




Occurrence of errors in the preparation and administration of medications in an emergency care unit*

Ocorrência de erros no preparo e na administração de medicamentos em unidade de pronto atendimento

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ABSTRACT

Objective: to characterize errors during the preparation and administration of injectable drugs in an emergency care unit. **Method:** descriptive cross-sectional study carried out in an emergency care unit. Data collection was performed by direct non-participant observation, for 30 consecutive days and the data were analyzed using descriptive statistics. **Results:** 751 doses were observed during the drug preparation and administration process. The main errors were lack of hand hygiene, disinfection of vials and countertops, failure to provide information on the administered drug and patient identification and verification of drug allergy. **Conclusion:** errors in the medication preparation and administration process often occur in an emergency care unit. The study indicates and reinforces the need to restructure the emergency service for a safe practice and offers subsidies to plan permanent education and the training of new professionals.

Descriptors: Medication Errors; Patient Safety; Nursing, Team; Emergency Medical Services; Medication Systems, Hospital.

RESUMO

Objetivo: caracterizar os erros durante o preparo e a administração de medicamentos injetáveis em unidade de pronto atendimento. **Método:** estudo transversal descritivo realizado em unidade de pronto atendimento. Foi realizada a coleta de dados por observação direta, não participante, durante 30 dias consecutivos e os dados foram analisados por estatística descritiva. **Resultados:** foram observadas 751 doses durante o processo de preparo e administração de medicamentos. Os principais erros foram ausência de higienização das mãos, desinfecção de frascos ampola e bancada, falha na informação sobre o medicamento administrado e na identificação do paciente e verificação de alergia medicamentosa. **Conclusão:** os erros no processo de preparo e administração de medicamentos ocorrem frequentemente em unidade de pronto atendimento. O estudo indica e reforça a necessidade de reestruturação do serviço de emergência para uma prática segura e oferece subsídios para planejar a educação permanente e a formação de novos profissionais.

Descritores: Erros de Medicação; Segurança do Paciente; Equipe de Enfermagem; Serviços Médicos de Emergência; Sistemas de Medicação no Hospital.

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INTRODUCTION

The medication system consists of a complex, interdependent and multidisciplinary process⁽¹⁾ that comprises several steps, including the preparation and administration of medications⁽²⁾. Due to the dynamics of the actions involved, the preparation and administration can favor the occurrence of errors. According to the National Coordinating Council for Medication Error Reporting and Prevention, a medication error is “[...] any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer”⁽³⁾.

Errors that occur during medication administration are considered the most frequent in health systems, with an average rate of 32.1%⁽⁴⁾ and the second cause of health-related incidents⁽⁵⁾. Injectable drugs are the ones with the highest risk because they are complex in the way they are prepared and administered⁽⁴⁾.

Medication errors are significant sources of morbidity and mortality. It is estimated that there are twice as many drug-related deaths in patients in developing countries. This places a large economic burden on health systems. Worldwide, the cost associated with errors has been estimated at US\$ 42 billion per year, which represents almost 1% of global health expenditures. To this end, in 2017, the World Health Organization launched the third global challenge, an initiative to reduce by 50%, in the next five years, the serious and avoidable harm associated with medicines in the world⁽⁶⁾.

In Brazil, the latest recorded data show the notification of 2,119 incidents caused by failures involving medicines, which represents 2.05% of all reported incidents and a fraction of 8.94% of incidents that occurred in urgency and emergency services⁽⁷⁾. Medication errors, as a phenomenon of investigation, are widely studied in hospital services. However, urgency and emergency services remain an unexplored field, especially health establishments of intermediate non-hospital complexity, such as Emergency Care Units. The dynamics of emergency care overloads the health system and favors the occurrence of errors. Around 25% of patients who used Brazilian emergency services suffered some damage related to medication errors⁽⁸⁾.

Considering that these errors compromise patient safety and can lead to death, identifying the types of errors related to the medication preparation and administration process helps to prevent its occurrence, improve patient safety and develop strategies for the safe administration of medication. The study of this theme can affect the social and economic life of patients, their families and health services, as well as support the planning of these stages of the medication system in health facilities. Thus, the present study aimed to characterize errors during the preparation and administration of injectable drugs in an emergency care unit.

