Title page:

TITLE: Development of an obstetrics triage tool for pharmacists in an urban medical centre

SHORT TITLE: Pharmacist tool for obstetrics triage

AUTHORS:

Jordan R. Covvey, Pharm.D., Ph.D., BCPS

Assistant Professor; Division of Clinical, Social and Administrative Sciences

Duquesne University Mylan School of Pharmacy; Pittsburgh, PA 15282, United States

June Grant, B.Sc. (Hons) Pharm, MRPharmS

Lead Clinical Pharmacist; Obstetrics and Gynaecology, Women & Children's Services

NHS Greater Glasgow & Clyde; Glasgow, United Kingdom G31 2ER

Alexander B. Mullen, B.Sc. (Hons) Pharm, Ph.D., MRPharmS **(corresponding author)**

Professor; Strathclyde Institute of Pharmacy and Biomedical Sciences

University of Strathclyde; 161 Cathedral St

Glasgow G4 0RE, United Kingdom

Tel: +44 (0)141 548 4409

Fax: +44 (0)141 552 2562

Email: a.mullen@strath.ac.uk

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Summary:

WHAT IS KNOWN AND OBJECTIVES: Obstetrics services are a high-throughput and high-risk environment poised for pharmacist involvement, but determining how to ideally allocate services is difficult. There is recent interest in the development of tools for service prioritisation, but none are specifically targeted to obstetrics. Therefore, the aim of this study was (1) to conduct a practice audit surveying the demographics of patients attending obstetrics wards at a high-capacity maternity hospital, and (2) to evaluate a triage tool developed to prioritise pharmacy services.

METHODS: A retrospective case review of women discharged after birth admissions was undertaken at a hospital in National Health Service (NHS) Scotland during June 2014. Demographic and admission data were collected, as well as pharmacist interventions and missed opportunities in patient care on postnatal wards. A pharmacy triage tool was developed and retrospectively applied to each case to ascertain a risk category that would trigger and target pharmacist review. Interventions/opportunities were classified as either clinical (medication-related) or administrative (potential for error development).

RESULTS AND DISCUSSION: 175 cases were reviewed with a median age of 29 years old. Eighty-six patients (49.1%) were retrospectively classified with elevated risk using the triage tool. A total of 117 charts (66.9%) were identified with missed opportunities for pharmacist intervention, which was significantly higher among patients classified as higher risk (75.6 vs. 58.4%, p=0.017). Compared to low risk patients, patients with a higher risk classification had lower rates of administrative missed opportunities (55.4 vs. 80.8%, p=0.015), but numerically higher rates of clinical (26.2 vs. 9.6%, p=NS) and mixed clinical/administrative (18.5 vs. 9.6%, p=NS) missed opportunities, although this failed to reach statistical significance.

WHAT IS NEW AND CONCLUSION: Evaluation of a triage tool for obstetric services demonstrated potential for prioritising higher risk patients for pharmacist review and addressing opportunities for clinical improvements.

Main text:

WHAT IS KNOWN AND OBJECTIVE:

Pharmacists play an integral role in the hospital setting for ensuring the safe and optimal use of medications, as well as optimising medication therapy with the most efficient use of available resources. However, pharmacists themselves have become a limited resource in the face of increasing numbers of hospital admissions, changing patient demographics, and increased complexities of medication therapy regimens. In the absence of a clinical pharmacist ideally being involved in every hospital case, there is need to prioritise where services are most required.

Tools for pharmacist service prioritisation have been developed for the general hospital population. A recent effort to identify high-risk patients was trialled in National Health Service (NHS) Ayrshire & Arran health board using medication-specific 'flags' identified from the electronic prescribing system, such as use of anticoagulants, or extended durations of antibiotic utilisation.[1] Similarly, a group of pharmacists in New Zealand developed a fully integrated tool which expanded upon this concept and identified 38 clinical characteristics which contribute to calculating a priority risk score for a patient.[2] The tools rely largely on events during admission to determine potential risk, such as high-risk medications removed from automated dispensing cabinets (aka 'Pyxis machines'), transfers to higher acuity units, and extremes in laboratory values.[1-2] These tools have found good support among pharmacists, and have resulted in notable service improvements such as reduction in time to pharmacist intervention and time savings in service workload.[1-2]

