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Original Article

Using a checklist as a strategy for the reduction of mechanical ventilator-associated pneumonia in an adult intensive care unit

O uso de checklist como estratégia para redução de pneumonia associada à ventilação mecânica em uma unidade de terapia intensiva adulto

El uso de una lista de verificación como estrategia para reducir la Neumonía Asociada a la Ventilación Mecánica en una unidad de cuidados intensivos para adultos

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ABSTRACT

Objective: To evaluate the fast-checklist effectiveness, a tool developed by an interdisciplinary team as a strategy to reduce the time spent on mechanical ventilation (MV) and mechanical ventilator-associated pneumonia (VAP) in an adult intensive care unit. **Methodology:** This is a quantitative, cross-sectional and observational study, carried out between January 2018 and June 2019 in an adult intensive care unit in Paraná. The data were analyzed by Student's t-test. **Results:** 759 hospitalized adults were evaluated, of which 283 underwent MV. Data showed that before fast-checklist the mean number of VAP cases was 3.22, and, after the tool was implemented, the number dropped significantly to 0.33 (p=0.001); the same was observed for the days on MV. The mean MV time was 157 days and it dropped to 133 (p=0.037), VAP density was 21.62 and dropped to 2.82 (p=0.003). Through the analysis of the t-test, one can infer a 4.9% reduction of VAP cases per month. **Conclusion:** The use of tools as the checklist for the VAP reduction, along with a culture change and the active participation of interdisciplinary teams, are extremely important for the reduction of this type of infection and healthcare-associated infections.

Keywords: Interdisciplinary practices. Mechanical Ventilator-related Pneumonia. Intensive Care Unit. Checklist. Hospital Infection.

RESUMO
Objetivo: Avaliar a efetividade do instrumento *fast-checklist*, desenvolvido por uma equipe interdisciplinar como estratégia de redução de tempo de ventilação mecânica (VM) e pneumonia associada à ventilação mecânica (PAV) em uma unidade de terapia intensiva adulto. **Métodos:** Estudo quantitativo, longitudinal, observacional, realizado entre os meses de janeiro de 2018 e junho de 2019 em uma unidade de terapia intensiva adulto no Paraná. Os dados foram analisados pelo teste t-student. **Resultados:** Foram avaliados 759 internamentos, destes, 283 utilizaram VM. Os dados mostraram que antes do *fast-checklist* havia uma média de 3,22 casos de PAV, e após a instituição do instrumento, o valor reduziu significativamente para 0,33 (p=0,001); condição igualmente observado para os dias de VM. A média de VM era de 157 dias e passou para 133 (p=0,037) e a densidade de PAV era de 21,62 e passou para 2,82 (p=0,003). Através da análise do teste de t, dá para inferir uma redução dos casos de PAV de 4,9% ao mês. **Conclusão:** O uso de instrumentos como o *checklist* para redução de PAV, acompanhado da mudança de cultura e participação ativa de equipes interdisciplinares, são de extrema relevância na redução deste tipo de infecção e infecções relacionadas à assistência à saúde.
Descritores: Práticas interdisciplinares. Pneumonia Associada à Ventilação Mecânica. Unidade de Terapia Intensiva. Lista de checagem; Infecção hospitalar.

RESUMEN
Objetivos: Evaluar la efectividad del instrumento *fast-checklist* desarrollado por un equipo interdisciplinario como estrategia para reducir el tiempo de ventilación mecánica (VM) y la neumonía asociada con ventilación mecánica (PAV) en una Unidad de Cuidados Intensivos Adulta. **Métodos:** Estudio cuantitativo, longitudinal, observacional, realizado entre enero de 2018 y junio de 2019 en una unidad de cuidados intensivos para adultos en Paraná (Brasil). Los datos se analizaron mediante la prueba t student. **Resultados**: Se evaluaron 759 hospitalizaciones, de estas 283 utilizaron VM. Los datos mostraron que antes de la *fast-checklist* había un promedio de 3,22 casos de PAV y que después del uso del instrumento el valor disminuyó significativamente a 0,33 (p = 0,001). Esta condición también se observó para días de VM. El promedio de VM era de 157 días y pasó para 133 (p = 0,037) y la densidad de PAV que era de 21,62 pasó para 2,82 (p = 0,003). Por medio del análisis de la prueba t, es posible inferir una reducción de los casos de PAV de un 4,9% mes a mes. **Conclusión:** El uso de instrumentos como la lista de verificación para reducir la neumonía asociada con la ventilación mecánica, acompañado de un cambio en la cultura y la participación activa de equipos interdisciplinarios, son muy importantes para reducir este tipo de infección e infecciones relacionadas con la atención médica.
Palabras clave: Prácticas interdisciplinarias; Neumonía asociada al ventilador; Unidades de cuidados intensivos; Lista de verificación; Infección hospitalaria.