METHOD

Descriptive cross-sectional study, carried out in an Emergency Care Unit (UPA 24h) (non-hospital component of the emergency and intermediate emergency network of basic and hospital care) in the metropolitan region of the State of Goiás.

The sample consisted of observation opportunities in the process of preparation and administration of drug doses. Only subcutaneous, intramuscular and intravenous doses were included. The sample calculation based on finite populations, considering the 95% confidence level as parameters, was 600 doses, based on the monthly average of 3,000 doses prepared and administered in the unit. Medications suspended by medical order and those prescribed to patients under 12 years of age were excluded.

To record the data, a checklist developed by the researchers was used, based on the literature^(2,9-10), and appreciated by three nurses, doctors with expertise in the subject. A pilot test was carried out at the study unit to identify the operability of the instrument and the rate of agreement of observation among the assistants. At this stage, information was collected on 117 doses prepared and administered. Data were checked and agreement was verified by the index (Kappa) (CI>90%). These data were not included in the study.

Variables of interest were considered errors in the drug preparation and administration process. Among the errors in the preparation process are failures in ampoule and countertop disinfection, hand hygiene and drug inspection; failure to perform the needle change; non-use of PPE and drug association. Errors in medication administration were considered: failures in patient identification and drug allergy; lack of information to the patient about the medication administered; wrong route of medication administration; wrong dose; wrong infusion rate; wrong administration time; incorrect checking; dose omission, inadequate administration technique (several puncture attempts by the same professional, contamination of the puncture site and reuse of the catheter); incorrect material disposal and needle recapping.

Data collection was carried out by direct non-participant observation and took place between May and June 2017, during 14 days previously established, including holidays and weekends, during the day shift (07:00 – 19:00) and night shift (19:00 – 07:00). In this way, ensuring the homogeneity of the sample and the number of doses calculated for the study. Data collection totaled 168 hours of observation. Six research assistants – previously trained nursing students – collected data.

Although the doses prepared and administered were evaluated, these procedures performed by professionals were observed. Therefore, after data collection, professionals were informed about the study and were free to decide on their

participation. Upon accepting, they signed the Free and Informed Consent Form.

The study is part of the thematic project "Patient Safety: An Approach to Training and Care" approved by the Research Ethics Committee (CAAE: 59736216.1.0000.0037) under opinion No. 1,822,751. Which respected all ethical aspects of research involving human beings.

RESULTS

The process of preparing 751 doses of medication was observed. The predominance of errors related to ampoule disinfection was identified, being 100% (751/751); hand hygiene, 99.9% (750/751); countertop disinfection, 98.9% (743/751); drug inspection, 88.5% (664/751) and medication association, 58.4% (438/751) (Table 1).

Table 1. Distribution of errors in the process of preparing injectable drugs in an emergency care unit according to the error category (n=751). State of Goiás, Brazil, 2017.

Errors in the drug preparation process	n	%
Ampoule disinfection failure	751	100.0%
Hand hygiene failure	750	99.9%
Countertop disinfection failure	743	98.9%
Failure to inspect the medication in the ampoule	664	88.5%
Drug association	438	58.4%
Did not change needle	126	16.8%
Did not use Personal Protective Equipment (PPE)	44	5.9%

During the preparation of doses, it was observed that there was no indication of the type of diluent and the volume for dilution of the injectable drug; thus, the nursing professionals used distilled water.

During the administration of the 751 doses observed, there were errors related to the lack of information about the medication administered, 96.1% (722/751) and failures in the identification of the patient, 95.5% (717/751) and in the verification of drug allergy, 86.5% (650/751) (Table 2).

Of the 751 doses prepared, six were not administered by default. Of the 745 doses administered, the most used route was intravenous, 78.1% (582/745); followed by intramuscular, 20.5% (153/745). It was observed that only 25.1% (146/582) of the doses administered intravenously were handled with the use of procedure gloves.

Table 2. Frequency of errors in the administration of injectable drugs in an emergency care unit (n=751). State of Goiás, Brazil, 2017.

