ORIGINAL ARTICLE

Sepsis management in a rural hospital in Northwest Ontario

Len Kelly, MD, Mclin Sci, FCFP, FRRM[1], *Sharen Madden, MD, MSc, FCFP, FRRM*[2], *Catherine Wong, MD, CCFP (EM)*[1], *Sonya Fewer*[1], *Tamar Shemesh-Lobl, MD*[3,4,5], *Shanthive Asokan, CCRA, MPhil, MSc*[1], *Laurel Laakso, MD, CCFP*[1]

[1]*Sioux Lookout Meno Ya Win Health Centre, Sioux Lookout, ON, Canada,* [2]*Division of Clinical Sciences, Northern Ontario School of Medicine University, Sioux Lookout, ON, Canada,* [3]*Department of Emergency Medicine, Sinai Health, Schwartz/ Reisman Emergency Medicine Institute, Toronto, ON, Canada,* [4]*Department of Family and Community Medicine, University of Toronto, Toronto, ON, Canada,* [5]*Department of Emergency Medicine, Sheba Medical Center, Ramat-Gan, Israel*

Correspondence to: Sharen Madden, smadden@slmhc.on.ca

This article has been peer reviewed.

Access this article online

Quick Response Code:

Website: https://journals.lww.com/cjrm

DOI: 10.4103/cjrm.cjrm_60_24

Abstract

Introduction: A retrospective quantitative study of emergency department (ED) management of patients diagnosed with sepsis in a rural hospital in northwest Ontario was conducted to understand the management of sepsis guidelines and department performance.

Methods: Our study includes all adult ED patients (18+) receiving an ED diagnosis of sepsis as identified by hospital medical records coding according to National Ambulatory Care Reporting System diagnostic codes from January 1, 2021 to December 31, 2021. Charts were reviewed for patient demographics, initial presentation, timing of ED management and outcomes. Statistical analysis involved descriptive methods.

Results: Twenty-five adults were eligible, 16 female, average age 53.1 years (standard deviation [SD] = 21.9). Mortality rate was 28%. The average age of the 7 non-survivors was 64 (SD = 14.73). Time to nursing assessment averaged 8 min (SD = 7.27); time to MD assessment was 41 min (SD = 30.93). Canadian Triage and Acuity Scale scores were urgent or higher in 20 of 23 cases. Retrospective Systemic inflammatory Response Syndrome scores were elevated in 17/25 cases. Average time to fluids administration was 85 min (SD = 79.41). Sixteen of the 23 patients with recorded times of antibiotic delivery received them in 180 min or less.

Conclusion: Patients with sepsis present with a variety of clinical features, and laboratory findings. Awareness of the urgency of sepsis treatment and an organised departmental approach is important in the management of potentially septic patients.

Keywords: Emergency department, management, rural, sepsis

Résumé

Introduction: Une étude quantitative rétrospective sur la prise en charge aux urgences des patients diagnostiqués avec une septicémie dans un hôpital rural du nord-ouest de l'Ontario a été menée afin de comprendre les directives en matière de prise en charge de la septicémie et les performances du service.

Méthodes: Notre étude porte sur tous les patients adultes (âgés de 18 ans et plus) admis aux urgences et ayant reçu un diagnostic de septicémie selon le codage des dossiers médicaux de l'hôpital, conformément aux codes diagnostiques du Système national d'information sur les soins ambulatoires (SNISA), entre le 1er janvier 2021 et le 31 décembre 2021. Les dossiers ont été examinés afin de recueillir des données démographiques sur les patients, les premiers symptômes,

Received: 27-09-2024 **Revised:** 29-11-2024 **Accepted:** 30-12-2024 **Published:** 13-08-2025

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Kelly L, Madden S, Wong C, Fewer S, Shemesh-Lobl T, Asokan S, *et al*. Sepsis management in a rural hospital in Northwest Ontario. Can J Rural Med 2025;30:119-24.