Obstetric services have opportunity for pharmacist involvement due to the high-acuity environment, specialised knowledge required for use of medications during pregnancy and lactation, and potential risk associated with errors and adverse events.[3] Despite a relatively

young patient population, an estimated 80% of women use at least one prescription medication during pregnancy.[4] Obstetric admissions vary from uncomplicated spontaneous vaginal deliveries (SVD) in healthy women to more complex scenarios involving emergency or elective caesarean sections (EMCS/ELCS), drug dependency in mother and baby, and management of specialised co-morbidities such as gestational diabetes mellitus. Risks in pregnant women are unique compared to general medical admissions, and hospitalisations for obstetric services are often short, meaning the window for pharmacist review is small and adverse events may not be realised until after the patient is discharged. For these reasons, the use of established risk tools developed for the general medical population are not fully suitable.

Due to the urgency associated with obstetrics admissions, predicting service needs and coverage is difficult; as such, triage tools have been the focus among medical, nursing and midwifery staff.[5] Development of a triage protocol for pharmacists working in obstetrics is lacking, yet has the potential to not only aid patient care, but improve service planning. Accordingly, the aim of this study was (1) to conduct a practice audit surveying the demographics of patients attending maternity wards at a high-capacity obstetrics facility, and (2) to evaluate a triage tool developed to prioritise pharmacy services.

METHODS:

Practice setting

The study was undertaken in an urban medical centre in Scotland with 100 beds allocated to maternity and neonatal services. The wards service approximately 6500 births each year and at the current time, have 2.2 full-time equivalent (FTE) pharmacists specialising in Women and Children's Services providing clinical services for the neonatal unit from 0830-1700 Monday-Friday, including public holidays; these pharmacists are additionally responsible for obstetrics services as staffing levels allow. An additional team of pharmacists

provide general coverage in the central pharmacy on an in and out-of-hours basis when specialist pharmacists are not available. Hospital services currently utilise a mixed paper/electronic charting system, with handwritten medication orders recorded in the paper medication administration record (MAR, aka 'kardex'). Standardized pharmacist medication reconciliation at admission is not currently performed. Reconciliation at discharge is performed electronically using an immediate discharge letter (IDL) and is checked by a pharmacist where possible.

Study design and sampling

The present study was a retrospective chart review of patients during June 2014. Charts were randomly convenience sampled from two maternity wards and reviewed by a pharmacist during data collection; patients were included if their admission resulted in child birth (as opposed to other antenatal hospitalisations). Data collected included patient demographics (age, height, weight, allergies, gestation, gravida/parity) and admission characteristics (presentation [planned/spontaneous], length of stay [LOS], mode of delivery). Charts were assessed for evidence of pharmacist assessment or intervention at two time-points: (1) during the stay, signified by physical annotation in the chart or MAR, or (2) at the time of discharge, signified by a pharmacist screening notation on the IDL. Records were assessed to identify common medication-related issues as discussed and identified by the investigator team prior to the start of the study, classified as either 'clinical' or 'administrative' types. Clinical issues included those pertaining directly to medication therapy, such as identification of incorrect dosing schemes for standardized protocol medications used by the hospital, incorrect scheduling of the medication, lack of indication for a particular therapy, or need for pharmacokinetics. Primary areas of clinical assessment (common to all obstetric admissions) included analgesia regimen, antibiotic prophylaxis, venous thromboembolic (VTE) prophylaxis and need for iron supplementation; however, other clinical issues specific to patient cases were also recorded. Administrative issues included inconsistencies in charting and documentation, such as lack of notation of patient weight, allergies or

gravida/parity in the admission chart, or failing to use standardized hospital assessment forms, such as for determination of VTE risk and corresponding therapy. Administrative issues were included in the analysis as these may indicate areas with potential for downstream medication errors to develop based on procedural inefficiencies and omissions. Clinical and administrative issues were recorded as an 'intervention' (if addressed by a pharmacist during admission) or a 'missed opportunity' (if not addressed).