Errors in medication administration	n	%
Lack of information about the medication administered	722	96.1%
Failure in patient identification	717	95.5%
Drug allergy check failure	650	86.5%
Incorrect checking	218	29.0%
Wrong infusion rate	139	18.5%
Wrong dose	27	3.6%
Wrong route of medication administration	10	1.3%
Dose omission	6	0.8%
Wrong administration time	3	0.4%
Incorrect material disposal	1	0.1%
Needle recapping	1	0.1%

During the administration of drugs intravenously, some failures were found related to the technique of peripheral catheter insertion, such as several puncture attempts by the same professional, contamination of the puncture site and the reuse of the catheter, in the same patient, in different puncture attempts. Antisepsis at the drug application site and disinfection of the equipment in the septum of the infusion connection occurred in 98.0% (570/582) of the administered doses. However, the 30 seconds recommended for drying the alcoholic solution was not observed.

The 745 doses administered belonged to different pharmacological groups, most frequently analgesics, 31.7% (236/745); followed by anti-inflammatory drugs, 15.4% (115/745); and multivitamins, 12.1% (90/745).

Of the doses administered, 24 belonged to the group of potentially dangerous drugs (PDD), such as opioid analgesics, 2.4% (18/24); anticonvulsants, 0.1% (1/24); antithrombotics, 0.1% (1/24); regular insulin, 0.1% (1/24) and vasoconstrictor, 0.1% (1/24). In the administration of PDDs, among the most frequent errors, failure to provide information on the administered medication stands out, 95.8% (23/24); patient identification, 87.5% (21/24); verification of drug allergy, 91.7% (22/24) and infusion rate, 29.2% (7/24).

In relation to incorrect checking, the failures identified were the wrong administration time and patient identification. On the other hand, dose omissions occurred due to professional forgetfulness, because the patient did not present symptoms for drug administration and because the professional was unable to obtain venous access in the patient.

DISCUSSION

Evidence-based safe practice guidelines establish consensus standards that guarantee microbiological safety in the preparation and administration of injectable drugs^(9,11). Despite the recommendations, the results obtained in this study demonstrate the inexistence and inconsistency of adherence to practices in the preparation of medicines, which were also found in Brazilian studies⁽¹²⁻¹³⁾.

In this study, there was a predominance of errors related to the potential to alter the therapeutic response, such as failure in visual inspection before preparation, especially validity, staining and the presence of foreign bodies and particles. These factors can interfere with the expected and desired effect, as well as the incompatibility between the solutions⁽¹⁴⁾. In the findings, the association of drugs was frequent, which can cause chemical phlebitis, in addition to potentiating, neutralizing or reducing the effects of the drugs^(9,11).

Also noteworthy is the omission of the diluent prescription in the prepared doses, which shows flaws in the prescription, leaving the choice of diluent, as well as its quantity, to the discretion of nursing professionals. However, studies need to be undertaken to discuss this issue.

It should be noted that safety in the drug preparation process is not restricted to the moment of preparation. This process must be preceded by an institutional organization that guarantees good practice protocols with the establishment of standardization of dilution and association of injectable solutions, biosecurity measures, in addition to training for the responsible team. These measures certainly contribute to the reduction of errors and minimize the risks to patients, especially those in emergency services.

The medication administration stage is considered the most susceptible to errors and the last opportunity to intercept them⁽¹⁵⁾. Therefore, the recommendation to adopt the nine rights precedes a safe practice in this process⁽¹⁰⁾. A third of medication errors occur at this stage and the majority due to non-observance of the nine rights⁽¹⁶⁾. The findings in this study point to weaknesses that reduce the safety and quality of patient care, especially with regard to the right medication, the right patient and the right record. In Spain⁽¹⁷⁾ and Australia⁽¹⁸⁾ these same failures were also found in emergency services, but to a lesser extent.

For a safe administration, it is essential to inform the patient about the drug to be administered, the treatment indication and the expected effects. Patient identification must be performed before care, as well as verification of the patient's full name and the use of at least two identifiers to confirm the patient's identity⁽¹⁰⁾. Patient identification is considered an important strategy so that medication is not administered to the wrong patient. Mainly in emergency situations, in which the clinical condition of the patient and

the use of a greater number of medications in a shorter time stand out⁽¹⁷⁾.

According to international and national studies on the main errors in medication administration in hospital and non-hospital urgency and emergency services, factors as wrong infusion rate^(12,17), wrong administration time and wrong dose^(17,19-20), wrong route of medication administration^(19,21-22) and dose omission^(17,19-22) were cited and reveal the weaknesses in the services, because these errors contribute to adverse events during care.