le moment de la prise en charge aux urgences et les résultats. L'analyse statistique a été réalisée à l'aide de méthodes descriptives.
Résultats: Vingt-cinq adultes étaient admissibles, dont 16 femmes, avec un âge moyen de 53.1 ans (écart-type = 21,9). Le taux de mortalité était de 28%. L'âge moyen des seven patients décédés était de 64 ans (écart-type = 14,73). Le délai moyen avant l'évaluation infirmière était de 8 min (écart-type = 7,27); le délai avant l'évaluation médicale était de 41 min (écart-type = 30,9). Les scores de l'échelle canadienne de triage et d'acuité étaient urgents ou supérieurs dans 20 cas sur 23. Les scores rétrospectifs du syndrome de réponse inflammatoire systémique étaient élevés dans 17 cas sur 25. Le délai moyen avant l'administration de liquides était de 85 min (écart-type = 79,41). Seize des 23 patients pour lesquels le délai d'administration des antibiotiques a été enregistré les ont reçus en 180 min ou moins.
Conclusion: Les patients atteints de septicémie présentent divers signes cliniques et résultats de laboratoire. Il est important de connaître l'urgence du traitement de la septicémie et d'adopter une approche organisée au sein du service pour prendre en charge les patients potentiellement septiques.

Mots-clés: Septicémie, prise en charge, milieu rural, service d'urgence

INTRODUCTION

Survival from sepsis improves with early recognition and treatment.[1] Descriptions of best practice suggest a 3-h window for initial assessment and treatment for possible sepsis, and a recommended '1-h bundle' of investigations and treatment for septic shock.[2] The major components of management are timely investigations with serum lactic acid, blood cultures and early administration of intravenous fluids and broad-spectrum antibiotics.[1] Our study is part of a quality improvement initiative at the Sioux Lookout Meno Ya Win Health Centre (SLMHC) in northwest Ontario. We examined the clinical presentation and timeliness of investigations and management of adult patients diagnosed with sepsis in the emergency department (ED).

SLHMC is a 65-bed general hospital with a catchment population of 30,000, including 25,000 residents among 30 remote First Nations communities.[3] Adult and paediatric medicine, surgery and obstetrics programs are provided at SLMHC. Patients requiring management in an intensive care unit (ICU) receive initial stabilisation before being transferred to a tertiary care centre. Several road-accessible First Nations communities and neighbouring towns access the ED directly or by land ambulance. For patients from remote communities, emergency care is started in the community nursing station before a medevac to Sioux Lookout or directly to an urban centre if warranted. If there is no onsite physician available, initial assessment is by community nursing staff supported by telephone consultation by a 'virtual ED' physician. Initial blood cultures and other laboratory samples are generally collected in-community before intravenous antibiotics and transfer.

METHODS

Our study included all adult ED patients (18+) receiving an ED diagnosis of sepsis as identified by hospital medical records coding according to National Ambulatory Care Reporting System diagnostic codes from January 1, 2021 to December 31, 2021.[4] Charts were reviewed by 2 clinical researchers for: Age, sex, timing of ED management and outcomes. Our data were limited to ED management; we did not access pre-hospital data.

Data included timing of RN/MD assessment, fluid and antibiotic administration and laboratory measurements: Lactate, white blood count (WBC) and C-reactive protein (CRP). Clinical data included temperature, respiratory and heart rates and blood pressure (BP). Outcomes were survival and transfer to other facilities. Canadian Triage and Acuity Scale (CTAS)[5] scores were recorded and, while our hospital does not use Systemic Inflammatory Response Syndrome (SIRS) scores, retrospective SIRS[6] scores were calculated (positive if ≥2 present: Temp >38 or <36; heart rate >90 bpm; respiratory rate >20 breaths per minute; WBC >12,000 × 10^9/L).[6] Laboratory values were considered abnormal for white blood cell count (WBC) >12,000 × 10^9/L; lactate >2 mmol/L; CRP >10 mg/L.[7]

The study was approved by the SLMHC Research Review and Ethics Committee (#01-23).

RESULTS

In 2021, 34 SLMHC ED charts received a sepsis-related code; 9 were excluded (4 paediatric, 2 direct admissions from the outpatient day medicine department to inpatient care, 1 outpatient endometritis, 1 septic arthritis, and 1 patient incorrectly coded as septic). See Appendix A. Data were collected from the ED charts of the 25 eligible adults [Table 1]. Sixteen of the 25 cases were female; the average age was 53.1 years (standard deviation [SD] = 21.9); approximately one-half (12/25) were over 60 years, including 10 patients over 70.