A pharmacy triage tool was developed to risk stratify patients admitted to the obstetrics service to help prioritise services (**Figure 1**). The tool was designed by an expert group of three clinical pharmacists delivering obstetric services, as well as informal input from several academic collaborators in the clinical area. Several rounds of revision and trial were used to balance the tool for incorporation of variables of interest and to be efficient within the realistic time constraints of clinical service. Upon completion of the triage tool, patients were assigned to one of two risk categories: (1) red – need for obstetric pharmacist to review, or (2) green – no need for specialist review unless requested by medical/nursing staff. Criteria for red classification were developed with input pharmacists from the service on common issues requiring prioritisation for potentially vulnerable patients, including demographic characteristics (young age, extreme weight, poor literacy), substance abuse/misuse, common medical co-morbidities and high-risk medication use. The triage tool was retrospectively applied to each patient case to ascertain what their risk category would have been upon triage, utilising referral letters and admission documentation. Not all medical co-morbidities and medications were automatically deemed as qualifiers for red classification; determination of severity was made by a pharmacist reviewing the chart based whether the disease was uncontrolled or of changing status, if it required active medication for treatment, or if there was potential for adverse events with use or withdrawal. Characteristics were described as a function of the full cohort, and additionally split by risk category. Interventions were assessed by red/green risk category to compare rates of current service intervention during admission and discharge.

Statistical analysis

Statistical analysis was performed using Minitab® 16 (Minitab Ltd., Coventry, UK) and SPSS Statistics 21 (IBM Corporation, Armonk, NY, USA). Continuous data were compared using a Mann-Whitney test, and categorical data were compared with a 2-proportion test with a Bonferroni correction applied to reduce the error associated with multiple comparisons. The project was considered a service evaluation by the West of Scotland Research Ethics Service and was exempt from ethics review.

RESULTS AND DISCUSSION:

A total of 175 patient charts were retrospectively reviewed, with demographic and admissions characteristics detailed in **Table 1**. Patients had a median age of 29 years old, and largely were on their 2nd pregnancy with a median gestation of 39 weeks and 2 days. The slight majority of patients had planned admissions, of which 34 patients (37.0% of cases) resulted in SVD; a total of 54 patients (65.1%) with spontaneous admissions resulted in an SVD (p<0.001 for difference). Median LOS was reduced slightly (2.5 vs. 3.0 days, p<0.001) among spontaneous admissions. Less than 10% of patients delivered by assisted methods (labelled as 'other'), including forceps, ventouse or breech deliveries. Some demographic data were unavailable (<3% patients) due to lack of notation in the chart.

A total of 86 patients (49.1%) were retrospectively classified as higher risk ('red') using the triage criteria. The most common criteria for red classification was medical co-morbidity (57 patients; 66.2% of group), followed by demographics (43 patients; 50.0% of group) and high-risk medication use (33 patients; 38.4% of group); substance use/misuse made up a minority of red classifications with 6 patients (7.0% of group). A total of 45 patients (52.3% of group) were classified as red based on more than 1 criterion on the triage tool. Demographic and admission characteristics were statistically similar between red and green groups, with the

exception of body mass index (BMI), which was lower among patients with a green classification. Patients classified as red had lower rates of SVD (47.6 vs. 53.9%) and ELCS (17.9 vs. 21.4%) but a higher rate of EMCS (25.0 vs. 15.7%) compared to patients classified as 'green,' although none of these differences reached statistical significance.

There was evidence of pharmacist intervention during admission and professional screening at discharge in approximately half of all charts reviewed (**Table 2**). Among charts with interventions, the majority (60.5%) were administrative while the remainder were clinical (20.9%) or mixed clinical/administrative (18.6%). Upon review, a total of 117 charts (66.9%) overall were identified with missed opportunities for intervention, with a similar split of problems identified. When retrospectively classified according to red/green risk, there were similar rates of pharmacist intervention during admission and professional screen. However, the rate of missed opportunities for intervention was significantly higher among red patients (75.6 vs. 58.4%, p=0.017). Compared to green, patients with a red classification had lower rates of administrative missed opportunities (55.4 vs. 80.8%, p=0.015), but numerically higher rates of clinical (26.2 vs. 9.6%, p=NS) and mixed clinical/administrative (18.5 vs. 9.6%, p=NS) missed opportunities as well.

The most common administrative issue identified during interventions (61/68; 89.7% of group) and missed opportunities (60/95; 63.2% of group) was a lack of patient weight recorded on the MAR. Charting discrepancies, such as different recorded weights, gravida/parities and allergies were noted in 19 instances of missed opportunities (20.0% of group). Common clinical issues addressed during admission included dose and regimen adjustments for analgesia (18/34; 52.9% of group) and VTE prophylaxis (6/34; 17.6% of group), while missed opportunities included several additional issues, relating to medication reconciliation (13/39; 33.3% of group), or incorrect assessment of VTE risk (8/39; 20.5% of group) and incorrect low-molecular weight heparin (LMWH) doses (9/39; 23.1% of group) based on institutional algorithms.