When considering the emergency service as one of the critical entry points into the health system, whose complex and dynamic environment is characterized by high patient turnover and severity, some factors may contribute to the occurrence of these errors such as overcrowding, waiting time and hospitalization, excessive flow of care and the patient's clinical condition⁽²³⁾.

These factors can lead to the suppression of important steps in drug administration, such as non-observance of aseptic technique, which is fundamental for the prevention of infections in the administration of injectables. Technical failures related to venous access found in this study involved lack of skills and non-compliance with standard precautions, which were also observed in other studies^(12,20). There is a strong recommendation for the use of Personal Protective Equipment at the time of administration of injectables^(9,11) and its non-use exposes the professional to body fluids, such as blood and, consequently, to occupational risks. Aseptic technique is essential for safe administration and the use of barriers and technologies can help prevent errors.

Practice based on scientific evidence, associated with technological innovation during peripheral venipuncture, facilitate the procedure and minimize the effects of multiple attempts. The use of ultrasound for intravenous therapy in the different realities of care enhances the professionals' handling skills and provides greater safety for the patient⁽²⁴⁾. Although this technology is considered an important ally in preventing errors, it is not always available in most emergency and urgency services in public health facilities. This requires, therefore, greater professional skills to assess venous access before and after administration⁽¹¹⁾.

Medication administration represents an essential care in all health services, especially in emergency units. In this study, it was identified that, among the doses administered, there were potentially dangerous drugs that require greater attention in their administration. However, the data show that, even in the case of high-risk drugs, there was no identification of the patient, which increases the risk of the occurrence of serious adverse events.

The use of these drugs occurs in different healthcare environments, especially cardiovascular drugs, central nervous system drugs, anticoagulants, insulin, antithrombotics and

hypertonic solutions⁽¹⁴⁾. Thus, it is recommended that health facilities standardize their use according to the therapeutic classes, the prior identification of antidotes and reversal agents to ensure patient safety⁽¹³⁾.

Based on the results obtained in this study and the discussions presented, it is emphasized that the preparation and administration of medications require clinical and professional assessments, supervision and critical thinking. Therefore, the prevention of errors and the monitoring of adverse events are not only the responsibility of nursing and require a multifaceted approach with a combination of continuing education, management strategies and the use of barcode technology and automated dispensing⁽²⁵⁾. However, it is worth noting that, despite being a joint action, medication administration remains under the responsibility of the nurse, who must maintain constant supervision of the team and contribute to the elaboration and adequacy of medication preparation and administration protocols.

The impossibility of evaluating the damage associated with each error that occurred and the clinical conditions related to the therapeutic adequacy of the patient treated at the unit are considered limitations of this study. These are approaches to be investigated in other studies. The results come from direct observations of medication practice and show flaws in the preparation and administration process, which represent a great challenge for the organization of the service to ensure the quality of care and patient safety.

CONCLUSION

The results found showed the frequent occurrence of errors in the process of preparation and administration of injectable drugs in an emergency care unit. In the medication preparation process, there was low adherence to the recommendations of current regulations, especially those related to biosafety measures and those that alter the therapeutic response of the medication. In administration, errors were related to the communication between the professional and the patient, such as the lack of patient identification, information about the drug to be administered and verification of drug allergy.

Such findings bring to light the importance of adopting and reviewing good practices in the medication process in emergency services to mitigate errors and raise the discussion about the implementation of systematized protocols and permanent education with the teams.

The weaknesses pointed out reinforce that emergency services have specific characteristics and situations that can favor a greater occurrence of errors with harmful outcomes for patients. The results provide subsidies for the development of strategies that can improve systemic and human conditions in emergency care units.