The average time to nursing assessment from registration was 8 (SD = 7.27) minutes; time to MD assessment was 41 (SD = 30.93) minutes. Most patients (23/25) had a documented CTAS score at triage, 87% (20/23) of whom were coded as urgent or higher acuity [Tables 1 and 2]. Retrospective SIRS scores indicated possible sepsis in 68% (17/25) of cases. The BP of 4 of the 5 patients with an initial BP <90 mmHg normalised after initial fluid resuscitation. The 5th patient with ongoing hypotension was diagnosed with septic shock and received antibiotics at 53 min and 5 h of norepinephrine support before transfer to the regional ICU, where they expired.

All 25 patients had a complete blood count, and WBC values were above normal in 19 cases. Lactate measurements were recorded in 24 cases and elevated in 12; most lactate measurements were obtained within 3 h of registration (19/24) [Table 1], [Figure 1]. CRP was measured in 20 cases and above normal (>10 mg/L) in 18, including 15 markedly elevated levels (>100 mg/L) [Table 1].

The average time to initiation of fluids, recorded in 24 of 25 charts, was 85 min (SD = 79.41). The time to initial antibiotic administration was recorded for 23 patients; 16 (70%) received broad-spectrum antibiotics in 180 min or less [Figure 2]. Among the 7 'delayed' cases, 4 of these presented with non-urgent, non-septic complaints (anaemia, leg pain, medication re-order, social admission) and appeared to have developed signs of sepsis after their initial ED presentation. Because of these outliers, we did not calculate the average time to antibiotic administration and did not include times beyond 600 min in the analysis. The common choice of antibiotics was ceftriaxone (n = 12) and piperacillin/tazobactam (n = 11); 2 patients received clindamycin plus gentamycin or penicillin.

Table 1. Baseline characteristics

Characteristics	Results
Total *n*	25
Age, years (SD)	53.1 (21.92)
Male, *n* (%)	9 (36)
Female, *n* (%)	16 (64)
SBP <90 mmHg, *n* (%)	5 (20)
SIRS criteria, *n*=25 (%)	
Temperature	
>38°	10 (40)
<36°	0 (0)
HR >90, *n* (%)	16 (64)
RR >20, *n* (%)	10 (40)
WBC >12,000, *n* (%)	19 (76)
SIRS score ≥2	17 (68)
CTAS scores, *n*=23, *n* (%)	
1 (resuscitation)	4 (17)
2 (emergent)	6 (26)
3 (urgent)	10 (41)
4 (less urgent)	3 (13)
5 (non-urgent)	0
Abnormal laboratory values	
WBC >12,000, *n* (%)	19/25 (76)
Lactate >2 mmol/L, *n* (%)	12/24 (50)
C-reactive protein >10 mg/L, *n* (%)	18/20 (90)

SD: Standard deviation, SBP: Systolic blood pressure, SIRS: Systemic inflammatory response syndrome, HR: Heart rate, RR: Respiratory rate, WBC: White blood cell, CTAS: Canadian Triage and Acuity Scale

Table 2: Assessment and outcomes

Characteristics	Results
Mean time to RN assessment, min (SD)	8 (8)
Mean time to MD assessment, min (SD)	41 (31)
Mortality, *n*=25, *n* (%)	7 (28)
Transferred to tertiary care centre	11 (44)

SD: Standard deviation, RN: Registered nurse

The mortality rate was 28% (7/25). The average age of the 7 non-survivors was 64 years (SD = 14.73). They portrayed a range of laboratory values; 3 had an elevated WBC with normal lactate, and another 3 had a normal WBC with elevated lactate values. All 3 had abnormal CRPs. Results from CTAS triaging and retrospective calculation of SIRS sepsis screening scores were disparate: Only 4 cases had both positive SIRS scores and a CTAS score greater than urgent.

Eleven patients were transferred to the regional tertiary care centre, including all 7 non-survivors.