This retrospective ward audit described the characteristics of patients attending the maternity ward and evaluated the use of a simple tool to triage pharmacy services on the ward. Patients were retrospectively classified into two risk groups using the triage tool: red and green. Irrespective of classification, approximately 50% of patients received a screening by a pharmacist at discharge. The screening rate may relate to the time coverage (weekday, day-time hours) of specialist pharmacy services, or pressured pharmacist resources in comparison to patient care demands specifically within neonatal services. The health board reported that Women & Children's Obstetrics and Neonatal services in the hospital from the same month in the previous year totalled 2111 occupied bed days,[6] equating to 32 beds/day coverage for each FTE pharmacist. Approximately 30% of this capacity is consumed by neonatal beds, which generally are of higher acuity and require a greater share of service time.

The rate of any missed opportunities was increased 30% among 'red' patients; more importantly, the rate of clinical missed opportunities was nearly 3-fold higher. It is difficult from the nature of this study to quantify the measureable impact of pharmacist review/intervention and the eventual impact of these missed opportunities. This study did not focus on traditional 'hard' clinical outcomes such as death, but rather examined potential for optimisation of care in areas that may develop into adverse events (incorrect analgesia leading to unnecessary levels of pain, or incorrect VTE assessment leading to potential clot formation). However, a host of other literature supports the positive impact of pharmacist involvement in a variety of settings for enhanced patient satisfaction,[7-8] improvement in clinical outcomes[9-11] and reduction of errors.[12-14] Results from this study suggest that identifying and prioritising high risk (red) patients at admission using the triage tool would have potential for improvements in clinical care, as these patients made up over three-quarters of clinical problems that failed to be addressed.

For example, the incidence of VTE and pulmonary embolism has been shown to be 5-fold and 15-fold higher, respectively, in the postpartum period as compared to pregnancy alone.[15] Approximately 20% of clinical interventions/missed opportunities (and 4% of patients in the study) had evidence of suboptimal LMWH dosing, duration or use. Assuming the aforementioned risk of VTE in postpartum women[14] and obstetric capacity in the hospital over a year, this would have the potential to put approximately 260 postpartum women at risk and result in approximately 1 preventable VTE event each year. Triage of high risk patients to pharmacy services has potential to prevent such events.

Our data collection stratified interventions and opportunities according to whether they were administrative, clinical or a combination of both. Administrative issues were captured based on their procedural potential to develop into errors. For instance, a lack of accurately recorded weight has been associated with a variety of errors, most commonly resulting in over- or under-dosage, and usually among high-risk medications.[16] Lack of completeness and accuracy in charting is a known issue across many medical settings,[17-19] but pharmacists can significantly improve these problems,[20] and as a part of the multi-disciplinary team, have a professional obligation to optimise these practices whenever possible. The Safer Patients Initiative in the UK, published in 2011, identified medicines management as one of four key areas for improving reliability and safety in hospital care; among drivers promoting safe and effective processes, the use of standardised protocols, dose-guided algorithms and identification of high-risk areas were main components.[21] Therefore, the administrative issues identified in the present analysis may reveal areas poised for quality improvement and safer obstetric care.

The Standards for Maternity Care report, published by the Royal College of Obstetricians and Gynaecologists in 2008, notes the use of multi-disciplinary teams as an essential component of service delivery, particularly with regards to management of pre-existing medical conditions and intrapartum care.[22] However, the contribution of pharmacists to this

goal, alongside obstetricians and other clinicians, has yet to be fully realised.[23] Shared responsibility of medication-related issues across the multi-disciplinary team enhances patient care and lessens the potential for adverse events. At current time, pharmacists at the facility contribute to the development of practice guidelines and medical/pharmacy student teaching in addition to their clinical duties. Implementation of a triage tool would open up an untapped opportunity for pharmacy service involvement and input – medication reconciliation. One study from the USA estimated that 85% of order errors among hospitalised patients originated from suboptimal medication histories.[24] Guidance from the National Centre for Health and Clinical Excellence and the National Patient Safety Agency in the UK from 2007 states that policies should be in place to ensure responsibility for an accurate medication history upon hospital admission.[25] In 2012, the American Society of Health-System Pharmacists issued a statement on pharmacist involvement in medication reconciliation, recommending that the profession assume key roles in the development and execution of the process, while recognising that it remains a multi-disciplinary approach.[25] Implementation of the triage tool could be a good opportunity for efforts in medication reconciliation to be assisted by pharmacists, who are suited to contribute based on their training and expertise.[27]