REFERENCES

1. Souta MM, Telles Filho PCB, Vedana KGG, Pedrão LJ, Miasso AI. Medication system: analysis of actions taken by professionals in psychiatric units. *Texto contexto - enferm* [Internet]. 2016 [cited 2022 May 11];25(4):e0170015. Available from: <https://doi.org/10.1590/0104-07072016000170015>.
2. Gimenes FRE. Administração: não basta usar, é preciso conhecer a maneira correta. In: Organização Pan-Americana da Saúde; Organização Mundial da Saúde. *Uso Racional de Medicamentos: fundamentação em condutas terapêuticas e nos macroprocessos da Assistência Farmacêutica* [Internet]. Brasília: OPAS/OMS; 2016 [cited 2022 May 27]. Available from: <https://www.paho.org/bra/dmdocuments/Fasciulo18.pdf>.
3. National Coordinating Council for Medication Error Reporting and Prevention. *About Medication Errors* [Internet]. NCC MERP; 2014 [cited 2022 May 11]. Available from: <https://www.nccmerp.org/about-medication-errors>.
4. Sutherland A, Canobbio M, Clarke J, Randall M, Skelland T, Weston E. Incidence and prevalence of intravenous medication errors in the UK: a systematic review. *Eur J Hosp Pharm* [Internet]. 2020 [cited 2022 May 11];27(1):3-8. Available from: <https://doi.org/10.1136/ejhpharm-2018-001624>.
5. Karimian Z, Kheirandish M, Javidnikou N, Asghari G, Ahmadizar F, Dinarvand R. Medication Errors Associated With Adverse Drug Reactions in Iran (2015-2017): A P-Method Approach. *Int J Health Policy Manag* [Internet]. 2018 [cited 2022 May 11];7(12):1090-Available from: <https://doi.org/10.15171/ijhpm.2018.91>.
6. Organization WH. *Medication without harm* [Internet]. Geneva: World Health Organization; 2017 [cited 2022 May 11]. 16 p. Available from: <https://apps.who.int/iris/handle/10665/255263>.
7. *Boletim Segurança do Paciente e Qualidade em Serviços de Saúde nº 20: Incidentes Relacionados à Assistência à Saúde 2018* [Internet]. Brasília - DF: Agência Nacional de Vigilância Sanitária; 2019 Nov [cited 2022 May 11] 7 p. Available from: <https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/servicosdesaude/boletim-seguranca-do-paciente/boletim-seguranca-do-paciente-e-qualidade-em-servicos-de-saude-n-20-incidentes-relacionados-a-assistencia-a-saude-2018.pdf>.
8. Souza TT, Godoy RR, Rotta I, Pontarolo R, Fernandez-Llimos F, Correr CJ. Morbidade e mortalidade relacionadas a medicamentos no Brasil: revisão sistemática de estudos observacionais. *Revista de Ciências*

