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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ,რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Содержание:

IMPACT OF THE COVID-19 PANDEMIC ON THE SURVEILLANCE OF INFECTIOUS DISEASES: ASSESSMENT OF THE LEPTOSPIROSIS SURVEILLANCE SYSTEM IN THE ADJARA REGION (2020–2024)

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Abstract.

Leptospirosis is classified as an infection subject to mandatory notification; however, surveillance effectiveness varies across regions in Georgia. The aim of the present study was to assess the impact of the COVID-19 pandemic on the leptospirosis epidemiological surveillance system in the Adjara region during 2020–2024. A mixed-methods assessment was conducted following the CDC *Updated Guidelines for Evaluating Public Health Surveillance Systems* (MMWR, 2001) and national NCDC regulations. Data quality was high within the evaluated subset of cases (86.1%); however, overall system-wide data completeness was low (46.1%), reflecting substantial limitations in routine surveillance data quality. Timeliness significantly declined during 2020–2021 due to COVID-19–related system overload and laboratory delays. Case detection was uneven across municipalities, and field findings revealed gaps in case identification, diagnostic access, and accurate completion of mandatory reporting forms. The Adjara leptospirosis surveillance system demonstrated moderate performance but notable vulnerabilities amplified by the COVID-19 pandemic.

Key words. Leptospirosis, surveillance assessment, public health, epidemiology, COVID-19, Adjara, Georgia.

Introduction.

The COVID-19 pandemic posed a major challenge to public health systems worldwide, affecting not only the management of the pandemic itself but also the surveillance and control of other priority infectious diseases. Disruptions in routine healthcare services, redistribution of resources, reduced healthcare-seeking behavior, and overburdened laboratory networks significantly influenced the detection, notification, and laboratory confirmation of non-pandemic infections [1,2].

Leptospirosis is a globally important zoonotic disease whose true burden is often underestimated, particularly in low- and middle-income countries. In Georgia, leptospirosis is classified as a high-priority infectious disease subject to mandatory notification; however, the effectiveness of epidemiological surveillance varies across regions. International frameworks, including the International Health Regulations (IHR 2005), WHO PRET (2023), and the CDC Public Health Surveillance Guidelines (MMWR, 2001), emphasize the need for surveillance systems that remain resilient and functional during public health emergencies.

Globally, leptospirosis causes an estimated 1.03 million cases and approximately 58,900 deaths annually, corresponding to a global incidence of 14.8 cases per 100,000 population and a disease burden of approximately 2.9 million DALYs [3,4]. In Georgia, leptospirosis is reported in nearly all regions, with Adjara consistently exhibiting the highest incidence and a pronounced seasonal pattern during summer months [5-7]. Surveillance data from 2020–2024 indicate a marked decline in reported leptospirosis cases during 2020–2021, coinciding with the peak of the COVID-19 pandemic. This decline likely reflects pandemic-related disruptions, including limited laboratory testing, reduced clinical utilization, and temporary underreporting of non-pandemic infections [8]. From 2022 onward, reported incidence increased, potentially reflecting both recovery of surveillance activities and underlying epidemiological trends.

The aim of this study was to evaluate the leptospirosis epidemiological surveillance system in the Adjara region during 2020–2024 using quantitative and qualitative attributes, with a specific focus on assessing system performance and the impact of the COVID-19 pandemic. The objectives were to conduct a descriptive epidemiological analysis of leptospirosis cases by person, place, and time, and to assess key surveillance system attributes in accordance with established international guidelines.

Methods.

A mixed-methods assessment design was used in this study, integrating both quantitative and qualitative attributes. The assessment was based on the CDC guidelines *“Updated Guidelines for Evaluating Public Health Surveillance Systems”* [9], as well as relevant normative documents of the National Center for Disease Control and Public Health of Georgia (NCDC), including Ministerial Orders №01-26/□ (2019) and №01-58/□ (2021) [10,11]. Data collection was conducted through the integration of three components.