INTRODUCTION

Adult Intensive Care Units (ICU) are a complex environment that assists severe and unstable patients where invasive procedures are performed for the maintenance of life. Such procedures may enable the acquisition of healthcare-associated infections (HAIs), such as: mechanical ventilator-related pneumonia (VAP), catheter-associated urinary tract infections (CAUTI), central line-associated bloodstream infections (CLABSI), among others[1].

VAP, in particular, is an infection acquired by patients on ventilatory support. These patients' mortality rate is high, ranging from 20% to 70%[2]. Such range is related to the pathogen's potential of latency and mortality, to the use of antibiotic therapy, base pathology, increase in days on mechanical ventilation (MVDAYS) and hospitalization days[2]. In this sense, preventive measures must be taken.

For that, adult ICU demands interdisciplinary interventions that include problem-solving, prevention, and good care practices, such as the development of protocols that facilitate practice, reduce risks for the user, and encourage good care practices[3]. They must be used periodically and verify whether desirable items comply to the prevention of a certain infection[4]. The development of HAI prevention tools is recommended by the Centers for Disease Control and Prevention (CDC)[5], an organization that fosters good care practices for the control and prevention of health aggravations. Each institution is responsible for analyzing and orchestrating the best way to apply the recommendations.

In this sense, the Regional University Hospital of Campos Gerais created a team of infection control specialists, who analyzed CDC's recommendations and designed a specific protocol to control VAP in the institution, called "Fast checklist – HAI prevention".

Given that, this study aimed to evaluate the effectiveness of the tool developed by an interdisciplinary team as a strategy for reducing the period on mechanical ventilation and VAP in an adult ICU.

METHODOLOGY

This is a cross-sectional and observational study, of quantitative, descriptive, and retrospective approach, carried out between January 2018 and June 2019 in an adult ICU in the Regional University Hospitals of Campos Gerais (HURCG), Paraná. The institution is a teaching hospital specialized in uni- and multiprofessional medical residency. It has 20 adult ICU beds equally distributed between two units, which will be referred as Unit 1 and Unit 2, given that the study focused on the first one, since it has chronic patients and it is reference for the care in 12 municipalities composing the 3rd Health Region of Paraná.

A tool was developed by the interdisciplinary team, composed by specialists in the area: nurse, physician, pharmacist, and physical therapist; it is called "Fast checklist – HAI prevention" and was based on the recommendations proposed by CDC. This tool is composed by 17 items with closed answers covering the following aspects: hygiene, bed positioning, sedation, feeding, removal of invasive items, ventilatory support, and new goals (Chart 1).

Chart 1 – *Fast checklist* – HAI Prevention – applied daily in an adult ICU. Ponta Grossa, Paraná, 2019.

Item	***Description***	***N/A***	***Yes***	***No***	***Action***
1	Proper analgesia?				
	Sedation needed?				
2	Eye protection?				
	Raised headboard >45 DD or 30º LD?				
	Daily awakening?				
3	Existing PI? Treatment				
4	CVC needed?				
5	Feeding: proper nutritional support?				
	Phono evaluation?				
6	PA/FiO2 ?: proper ventilatory support?				
	OTT depth / proper Cuff?				
	Extubation / ventilatory weaning: begin?				
7	Remove patient from bed?				
8	Keep LTUC?				
9	General guide: alarms OK? Volume OK?				
10	Extended visitation?				
	Daily pre-goals?				

