' = positive effect, '-' = negative effect, 'o' = neutral effect, '+/o' = mixed positive and neutral effects, 'o/-' = mixed negative and neutral effects, '+/-' = mixed positive and negative effects, '+/o/-' = mixed positive, neutral and negative effects

EMR Intervention (n=4)	Study Outcomes (n=7)						
	Medication Errors	ADEs	Morbidity/Mortality/LOS/Re-hospitalisation	Appropriate Prescribing/Documentation	Quality Use of Anticoagulant	Cost Effectiveness	User Acceptance
CPOE	+	+		+/o	+/o		+
CDSS - HIT Alert		o (-' superficial thrombosis)	o	+/o/-			+
CDSS - DI Alert	+			+/o (-' early cessation of trial due to clinical impact)			
CDSS - Epidural Alert	o (+' on enoxaparin orders)	o					
CDSS - Other Alerts	+	o	+/o	+			o
CDSS - UFH Nomograms					+		
CDSS - General Order Sets/Order forms			+/o	+/o		o	
Multiple CPOE/CDSS	o/-		+/o				
Dashboard	+		+/o				
EMR in General	+/o	+/o	+/o	+/o			

\*Only statistically significant results included. An outcome may have >1 study with the same effect, this will only be indicated once within the table (i.e. + or o or -)

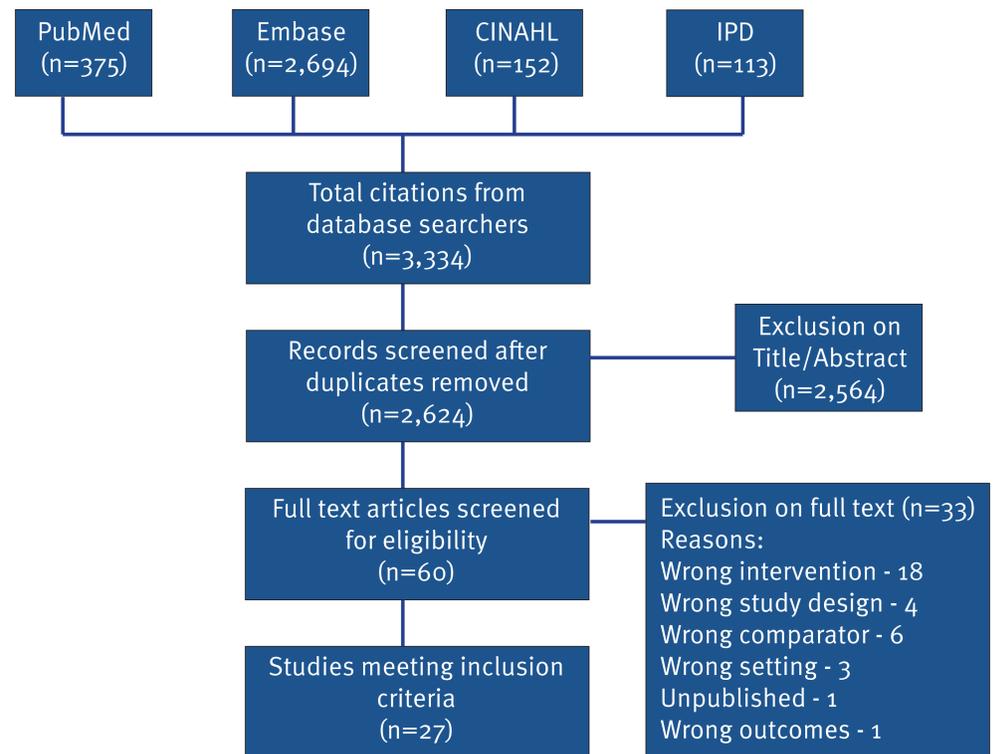
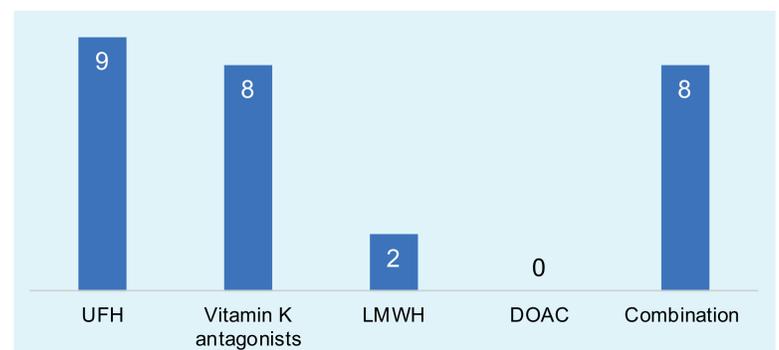


Figure 1: Outcomes of search strategy



UFH = unfractionated heparin, LMWH = low molecular weight heparin, DOAC = direct acting oral anticoagulant

Figure 3: Number of studies per type of anticoagulant

## Discussion

Most research has focused on UFH and warfarin. This is not unexpected as traditionally these drugs are the most complex to manage and make rational targets. Research is lacking for DOACs. Most research has evaluated clinician compliance, with less focus on clinical impact or cost effectiveness. Targets for future robust research include the integration of 'stealth' alerts, nomograms into digital systems and the use of dashboards within clinical practice.

## Conclusion

There has been limited research to demonstrate the optimal methods to design, implement and safely manage therapeutic anticoagulation within an EMR. Further research is required on the clinical impact of these interventions. Given the significant investment to implement an EMR, cost-effectiveness is important.

## Reference

Austin JA, Barras MA, Sullivan CM. Interventions designed to improve the safety and quality of therapeutic anticoagulation in an inpatient electronic medical record. Int J Med Inform. Forthcoming 2019