Electronic surveillance data (EIDSS, 2020–2024): All registered leptospirosis case data from the EIDSS electronic surveillance system were extracted for the period 2020–2024 in the Adjara region based on: case registration dates; laboratory status; epidemiological linkage; notification channels and standardized fields from case reporting forms (60/A, 60/B, IV-03, 58/3f) [12-17]. Additionally, data completeness, accuracy, chronological consistency, and the quality of form completion were assessed based on NCDC reports, regional epidemiological situation reviews, standard operating procedures for surveillance, national protocols on leptospirosis, and international guidelines (WHO, CDC) [9,12-15]. Data for 2024 were extracted from the EIDSS system as available at the time of analysis and should be considered provisional, as final validation and case closure were ongoing.

Field assessment of the surveillance system: As part of the surveillance system assessment, fieldwork was conducted using a structured questionnaire. The objective was not only to assess system attributes but also to verify the real-world practice of identifying, diagnosing, and entering leptospirosis cases into the EIDSS system at the clinical level. Fieldwork included visits to primary healthcare facilities across all six municipalities of Adjara, where standardized interviews were conducted with epidemiologists and clinicians. The assessment covered: how suspected leptospirosis cases are identified in clinical practice; whether clinicians apply the national clinical-epidemiological criteria for leptospirosis; completeness of case reporting forms (60/A, 60/B, IV-03); timeliness of reporting to the Municipal Public Health Center; sequence and accuracy of data entry into EIDSS and presence of duplicate or missed cases. The field component enabled a practical assessment of how effectively the surveillance system functions, the extent to which EIDSS data reflect actual clinical events, and where gaps exist in data completeness, reporting timeliness, or diagnostic processes.

Surveillance system attribute assessment: The assessment of the leptospirosis surveillance system was conducted in accordance with CDC MMWR guidelines and included both quantitative and qualitative attributes. Quantitative components included: data quality; timeliness; sensitivity; PPV. Qualitative components were assessed based on: representativeness, simplicity, flexibility and stability. Additionally, content analysis was applied to identify the impact of the COVID-19 pandemic, enabling assessment of system disruptions, changes in data completeness, and timeliness during 2020–2024. Comparative assessment of the attributes was carried out according to CDC (MMWR, 2001) and NCDC methodological guidelines. The study utilized anonymized surveillance data; no personal information was processed. Only data compliant with Georgian legislation and NCDC regulations were used [9-12,18].

Results.

Data transmission to the Regional Public Health Center of Adjara occurs at the beginning of each subsequent month in aggregated form (58/3f) from the municipal Public Health Centers. For diseases subject to immediate notification, reporting is conducted via telephone, and the case is simultaneously registered in the EIDSS system. At the municipal level, information on notifiable diseases is received from primary healthcare facilities (clinics and polyclinics, i.e., the local level). From the regional level, notifications are sent to the NCDC, which serves as the central authority. In the case of zoonotic diseases, notification is also sent to the National Food Agency of Adjara. Leptospirosis surveillance data are collected by primary healthcare facilities (clinics, ambulatory units, polyclinics), where suspected or confirmed cases are recorded. The primary source of data is medical personnel, including physicians, laboratory specialists, and epidemiologists. Upon detection of a case, information is recorded in the standard forms (60/A, 60/B) and sent to the municipal Public Health Center. Notification occurs immediately through telephone communication or electronically via the EIDSS platform. Aggregated municipal-level data are transmitted monthly to the Regional Public Health Center (form 58/3f), while significant cases are reported without delay. From the regional level, data are submitted to the National Center for Disease Control and Public Health, where data processing, summarization, and use for surveillance, risk identification, and public health response planning take place.At all levels, data transmission occurs through both the integrated electronic system (EIDSS) and telephone and document-based channels (forms 60/A, 60/B, 58/1, 58/3f). This multi-level data transmission architecture ensures the timely, consistent, and reliable flow of information across the national surveillance network [10-12,17].