Routine doctor: _____ Physician on duty: _____ Nurse: _____
Physical therapist: _____ Nurse Technician: _____ Phono audiologist: _____
Nutrition _____ Social Ass.: _____

Key: DD: dorsal decubitus; LD: lateral decubitus; PI: pressure injury; CVC: central venous catheter; PA/FiO2: ratio of pressure arterial oxygen and fraction of inspired oxygen; OTT: orotracheal tube; LTUC: long-term urinary catheter

Before using the tool, the involved team was trained so that it could be correctly applied by the interdisciplinary team.

After developing the tool and the agreement of the whole team, in October 2018, its full version was included as a routine in the ICU. HURCG has a system based on scientific evidence and all protocols and clinical practices, which must be followed by the hospital team, are

available online, and, when inserting new documents on the site, all employees are instructed to follow its norms.

The sample was conveniently selected, constituted by 759 hospitalized patients, from January 2018 to June 2019. 283 of them used MV, composing the final sample. Inclusion criteria were: being hospitalized in the adult ICU – Unit 1, and being on invasive mechanical ventilation. The evaluation was performed once a day at 11 a.m. during the multiprofessional visit.

Data collection happened from the 1st to the 20th of July 2019 through the analysis of VAP indicators[1], MVDAYS, and density of VAP incidence (DVAPI). These data were directly collected with the institution's nucleus for hospital infection control (NUCIH), after evaluating the Diagnosis Criteria for Healthcare-Associated Infections (HAIs), and inserted in the database of the Microsoft Excel® software, version 2016, according to the variables developed for the study.

To evaluate the tool's effectiveness, collected data were stratified in two moments: the first comprised nine months when the tool was not used (January to September 2018); the second one comprised nine months after the tool was implemented (October 2018 to June 2019).

Variables were analyzed by the software Statistical Package for the Social Sciences (SPSS), version 22.0, as descriptive statistics with absolute and relative frequency, and parametric test, independent Student's t-test.

This research followed ethical recommendations and was approved by the Human Research Ethics Committee of the institution, CAEE: 01599618.6.0000.0105.

RESULTS

During the analyzed period, there were 283 patients on MV. 163 of them (57.57%) were male and 120 (42.43%) were female. Their age ranged from 12 to 96 years-old, with 59.17 years (±19.43) as the mean age. Hospitalization days were also analyzed, which showed a minimum hospitalization of a day and maximum of 95 days; mean 6.35 hospitalization days

[1] VAP indicators: number of patients that developed VAP; MV days: number of patients on MV per day; density of VAP incidence: number of VAP episodes in ICU patients per number of patients on MV per day, multiplied by 1,000. Source: Brasil. Agência Nacional de Vigilância Sanitária. Critérios Diagnósticos de Infecções Relacionadas à Assistência à Saúde/Agência Nacional de Vigilância Sanitária. Brasília: Anvisa, 2017.

(±7.35). As for the patients' outcome, 207 (73.25%) were discharged and 76 (26.75%) deceased.

The VAP rate before and after the use of fast checklist was evaluated, and it can be observed in Tables 1 and 2 and Figure 1.

Table 1 – VAP analysis, VAP density and days on mechanical ventilation from January 2018 to June 2019 (n=283). Ponta Grossa, Paraná, 2018-2019.

GROUPS	MONTHS	MEAN	SD	*p value*
VAP 1	9 (JAN-SEP 2018)	3.22	2.11	
VAP 2	9 (OCT 2018-JUN 2019)	0.33	0.50	0.001**
DVAPI 1	9 (JAN-SEP 2018)	21.62	15.75	
DVAPI 2	9 (OCT 2018-JUN 2019)	2.83	4.30	0.003**
MVDAYS 1	9 (JAN-SEP 2018)	157.00	17.15	
MVDAYS 2	9 (OCT 2018-JUN 2019)	133.78	25.37	0.037*

Source: the authors, 2019. Note: t test: * significant for <0,05; ** significant for <0,01. Key: VAP 1: mechanical ventilator-related pneumonia – from January to September 2018; VAP 2: mechanical ventilator-related pneumonia – from October 2018 to June 2019; DVAPI 1: density of mechanical ventilator-related pneumonia – from January to September 2018; DVAPI 2: density of mechanical ventilator-related pneumonia – from October 2018 to June 2019; MVDAYS 1: days on mechanical ventilation – from January to September 2018; MVDAYS 2: days on mechanical ventilation – from October 2018 to June 2019.