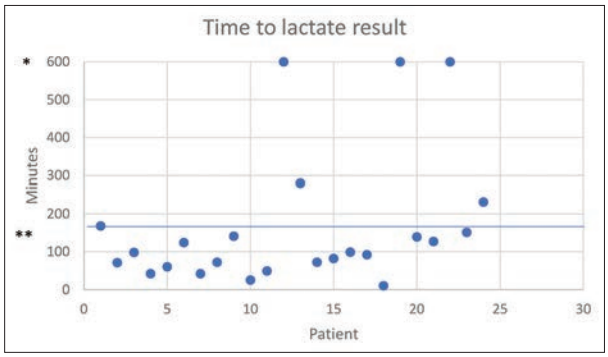


Figure 1: Time to Lactate result. *≥600 min was used as marker for a prolonged time period. **Recommended 3-h mark for investigating possible sepsis.

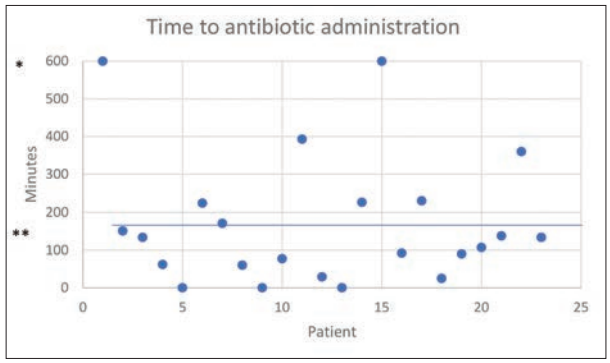


Figure 2: Time to Antibiotic administration. *≥600 min was used as marker for a prolonged time period. **Recommended 3-h mark for investigating possible sepsis.

DISCUSSION

Recommendations for the management of sepsis have evolved over the past decade due to a series of research-driven international consensus statements by the Surviving Sepsis Campaign.[1,8] The 28% overall mortality rate for septic patients treated at the SLMHC ED is within the expected range of 30%–50%.[8-10]

The hallmark of best practices is the early administration of antibiotics. A 2017 US tertiary care study documented an increase in septic shock mortality of 4% for every additional hour delay.[11] Current guidelines for possible or suspected sepsis recommend a 3 h time frame for lactate measurement, antibiotic and fluid administration, and a 1-h window for a definitive initial diagnosis of sepsis, or septic shock (systolic blood pressure <90 mmHg after initial fluid resuscitation).[1,12]

Our average time to MD assessment of 41 min compares to 50 min time in a 2020 study of 3 Ontario community hospitals.[13] The times to lactate measurement (19/24) commonly fell within the 3 h recommended mark. Timely antibiotic administration occurred less often (16/23), including 4 patients within 60 min; 3 had ongoing antibiotics upon admission to the ED. Our performance is likely slower than the average time of 129 min in Lo's Ontario study.[13] We did not calculate an average time to antibiotic administration due to the presence of 3 extreme outliers who did not initially present with sepsis. The choice of broad-spectrum antibiotics (pip/tazo, ceftriaxone) is similar to a recent international review of ED management.[14]

CTAS acuity scores did not always align with cases diagnosed with sepsis, presumably because patients presented at different points along the clinical sepsis pathway. However, they were more (87%) consistent with a subsequent diagnosis of sepsis than SIRS scores which were specifically developed to assist in the early identification of sepsis. While our ED does not use SIRS scoring, we retrospectively calculated these and found it identified only 68% of septic patients. In other settings, a positive SIRS score has a sensitivity of 0.82 (95% confidence interval [CI]: 0.78–0.75), but a low specificity of 0.24 (95% CI: 0.19–0.29).[15] We note that the BC SIRS scoring system model uses altered mental state as the 4th criteria, while most centres and this study used an elevated WBC.[1,12]

Two other screening tools for sepsis are also in use with varied results. The Quick Sequential Organ Failure Assessment screening was developed to predict survival in an ICU setting;[16] and the National Early Warning Score, a pre-hospital screening tool developed in the UK.[17]

In our study, patients with the late investigation and treatment attest to the difficulty in recognising sepsis. A quality improvement nursing and physician education initiative is being developed to prioritise sepsis management. These include presenting these results at ED team and hospital grand rounds and considering adopting some of the available nursing and physician educational programs developed by Health Quality BC.[18] These initiatives combine group training as well as point-of-care poster material. These will be important components to improving care and achieving recommended 1 and 3-h treatment guidelines.