Leptospirosis is included in Georgia's list of diseases subject to mandatory and immediate notification and represents a zoonotic infection within the national surveillance system. Its assessment requires not only quantitative analysis of cases but also an in-depth assessment of system attributes such as data quality, timeliness, sensitivity, and other key performance indicators. Leptospirosis is recognized in Georgia as a zoonotic infectious disease and is included in the list of conditions requiring mandatory and urgent notification. All suspected or confirmed cases must be documented using the standard notification forms (60/A and 60/B) and reported to the municipal Public Health Center within 24 hours through any available communication channel (telephone, fax, or email). Case information is also entered electronically into the EIDSS surveillance system. The notification process is regulated by standards approved by the Ministry of Health and the NCDC. The formal structure of surveillance includes the following case classifications:

- **Possible case:** an acute febrile illness (t >38°C) accompanied by symptoms such as headache, chills, weakness, myalgia, arthralgia, conjunctivitis (red eyes), jaundice, respiratory disturbances, rash, or organ involvement.
- **Probable case:** a case consistent with the clinical description and supported by a corresponding serological test (elevation of Leptospira agglutination titer in a single serological sample).
- **Confirmed case:** a case meeting the clinical description and confirmed by laboratory testing (increase of Leptospira agglutination titer in two or more serological samples).
- **Discarded case:** a case meeting the clinical description but with a negative laboratory test result.

Following notification, the epidemiological investigation must begin within 72 hours. During this process, the epidemiologist uses the case investigation form available in the EIDSS system, which documents clinical history, laboratory results, and information obtained through interviews with the patient or clinicians [10,11,14,17].

Incidence Rate by Local Administrative Units (2020–2024).

During 2020–2024, the highest incidence rates of leptospirosis in the municipalities of Adjara were recorded in 2024 in Batumi, Keda, and Khelvachauri (35–38 cases per 100,000 population). The relatively low incidence rates in 2020–2021 are likely associated with the COVID-19 pandemic, which significantly limited laboratory diagnostics, clinical health-seeking behavior, and overall surveillance of other infectious diseases (Figure 2).

During 2020–2024, a rising trend in the incidence of leptospirosis was observed in the Adjara region. The lowest incidence rate was recorded in 2021, which was likely associated with limitations in the surveillance of other diseases during the COVID-19 pandemic. From 2022 onward, the incidence rate began to increase again, reaching its peak in 2024 at **32 cases per 100,000 population,**

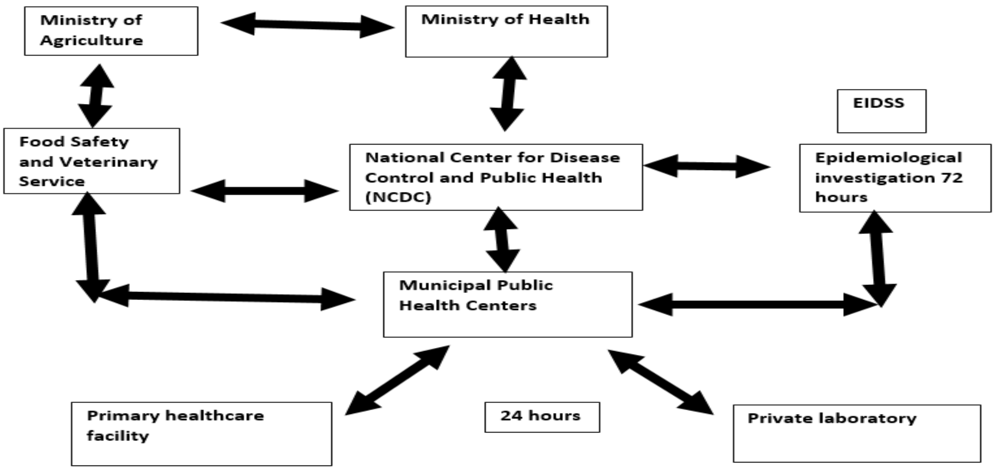

Figure 1. Information flow diagram of the leptospirosis surveillance system.