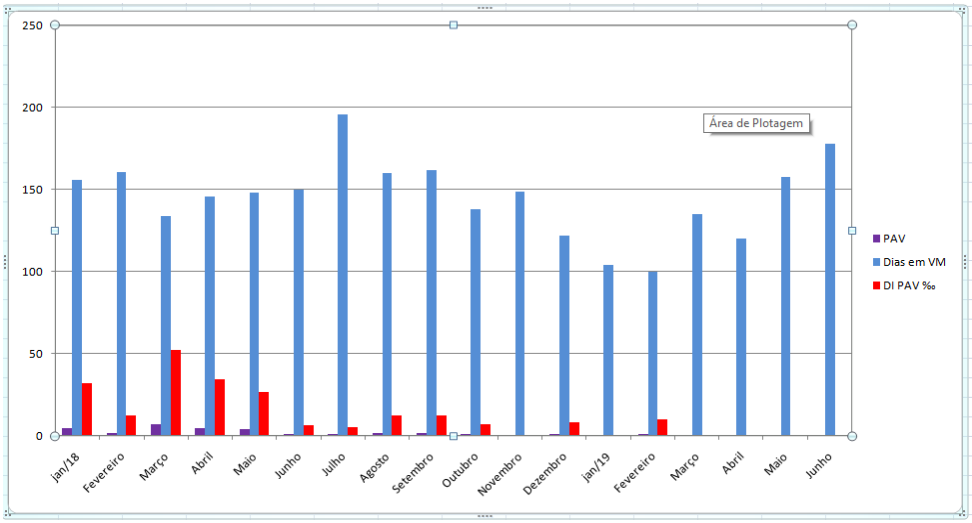
Table 2 – Analysis of the number of VAP patients, days on mechanical ventilation, its respective months, and VAP density. Ponta Grossa, Paraná, 2018-2019.

Year	Month	no. of VAP patients	Days on MV	DVAPI %
2018	January	5	156	32.05
	February	2	161	12.42
	March	7	134	52.24
	April	5	146	34.25
	May	4	148	27.03
	June	1	150	6.67
	July	1	196	5.1
	August	2	160	12.5
	September	2	162	12.35
	October	1	138	7.25
	November	0	149	0
	December	1	122	8.2
2019	January	0	104	0
	February	1	100	10

	March	0	135	0
	April	0	120	0
	May	0	158	0
	June	0	178	0

Source: the authors, 2019.

Figure 1 – Monthly comparison among mechanical ventilator-related pneumonia, days on mechanical ventilation, and density of mechanical ventilator-related pneumonia incidence, from January 2018 to June 2019. Ponta Grossa – Paraná, 2018-2019.



Source: the authors, 2019.

[TRADUÇÃO DA FIGURA 1:

Jan/18 – February – March – April – June – July – August – September – October – November – December – Jan/19 – February – March – April – May – June

- VAP
- Days on MV
- DVAPI ‰

Data show that before implementing the fast checklist protocol, VAP mean was 3.22, and, after implementing it, this value reduced significantly to 0.33 (p=0.001). A similar condition was observed for the days on MV. Before using the tool, the mean use of MV was 157 days, and it dropped to 133 with the application of fast checklist, representing an mean reduction of 24 days, which is significant (p=0.037). DVAPI also presented a significant reduction, from 21.62 to 2.82 after applying the tool.

DISCUSSION

The profile of ICU patients submitted to mechanical ventilation was prevalently male, mean age 59 years-old, which confirms a previous study[6]. Research has found studies with the same predominance of male individuals[7,8]. This demonstrates men's lack of care with their health, since they do not look for health services in due time, which could avoid problems and aggravations related to the primary illness[9].

The older age may be seen as a significant risk factor for HAIs, and it is even more relevant when associated to other factors, such as invasive procedures, clinic practice, use of antibiotic therapy, prognosis, among others[10].

Mean hospitalization lasted 6.35 days, which confirms another study that evinced a similar hospitalization period[11]. However, it is known that, depending on the hospital's complexity, this number can increase, as it happened in a university hospital in São Paulo, for which the mean hospitalization lasted 15.6 days[6]. Regarding this aspect, HAIs are considered more severe in ICUs, since there is a demand of patients depending on intensive life support, which increases hospitalization, costs, and the possibility of infections[12].