- Farmacêuticas Básica e Aplicada [Internet]. 2014 [cited 2022 May 11];35(4):519-32. Available from: <https://rcfba.fcfar.unesp.br/index.php/ojs/article/view/82>.
9. Dolan SA, Arias KM, Felizardo G, Barnes S, Kraska S, Patrick M, et al. APIC position paper: Safe injection, infusion, and medication vial practices in health care. *Am J Infect Control* [Internet]. 2016 [cited 2022 May 11];44(7):750-7. Available from: <https://doi.org/10.1016/j.ajic.2016.02.033>
 10. Ministério da Saúde; Agência Nacional de Vigilância Sanitária. Protocolo de Segurança na Prescrição, uso e Administração de Medicamentos [Internet]. Brasília: ANVISA; 2013 [cited 2022 May 27]. Available from: <https://portaldeboaspraticas.iff.fiocruz.br/biblioteca/protocolo-de-seguranca-na-prescricao-uso-e-administracao-de-medicamentos/>.
 11. Evidence-based safe practice guidelines for I.V. push medications. *Nursing* [Internet]. 2016 [cited 2022 May 11];46(10):44-5. Available from: <https://doi.org/10.1097/01.NURSE.0000499868.04151.f0>.
 12. Pereira FGE, Aquino GÂ, Melo GAA, Praxedes CO, Caetano JÁ. Conformidades e não conformidades no preparo e administração de antibacterianos. *Cogitare Enferm* [Internet]. 2016 [cited 2022 May 11];21(5):1-9. Available from: <https://doi.org/10.5380/ce.v21i5.45506>.
 13. Mendes JR, Lopes MCBT, Vancini-Campanharo CR, Okuno MFP, Batista REA. Types and frequency of errors in the preparation and administration of drugs. *einstein* (São Paulo) [Internet]. 2018 [cited 2022 May 11];16(3):1-6. Available from: <https://doi.org/10.1590/S1679-45082018AO4146>
 14. Institute for Safe Medication Practices (ISMP). ISMP Targeted Medication Safety Best Practices for Hospitals [Internet]. Montgomery: Institute for Safe Medication Practices; 2021 [cited 2022 May 11]. Available from: <https://www.ismp.org/guidelines/best-practices-hospitals>.
 15. Pop M, Finocchi M. Medication Errors: A Case-Based Review. *AACN Advanced Critical Care* [Internet]. 2016 Feb 1 [cited 2022 May 11];27(1):5–11. Available from: <https://doi.org/10.4037/aacnacc2016172>.
 16. Godshall M, Riehl M. Preventing medication errors in the information age. *Nursing* [Internet]. 2018 [cited 2022 May 11];48(9):56-8. Available from: <https://doi.org/10.1097/01.NURSE.0000544230.51598.38>.
 17. Pérez-Díez C, Real-Campana JM, Noya-Castro MC, Andrés-Paricio F, Reyes Abad-Sazatornil M, Bienvenido Povar-Marco J. Errores de medicación en un servicio de urgencias hospitalario: estudio de situación para mejorar la seguridad de los pacientes. *Emergencias* [Internet]. 2017 [cited 2022 May 11];29(6):412-5. Available from: <http://emergencias.portalsemes.org/numeros-anteriores/volumen-29/numero-6/errores-de-medicacion-en-un-servicio-de-urgencias-hospitalario-estudio-de-situacion-para-mejorar-la-seguridad-de-los-pacientes/>.
 18. Cabilan C, Hughes JA, Shannon C. The use of a contextual, modal and psychological classification of medication errors in the emergency department: a retrospective descriptive study. *J Clin Nurs* [Internet]. 2017 [cited 2022 May 11];26(23-24):4335-43. Available from: <https://doi.org/10.1111/jocn.13760>.
 19. Valle MMF, Cruz EDA, Santos T. Incidentes com medicamentos em unidade de urgência e emergência: análise documental. *Rev Esc Enferm USP* [Internet]. 2017 [cited 2022 May 11];51:e03271. Available from: <https://doi.org/10.1590/S1980-220X2016033303271>.
 20. Shitu Z, Aung MMT, Tuan Kamauzaman TH, Ab Rahman AF. Prevalence and characteristics of medication errors at an emergency department of a teaching hospital in Malaysia. *BMC Health Serv Res* [Internet]. 2020 [cited 2022 May 11];20:56. Available from: <https://doi.org/10.1186/s12913-020-4921-4>.
 21. Björkstén KS, Bergqvist M, Andersén-Karlsson E, Benson L, Ulfvarson J. Medication errors as malpractice—a qualitative content analysis of 585 medication errors by nurses in Sweden. *BMC Health Serv Res* [Internet]. 2016 [cited 2022 May 11];16:431. Available from: <https://doi.org/10.1186/s12913-016-1695-9>.
 22. Misasi P, Keebler JR. Medication safety in emergency medical services: approaching an evidence-based method of verification to reduce errors. *Ther Adv Drug Saf* [Internet]. 2019 [cited 2022 May 11];10:2042098618821916. Available from: <https://doi.org/10.1177/2042098618821916>.
 23. Ortíz-Barrios MA, Alfaro-Saiz JJ. Methodological Approaches to Support Process Improvement in Emergency Departments: A Systematic Review. *Int J Environ Res Public Health* [Internet]. 2020 [cited 2022 May 11];17(8):2664. Available from: <https://doi.org/10.3390/ijerph17082664>.
 24. Oliveira AM, Danski MTR, Pedrolo E. Inovação tecnológica para punção venosa periférica: capacitação para uso da ultrassonografia. *Rev Bras Enferm* [Internet]. 2016 [cited 2022 May 11];69(6):1052-8. Available from: <https://doi.org/10.1590/0034-7167-2016-0125>.
 25. WolfZR, Hughes RG. Best Practices to Decrease Infusion-Associated Medication Errors. *J Infus Nurs* [Internet]. 2019 [cited 2022 May 11];42(4):183-92. Available from: <https://doi.org/10.1097/NAN.0000000000000329>.