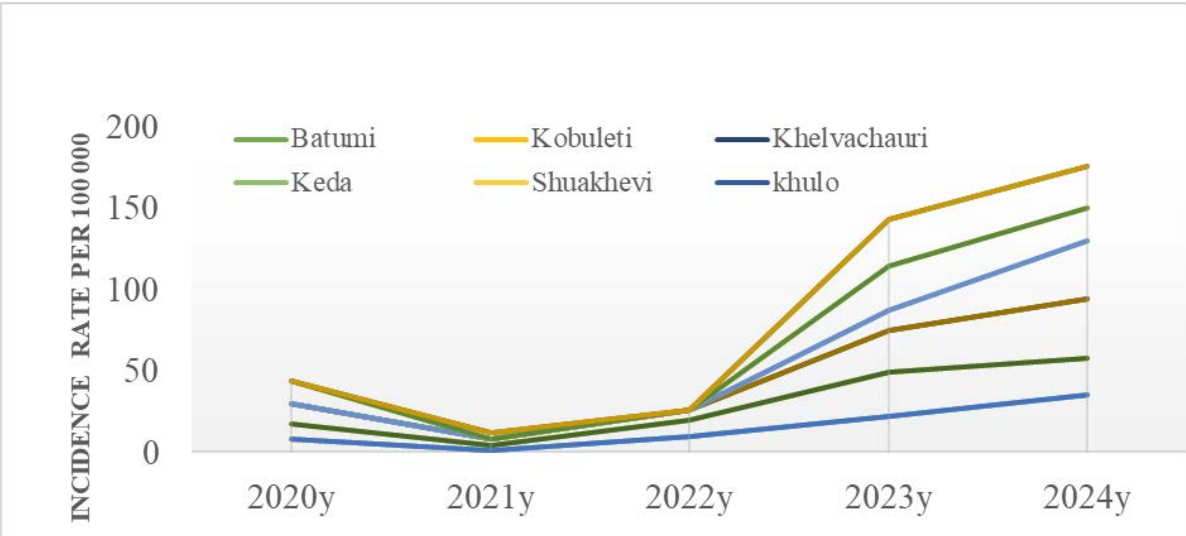

Figure 2. *Trends in reported suspected leptospirosis incidence by municipality in the Adjara region, 2020–2024 (per 100,000 population; n = 267).*

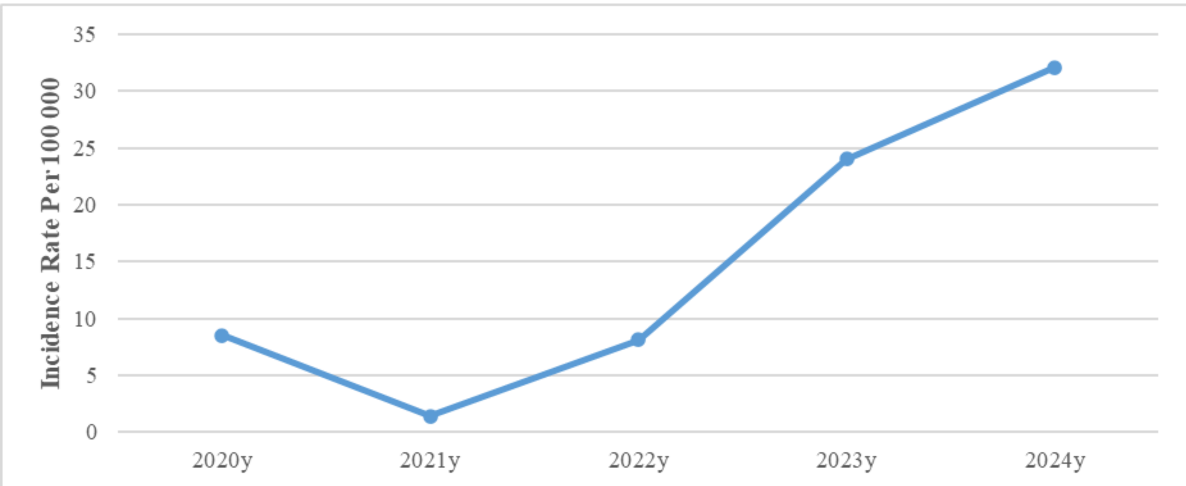

Figure 3. *Trends in reported suspected leptospirosis incidence per 100,000 population in the Adjara region, 2020–2024 (n = 267).*