Early laboratory testing and results contribute to timely diagnosis and treatment.[8,10] While SLMHC has on-site laboratory personnel, many small rural hospitals may not. Point-of-care testing may be an option for these hospitals; it has been successfully introduced in many northern nursing stations and remote settings.[19] In our region, point-of-care serological had been introduced in several remote First Nations nursing stations. There has been no formal evaluation, but physicians find real-time haematologic and biochemical results provided by community nurses an important adjunct to clinical assessments. As commercially available testing includes WBC, serum lactate and CRP, its impact on the identification and treatment of sepsis holds promise.

Our study has several limitations, primarily its retrospective methodology and small cohort size. Another limitation is the accepted use of hospital coding for the identification of cases of sepsis, which would not capture misdiagnosed cases or those diagnosed later during their admission. Other studies use evaluation of prospective screening tools to identify sepsis and our data is not directly comparable. We did not have access to the timeliness of medical transportation from remote communities or for inter-hospital transfers, which affect treatment and survival. We used the time of ED registration as our baseline, rather than RN assessment time used in other studies, slightly increasing time assessments. Despite chart review of ED charts by 2 clinical researchers, some data were not available. SLMHC ED is unique as it receives medevac'd patients from remote First Nations communities and our hospital-based data does not capture their complete treatment pathway.[20,21]

CONCLUSION

Patients with sepsis presented at the SLMHC ED with varied clinical features and laboratory results. Screening tools can support but will not replace clinical judgement. Awareness of the urgency of sepsis treatment and an organised departmental approach are important in the management of potentially septic patients. A larger regional study of sepsis management, including medical transportation and pre-hospital care, would further inform the understanding of the care pathway and areas of improvement, particularly for patients living remotely.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

REFERENCES

1. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, *et al*. Surviving sepsis campaign: International guidelines for management of sepsis and septic shock 2021. Crit Care Med 2021;49:e1063.
2. Levy MM, Dellinger RP, Townsend SR, Linde-Zwirble WT, Marshall JC, Bion J, *et al*. The surviving sepsis campaign: Results of an international guideline-based performance improvement program targeting severe sepsis. Intensive Care Med 2010;36:222-31.
3. Walker R, Cromarty H, Kelly L, St Pierre-Hansen N. Achieving cultural safety in aboriginal health services: Implementation of a hospital crosscultural safety model. Divers Health Care 2009;6:11-22.
4. Canadian Institute for Health Information. In Hospital Sepsis. Available from: https://www.cihi.ca/en/indicators/in-hospital-sepsis. [Last accessed on 2024 Mar 14].
5. Prehospital Canadian Triage and Acuity Scale. Available from: https://www.lhsc.on.ca/media/2904/download. [Last accessed on 2024 Mar 14].
6. Kaukonen KM, Bailey M, Pilcher D, Cooper DJ, Bellomo R. Systemic inflammatory response syndrome criteria in defining severe sepsis. N Engl J Med 2015;372:1629-38.
7. Medical Council of Canada. List of Normal Lab Values. Available from: https://mcc.ca/examinations-assessments/resources-to-help-with-exam-prep/normal-lab-values/. [Last accessed on 2024 Jul 12].
8. Seymour CW, Rea TD, Kahn JM, Walkey AJ, Yealy DM, Angus DC. Severe sepsis in pre-hospital emergency care: Analysis of incidence, care, and outcome. Am J Respir Crit Care Med 2012;186:1264-71.
9. Nasir N, Jamil B, Siddiqui S, Talat N, Khan FA, Hussain R. Mortality in sepsis and its relationship with gender. Pak J Med Sci 2015;31:1201-6.
10. Husak L, Marcuzzi A, Herring J, Wen E, Yin L, Capan DD, *et al*. National analysis of sepsis hospitalizations and factors contributing to sepsis in-hospital mortality in Canada. Healthc Q 2010;13:35-41.
11. Seymour CW, Gesten F, Prescott HC, Friedrich ME, Iwashyna TJ, Phillips GS, *et al*. Time to treatment and mortality during mandated emergency care for sepsis. N Engl J Med 2017;376:2235-44.
12. BC Sepsis Network Working Group. BC Emergency Department Adult Sepsis Guidelines. Available from: https://www.file:///H:/Trnsend/SLMHC/SEPSIS/Articles/2022-Emergency-Department-Guidelines-FINAL_Sept-2023.pdf. [Last accessed on 2024 Mar 14].
13. Lo VC, Su H, Lam YM, Willis K, Pullar V, Kowgier M, *et al*. Management of patients with sepsis in Canadian community emergency departments: A retrospective multicenter observational study. Health Serv Res Manag Epidemiol 2020;7:1-6.
14. Guarino M, Perna B, Cesaro AE, Maritati M, Spampinato MD, Contini C, *et al*. 2023 update on sepsis and septic shock in adult patients: Management in the emergency department. J Clin Med 2023;12:3188.
15. Wang C, Xu R, Zeng Y, Zhao Y, Hu X. A comparison of qSOFA, SIRS and NEWS in predicting the accuracy of mortality in patients with suspected sepsis: A meta-analysis. PLoS One 2022;17:e0266755.