There are limitations associated with our work. As a retrospective quality improvement audit, the present study is restrained by its sample size and technique. However, birth statistics at the national level indicate the patient population included in this study to be well-matched with regards to mode of delivery, maternal age and gestation,[28] demonstrating the external validity of our patient cohort. There is also limitation in the capture of pharmacist interventions through the use of retrospective data collection, as recommendations made by pharmacists on the ward may be verbal (and not documented in the chart), or pre-emptive to physician orders. Therefore, the issues captured by the current study likely represent only a sample of the full spectrum of pharmacist involvement in clinical care; however, full capture would not likely be possible under any research protocol.

WHAT IS NEW AND CONCLUSION:

Evaluation of a triage tool for obstetric services demonstrated an effective means of targeting and prioritising higher risk patients for pharmacist review. Opportunities exist for several service improvements with said tool, including formalised medication reconciliation, better coordination within the multi-disciplinary team and prevention of adverse events through enhanced safety. Our future work will test clinical implementation of the triage tool on the ward on a longitudinal basis to investigate interdisciplinary acceptance of its use, as well as clinical outcomes. There is further potential in the future to expand pharmacist involvement into the late antenatal period through clinic visits, to pre-empt risk on admission and aid in service planning.

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Figure 1: Obstetric service pharmacist triage tool

Table 1: Demographic and admission characteristics

Characteristic	Overall (n=175)	Red (n=86)	Green (n=89)
Demographics			
Median age (IQR), years	29 (26-34)	29 (26-34)	29 (26-34.5)
<18 years, n (%)	4 (2.3)	3 (3.5)	1 (1.1)
18-29 years, n (%)	92 (52.9)	43 (50.6)	49 (55.1)
30-35 years, n (%)	49 (28.2)	26 (30.6)	23 (25.8)
≥36 years, n (%)	29 (16.7)	13 (15.3)	16 (18.0)
Median BMI (IQR), kg/m^2	27.8 (23.9-31.5)	29.0 (25.0-35.7)	26.7 (22.9-29.8) [†]
Median gestation, weeks+days	39+2	39+0	39+3
Median gravida/parity	G2 P1	G2 P1	G2 P1
Admission			
Presentation			
Planned, n (%)	92 (52.6)	46 (53.5)	46 (51.7)
Spontaneous, n (%)	83 (47.4)	40 (46.5)	43 (48.3)
Median LOS (IQR), days	3 (2-4)	3 (2-4)	3 (2-4)
Birth procedure			
SVD, n (%)	88 (50.6)	40 (47.6)	48 (53.9)
EMCS, n (%)	35 (20.1)	21 (25.0)	14 (15.7)
ELCS, n (%)	34 (19.5)	15 (17.9)	19 (21.4)
Other, n (%)	16 (9.2)	8 (9.5)	8 (9.0)

[†] *p<0.05 for difference between red and green*

BMI: body mass index; ELCS: elective caesarean section; EMCS: emergency caesarean

section; IQR: interquartile range; kg: kilograms; LOS: length of stay; m: metres; n: number;

SD: standard deviation; SVD: spontaneous vaginal delivery

Table 2: Interventions by retrospective triage stratification

Characteristic	Overall (n=175)	Red (n=86)	Green (n=89)
Pharmacist intervention during admission, n (%)	86 (49.1)	45 (52.3)	41 (46.1)
Administrative	52 (60.5)	25 (55.6)	27 (65.9)
Clinical	18 (20.9)	9 (20.0)	9 (21.9)
Administrative/clinical	16 (18.6)	11 (24.4)	5 (12.2)
Professional screen at discharge, n (%)	96 (54.9)	50 (58.1)	46 (51.7)
Missed opportunities for intervention, n (%)	117 (66.9)	65 (75.6)	52 (58.4) [†]
Administrative	78 (66.7)	36 (55.4)	42 (80.8) [†]
Clinical	22 (18.8)	17 (26.2)	5 (9.6)
Administrative/clinical	17 (14.5)	12 (18.5)	5 (9.6)

[†] *p<0.05 for difference between red and green*

n: number