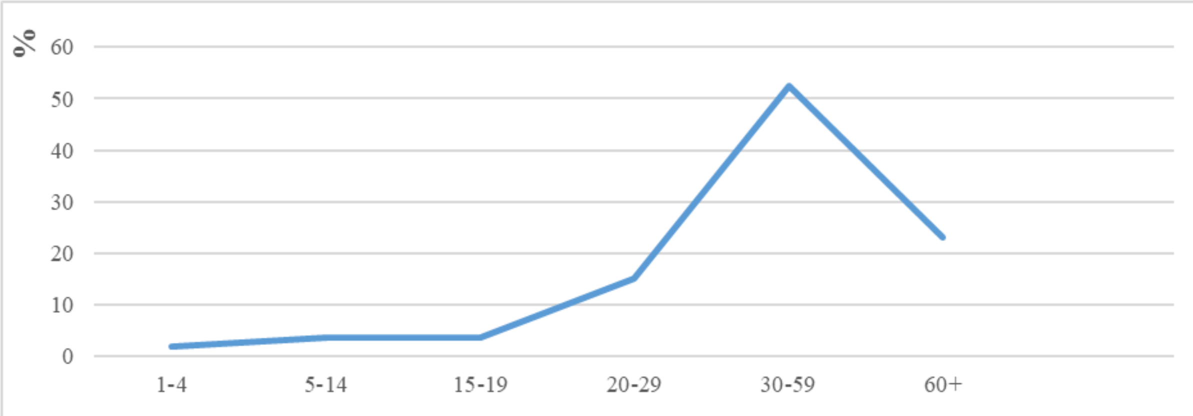

Figure 4. *Age-specific distribution of reported suspected leptospirosis cases per 100,000 population in the Adjara region, 2020–2024 (n = 267).*

which may indicate either a real increase in disease occurrence or improved surveillance and more complete detection of cases (Figure 3).

Based on the 2020–2024 data, the largest proportion of leptospirosis cases (approximately 52.4%) occurred in the 30–59 age group, indicating that the infection most significantly affects the working-age population. A notable increase was also observed in the 60+ age category, which accounted for approximately 23.2% of cases. This may be explained by age-related immune decline, the presence of chronic diseases, and frequent environmental exposure associated with agricultural activities. In the younger age groups (1–19 years), the number of cases was low, totalling no more than 9%, suggesting that the spread of the infection among children and adolescents is relatively limited. These data highlight the need for preventive measures and awareness-raising campaigns to be targeted toward populations aged 30 years and older, particularly those aged 60+, where an elevated risk of infection is observed (Figure 4).

Analysis of sex distribution showed a near-equal overall distribution between females and males during 2020–2024. Males predominated during 2021–2023 (58–62%), while in 2024 a higher proportion of reported cases was observed among females (53.5%). This variation likely reflects differences in case detection and reporting rather than a true change in disease risk and should be interpreted with caution.

Data Quality.

The assessment of data quality was based on records from the DZEIS surveillance system for leptospirosis cases registered in the Adjara region during 2020–2024. The complete surveillance database included 499 reported cases. Owing to limitations in human and technical resources, a detailed evaluation was conducted on a subset of 267 cases, representing approximately 53.5% of the total dataset. This subset was selected based on data availability and completeness rather than random sampling.

Data quality assessment focused on the completeness and internal consistency of key surveillance variables, including date of disease onset, documentation of clinical signs, laboratory confirmation status, and epidemiological linkage. Among the 267 evaluated records, 230 cases were fully completed, while 37 contained missing or incomplete fields. Accordingly, data completeness within the evaluated subset was 86.1%.

In contrast, assessment of the entire surveillance database showed that only 46.1% of all reported cases were fully completed, indicating substantially lower system-wide data completeness. This discrepancy suggests that the high level of completeness observed in the evaluated subset does not reflect the overall quality of routine leptospirosis surveillance data.

Overall, these findings indicate that, although well-documented records were present among a portion of cases, the leptospirosis surveillance system in Adjara was characterized by limited data completeness during the study period. This limitation highlights systemic challenges in routine data registration and underscores the need for strengthened data quality control, standardized form completion, and continuous training of surveillance personnel.

Timeliness.

Leptospirosis is included in the list of diseases subject to mandatory and immediate notification approved by the National Center for Disease Control and Public Health of Georgia. Notification requirements are regulated by Orders №01-26/□ (2019) and №01-58/□ (2021) of the Ministry of Internally Displaced Persons from the Occupied Territories, Labour, Health, and Social Affairs of Georgia, which clearly define reporting deadlines. Accordingly, notification must be carried out no later than 24 hours [10, 11].