16. Askim Å, Moser F, Gustad LT, Stene H, Gundersen M, Åsvold BO, *et al*. Poor performance of quick-SOFA (qSOFA) score in predicting severe sepsis and mortality – A prospective study of patients admitted with infection to the emergency department. Scand J Trauma Resusc Emerg Med 2017;25:56.
17. Pullyblank A, Tavaré A, Little H, Redfern E, le Roux H, Inada-Kim M, *et al*. Implementation of the National Early Warning Score in patients with suspicion of sepsis: Evaluation of a system-wide quality improvement project. Br J Gen Pract 2020;70:e381-8.
18. Sweet D, Hoiss S. BC Sepsis Guidelines 2022 Update and Sepsis Quality Improvement in BC. Available from: https://healthqualitybc.ca/improve-care/sepsis/emergency-department-sepsis-guidelines/. [Last accessed on 2024 Mar 14].
19. Harasemiw O, Ferguson T, Lavallee B, McLeod L, Chartrand C, Rigatto C, *et al*. Impact of point-of-care screening for hypertension, diabetes and progression of chronic kidney disease in rural Manitoba Indigenous communities. CMAJ 2021;193:E1076-84.
20. VanderBurgh D, Savage DW, Dubois S, Binguis N, Maxwell S, Bocking N, *et al*. Epidemiologic features of medical emergencies in remote First Nations in Northern Ontario: A cross-sectional descriptive study using air ambulance transport data. CMAJ Open 2020;8:E400-6.
21. Hummelen R, Lee H, Russell-Mahoney B, Maxwell S, Semple D, Osmond D, *et al*. Demographics of mental healthcare presentations in a Northwest Ontario emergency department. CJEM 2022;24:161-6.

Appendix A: Sepsis as main diagnosis in SLMHC ED 2021

NACRS Codes	2021
(A400) Sepsis due to *Streptococcus*, Group A	2
(A403) Sepsis due to *Streptococcus pneumoniae*	
(A408) Other *Streptococcal sepsis*	
(A410) Sepsis due to *Staphylococcus aureus*	4
(A4150) Sepsis due to *Escherichia coli*	3
(A4152) Sepsis due to *Serratia*	1
(A4158) Sepsis due to other Gram-negative organisms	2
(A418) Other specified sepsis	2
(A419) Sepsis, unspecified	10
Not available	1
Total	25

NACRS: National Ambulatory Care Reporting System, SLMHC: Sioux Lookout Meno Ya Win Health Centre, ED: Emergency department

CALL FOR PAPERS

The Canadian Journal of Rural Medicine (CJRM) is a quarterly peer-reviewed journal available in print form and open access online. It is the first rural medical journal in the world indexed in Index Medicus, as well as MEDLINE/PubMed databases.

The CJRM seeks to promote research into rural health issues and promote the health of rural and remote communities. It looks to support and inform rural practitioners, provide a forum for debate and discussion of rural medicine, provide practical clinical information to rural practitioners and influence rural health policy by publishing articles that inform decision-makers.

The material in the following categories will be considered for publication.

- Original articles: research studies, case reports and literature reviews of rural medicine (3500 words or less, not including references)
- Commentary: editorials, regional reviews and opinion pieces (1500 words or less)
- Clinical articles: practical articles relevant to rural practice. Illustrations and photos are encouraged (2000 words or less)
- Off Call articles: a grab-bag of material of general interest to rural doctors (e.g., travel, musings on rural living, essays) (1500 words or less).
- Cover: artwork with a rural theme

For more information, please visit www.srpc.ca/cjrm