Concerning the analysis before and after implementing fast checklist, it was observed that VAP cases, their density, and days on mechanical ventilation reduced significantly after implementing the tool, demonstrating that the protocol is an efficient tool to control and prevent VAP. This can be the result of the systematized attention to all indicators recommended by CDC for HAI prevention that only protocols allow for.

A similar study showed DVAPI dropping from 4.08 to 1.16, which reduced VAP frequency 0.28 times in an ICU[13]. The researchers managed to reduce HAI rates after implementing a measure presentation protocol, which demonstrates that protocols can reduce VAP, allowing for improvements in patient care[13].

Another study has shown a significant VAP reduction, from 15.5 to 11.7, after implementing a 5-item protocol: I – not using MV on non-recommended patients; II – using and controlling the sedation protocol; III – washing hands and using alcohol after handling air passages; IV – oral hygiene with 0.12% chlorhexidine at every 8 hours; and V – controlling tube cuff pressure. After implementing it, a reduction of time in the ICU was also observed, showing that adopting prevention measures impacts on care quality[14].

A study carried out in Taiwan presented a significant VAP reduction from 3.3 to 1.4 DVAPI[15]. This reduction happened after the implementation of a 6-item VAP protocol and the joint work of a multidisciplinary team. The researchers credit the success to the engagement of

nurses, physicians, and physical therapists[5]; and concluded that the reduction of HAIs will only be effective with the combined work of the multidisciplinary team, service education, and with the segment's health professionals understanding the importance of using the checklist[15].

This condition was also observed by the researchers in this study, who considered that, in order to prevent and control VAP, it is necessary to list priorities based on the evaluation of the segment's needs and the reality of care. This was only possible with the implementation of the tool and multidisciplinary training, which enabled a VAP reduction within preconized definitions, constituting a great ally for the institution's care quality.

Regarding this, it is highlighted that, for the protocol to be successful, a multidisciplinary training must happen, encouraging adoption and problem-solving. Another key point to achieve the study's aims was to perform the multidisciplinary visit, which enable the identification of non-conformities and shifts in the routine, facilitating the management of practices in order to reduce VAP in this ICU.

It is also important to reduce MV use rates, since it will help lower global VAP rates in institutions and, as aforementioned, reduce hospitalization days and the costs related to patient care.

The success of this protocol showed that fast checklist aids care and assistance globally, and for that it should be adopted by health professionals as a way of ensuring patient safety during all hospitalization, preventing HAIs.

It is understood that adopting and following protocols reduces infection. However, their success is related to other intrinsic and extrinsic indicators, such as the adhesion by the multidisciplinary team, rational use of antibiotic therapy, MVDAYS, reduction of invasive procedures, user's age, comorbidities, among others.

Given the results presented, it is important to invest on protocol use, since they are efficient, low-cost, and feasible tools that do not demand great efforts by the teams. On the contrary, they facilitate the work process through a routine shift from an action with no evidence to a systematized decision-making process based on evidences.

This article proves the applied tool was efficient to reduce VAP. However, to achieve these results, it was necessary to change routine, implementing the multidisciplinary visit. This change, along with the daily use of the protocol, enabled decision-making for the involved professionals, resulting on the significant VAP reduction in this ICU.

As a contribution, based on this research, multidisciplinary teams may be supported by the use of a tool as the fast checklist, which was effective for VAP reduction and enabled improvements in user care quality.

REFERENCES

1. Backes MTS, Erdmann AL, Büscher A. O ambiente vivo, dinâmico e complexo de cuidados em Unidade de Terapia Intensiva. Rev. Latino-Am. Enfermagem. 2015;23(3):411-8. https://dx.doi.org/10.1590/0104-1169.0568.2570

2. Othman AA, Abdelazim MS. Ventilator-associated pneumonia in adult intensive care unit prevalence and complications. The Egyptian Journal of Critical Care Medicine. 2017. 5: 61–63. Available at: https://dx.doi.org/10.1016/j.ejccm.2017.06.001

3. Vilela R, Dantas SRPE, Trabasco P. Equipe interdisciplinar reduz infecção sanguínea relacionada ao cateter venoso central em Unidade de Terapia Intensiva Pediátrica. Rev. paul. pediatr. 2010. 28(4): 292-298. Available at: http://dx.doi.org/10.1590/S0103-05822010000400002