The analysis revealed that in Batumi, the notification process meets the timeliness standards — the average interval from diagnosis to notification is 0.33 days. In other municipalities — Khelvachauri and Keda/Khulo/Shuakhevi — the average interval ranges from 2.8 to 3.67 days, which is classified as moderate or delayed responsiveness according to CDC recommendations. It is also noteworthy that the average time for receiving laboratory results is 5–6 days, primarily due to weekly sample shipment to Tbilisi and resource limitations. For the assessment of timeliness, the following categorization was used, based on the 24-hour notification requirement: ≤2 days – good timeliness; 3–5 days – moderate timeliness and >5 days – delayed response.

Positive Predictive Value (PPV):

The finding that only 1% of reported cases were laboratory-confirmed raises important concerns regarding the interpretation of incidence trends. The majority of reported cases likely represent suspected or clinically compatible febrile illnesses rather than confirmed leptospirosis. Therefore, the observed trends should be interpreted as **surveillance-based reported incidence** rather than true disease incidence.

The inability to calculate PPV and sensitivity reflects a diagnostic gap within the surveillance system, characterized by limited laboratory confirmation, incomplete case classification, and constrained diagnostic capacity—challenges that were further exacerbated during the COVID-19 pandemic. This diagnostic limitation represents a critical weakness of the surveillance system and significantly affects the validity of incidence estimates.

Sensitivity:

The assessment of sensitivity in the leptospirosis surveillance system aims to determine how effectively the system captures all true cases, including both reported and unreported cases. The calculation of sensitivity requires at least two components: the number of reported and laboratory-confirmed cases (True Positives, TP); the number of confirmed but unreported cases False Negatives (FN). According to the available data, 499 leptospirosis cases were entered into the DZEIS system during 2020–2024, of which 5 were laboratory-confirmed (TP). No additional information is available on confirmed but unreported cases (FN). Consequently, the actual calculation of sensitivity is not possible. Therefore, the sensitivity of the leptospirosis surveillance system could not be fully assessed due to incomplete data.

Representativeness:

The assessment of representativeness showed that the surveillance system partially reflects the true distribution of leptospirosis cases in the Adjara region, with several observable gaps. Geographic analysis revealed that out of 267 cases, 162 cases (61%) occurred in Batumi and Khelvachauri, indicating a high concentration of cases in urban areas. This may be due to better access to information sources, greater health awareness, and consequently, higher health-seeking behavior in these locations. In the high-mountain municipalities (Keda, Shuakhevi, Khulo), the number of cases was comparatively lower 34 cases (13%). However, this may not fully reflect the real epidemiological situation, as these districts are considered endemic zones. Several factors may influence health-seeking behavior and case detection in these areas, including: higher risk of exposure to reservoir animals (livestock, forest areas); insufficient sanitation and living conditions and natural environmental risk factors. These conditions create a predisposition for disease transmission; however, low clinical utilization and diagnostic challenges may hinder the full detection of cases. By age distribution, most cases occurred among the working-age population: 30–59 years: 128 cases (48%); 60+ years: 91 cases (34%); In the 0–29 age category, approximately 18% of cases were recorded, reflecting both lower risk and potential underrecognition of symptoms in these age groups. According to sex distribution the male population was 145 and Female 122 cases. The disease appears almost evenly distributed, although in 2023–2024 a comparatively higher number of cases was recorded among males. Overall, the representativeness of the surveillance data can be considered moderate.

Stability:

During 2020–2024, the assessment of the EIDSS system revealed no documented technical interruptions or prolonged platform malfunctions. The system operated continuously and ensured the registration and transmission of data from primary healthcare facilities to municipal, regional, and national levels. However, the speed and regularity of data transmission from the regional to the national level were occasionally problematic, with possible contributing factors including: overload of human resources at the regional level; network interruptions in remote municipalities and incomplete or delayed completion of reporting forms by clinical personnel. Overall, the technical stability of the EIDSS platform is high; however, its operational stability can be considered moderate or inconsistently ensured. With regard to the high-mountain municipalities, such as Keda, Shuakhevi, and Khulo the number of leptospirosis cases is significantly lower. This may not reflect the true epidemiological situation and may instead be explained by the following systemic challenges: internet and connectivity problems, which hinder timely data entry into EIDSS; shortage of human resources epidemiological staff in municipal Public Health Centers are often overburdened or insufficiently trained; limited laboratory accessibility, resulting in low levels of diagnostic confirmation and geographic inaccessibility long distances to clinics, difficult terrain, and weak infrastructure frequently impede timely care-seeking.

Discussion.

The analysis of the functioning of the leptospirosis surveillance system revealed that the system in the Adjara region is multi-level, involving primary healthcare facilities, municipal and regional public health centers, and the EIDSS platform, which serves as the main channel for data transmission. Although information flows are formally well-defined, several operational delays were identified, many of which became significantly more pronounced during the COVID-19 pandemic. Leptospirosis is classified as an especially zoonotic infection. Despite this, certain surveillance standards were not consistently fulfilled, particularly in high-mountain municipalities, where infrastructural and human-resource limitations substantially affected. The effectiveness of the system an issue that became especially evident during the pandemic. The study showed that the formal structure of notification and investigation is generally adhered to upon detection, cases are registered in forms 60/A and 60/B; Notification in EIDSS is carried out with high priority and Epidemiological investigation must begin within 72 hours, as required by regulation. However, practical challenges including the overload of epidemiological services, limited laboratory diagnostic capacity, and delayed health-seeking behavior of patients had a direct impact on timeliness and data completeness.

The relatively low incidence in 2020–2021 was likely associated with pandemic-related constraints: reduced patient health-seeking behavior, restricted laboratory testing, and the full mobilization of surveillance resources toward COVID-19. The sharp increase in incidence from 2022 onward may reflect a true rise in disease occurrence; restoration of accurate case detection and registration or a combination of both factors. Age-and sex-specific analysis showed that the infection primarily affects the working-age population (30–59 years), while the 60+ group accounted for an elevated proportion of cases, potentially indicating higher risk exposure, chronic comorbidities, and increased environmental contact. Sex-distribution analysis showed that from 2020–2023, cases were relatively more common among males, which likely reflects environmental and occupational risk factors. In high-mountain municipalities, most agricultural, livestock-related, and physically demanding activities are performed by men, increasing their exposure to reservoir animals, humid environments, and contaminated water sources. These observations are consistent with WHO and international epidemiological literature. However, in 2024 the opposite trend was observed a slight increase in cases among females (53.5%). This does not necessarily indicate a fundamental shift in risk distribution; rather, it likely reflects increased healthcare-seeking behavior among women in the post-pandemic period. International data (WHO 2022–2024) also indicate that primary healthcare utilization among women substantially increased after the pandemic, leading to more clinically identified cases. Additionally, in some areas of Adjara in 2024, women's involvement in household animal care and agricultural tasks increased, which may be associated with localized risk factors.

Findings from the fieldwork further demonstrated that active case finding in 2024 enabled the identification of cases that had previously been missed due to incomplete reporting. As a result, case registration more accurately reflected the true population-level picture in 2024 compared to earlier years, which also influenced the observed sex distribution. Therefore, fluctuations in sex-specific trends are likely linked not only to actual epidemiological dynamics but also to changes in healthcare access, health-seeking behavior, and surveillance intensity.

The analysis of Data Quality revealed a major pattern: within the selected sample, data quality was high (86.1%), indicating that when forms were completed, the information provided was generally reliable. However, at the level of the full dataset, overall completeness was only 46.1%, clearly indicating systemic the following issues: insufficient time and human resources at clinical and municipal levels; incomplete form completion during the pandemic; frequent omission of laboratory fields and inadequate documentation of epidemiological linkage. This clearly demonstrates the need for systematic data monitoring and periodic staff retraining to strengthen the standardization of data entry in EIDSS.