4. Ministério da Saúde (BR), Agência Nacional de Vigilância Sanitária, Gerência de Vigilância e Monitoramento em Serviços de Saúde, Gerência Geral de Tecnologia em Serviços de Saúde. Critérios Diagnósticos de Infecções Relacionadas à Assistência à Saúde: Neonatologia [Internet]. Brasília: ANVISA, 2017. Available at: http://portal.anvisa.gov.br/documents/33852/3507912/Caderno+3+-+Crit%C3%A9rios+Diagn%C3%B3sticos+de+Infec%C3%A7%C3%A3o+Associada+%C3%A0+Assist%C3%AAncia+%C3%A0+Sa%C3%BAde+Neonatologia/9fa7d9be-6d35-42ea-ab48-bb1e068e5a7d

5. CDC. Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level. November2016. Available at: https://www.who.int/gpsc/ipc-components/en/

6. Alecrim RX, Taminato M, Belasco AGS, et al. Boas práticas na prevenção de pneumonia associada à ventilação mecânica. Acta paul. enferm. [Internet]. 2019. 32(1): 11-17. Available at: http://dx.doi.org/10.1590/1982-0194201900003

7. Ferreira EC; Kimura A, Ramos DF, et al. Prevalence of ventilator-associated pneumonia through analysis of tracheobronchial. Rev Rene. 2017. 18(1):114-20. Available at: http://dx.doi.org/10.1590/S1806-37132006000400013

8. Favarin SS, Camponogara S. Perfil dos pacientes internados na unidade de terapia intensiva adulto de um hospital universitário. Rev Enferm UFSM. 2012; 2(2):320-9. Available at: http://dx.doi.org/10.5902/217976925178

9. Alves AN. A importância da atuação do fisioterapeuta no ambiente hospitalar. Ens Ciênc Biol Agr Saúde. 2012; 16(6):173-84. Available at: https://pdfs.semanticscholar.org/1dd6/1a33b5f847cea6a3419a0f5b2c527ad65667.pdf

10. Hespanhol LAB, Ramos SCS, Ribeiro Junior OC, et al. Infection related to Health Care in an adult Intensive Care Unit. Enfer Global. 2019. 53: 229-41. Available at: http://dx.doi.org/10.6018/eglobal.18.1.296481

11. Carrilho CMDM, Grion CMC, Carvalho LM, et al. Ventilator-Associated Pneumonia in Surgical Intensive Care Unit. Ver Bras Ter Inten. 2006. 18(1): 38-44. PMID:25310326. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC31581/

12. Bastos ECB, Lima PS, Laurindo MV, et al. Epidemiological profile of infections in a unit of intensive emergency therapy. Braz. J. Hea. Rev. 2019. 2(3): 1654-60. Available at: http://www.brjd.com.br/index.php/BJHR/article/view/1432

13. Eom JS, Lee MS, Chun HK, et al. The impact of a ventilator bundle on preventing ventilator-associated pneumonia: a multicenter study. Am J InfectControl [Internet]. 2014;42(1):34-7. https://dx.doi.org/10.1016/j.ajic.2013.06.023

14. Rello J, Afonso E, Lisboa T, et al. A care bundle approach for prevention of ventilator-associated pneumonia. Clin Microbiol Infect [Internet]. 2013;19(4):363-9. https://dx.doi.org/10.1111/j.1469-0691.2012.03808.x

15. Lim KP, Kuo SW, Ko WJ, et al. Efficacy of ventilator-associated pneumonia care bundle for prevention of ventilator-associated pneumonia in the surgical intensive care units of a medical center. J Microbiol Immunol Infect [Internet]. 2015;48(3):316-21. https://dx.doi.org/10.1016/j.jmii.2013.09.007

Authors' contributions:

Simonei Bonatto, Carla Luiza da Silva, Fernanda Berger Ribas, and Luciana da Silva Lirani contributed to design, outline, analyze and write the article;

Carla Luiza da Silva, Simonei Bonatto, Danielle Bordin, and Luciane Patricia Andreani Cabral contributed on planning and final outline, as well as reviewing and approving the article;

All authors have approved the final version for publication and are responsible for all aspects of the work, including guaranteeing its precision and integrity.