Timeliness, one of the most sensitive system attributes, revealed notable differences within the Adjara region: in Batumi, timeliness was high (0.33 days) and in high-mountain municipalities, delayed responsiveness (2.8–3.67 days) was observed. The main reasons for the delay included late receipt of laboratory results (5–6 days), the practice of sending samples to Tbilisi only once per week, and infrastructural challenges particularly the overload of epidemiological services during the COVID-19 period. These factors indicate both operational and logistical challenges that the system was unable to overcome during the pandemic. The quantitative assessment of Sensitivity and PPV could not be completed due to incomplete data; however, fieldwork clearly demonstrated that the surveillance system likely experiences difficulties in both full case detection and laboratory confirmation. The identification of duplicate records, unregistered cases, and unsystematic clinical documentation indicated that the true sensitivity may be significantly lower than the officially reported data, although full calculation is impossible due to the absence of information on confirmed but unreported cases (FN).

The assessment of representativeness showed that the surveillance system only partially reflects the actual epidemiological distribution of leptospirosis in Adjara. Sixty-one percent of cases were recorded in Batumi and Khelvachauri, while only 13% occurred in high-mountain districts (Keda, Shuakhevi, Khulo), despite these being recognized endemic zones. Such imbalance indicates that surveillance coverage is not equally ensured across municipalities, and many cases in high-mountain areas likely remain unregistered or incompletely documented, which significantly distorts the real epidemiological picture. Age- and sex-specific analyses also revealed differences, though these seem more likely to reflect environmental, occupational, and behavioral risk factors rather than systemic failures in surveillance.

The technical stability of EIDSS is high, with no system-wide interruptions identified; however, operational stability is problematic. Epidemiologists were heavily overloaded during the COVID-19 period, municipal levels frequently experienced staff shortages, and infrastructural limitations in high-mountain areas hindered timely data entry. Limited laboratory accessibility further reduced the system's performance, all of which affected the functionality of the surveillance system, especially during the pandemic. This indicates that the surveillance system is functional but not uniform or consistent across all levels.

Study findings showed that the COVID-19 pandemic had a substantial impact on all system attributes, particularly case registration, laboratory testing, data completeness, timeliness, and regular monitoring. The pandemic significantly influenced key indicators, resulting in artificially low incidence rates during 2020–2021, a sharp decrease in data completeness (46.1%), undefined sensitivity and PPV, and the presence of duplicates and missing cases at the municipal level. Regarding structurally affected components, the most prominent challenges include: overload of human resources; strain on laboratory networks; disruption of prevention programs and complete redirection of attention toward COVID-19 management. These impacts fully align with WHO and CDC reports from 2021–2023, which describe global deterioration in surveillance of zoonotic and other infectious diseases during the pandemic. The findings clearly demonstrate that the leptospirosis surveillance system in Adjara operates but is overloaded, uneven, and requires strengthening in the post-pandemic years. The most critical problems include: data accuracy and completeness, sensitivity, timeliness, low proportion of laboratory confirmation and inter-municipal disparities.

WHO and CDC reports document similar global trends, where surveillance of other priority infections weakened during the pandemic due to limited laboratory testing, delayed notifications, and incomplete data. The same pattern was observed in

Adjara, reflected in frequent data gaps, low rates of laboratory confirmation, and temporarily decreased incidence. Because of these same reasons, it was not possible to calculate the disease burden (DALY/QALY), as these indicators require accurate, complete, and timely data on mortality and disability. During the pandemic, mortality recording was complicated due to: some patients not seeking clinical care, severe cases remaining unregistered, epidemiologists being unable to monitor cases due to overload with COVID-19 and limited and uneven laboratory confirmation across municipalities. DALY/QALY calculations are impossible in the context of incomplete mortality data and insufficiently documented cases, as both indicators depend on accurate YLL (Years of Life Lost) and YLD (Years Lived with Disability) components.

Workload for epidemiologists and clinicians increased substantially due to COVID-19 response activities (testing, epidemiological investigation, contact tracing), which often limited timely response to other infections. Under these conditions, a portion of leptospirosis cases did not appear in the surveillance system because: epidemiologists were unable to monitor patients who remained at home; hospitals did not systematically report all hospitalizations or complications; data entry into EIDSS was disrupted in regions, particularly in high-mountain municipalities and COVID-19 prioritization temporarily reduced active monitoring of other infections. Due to these systemic limitations, it was not possible to calculate the disease burden (DALY, QALY). Reliable estimation of DALY and QALY requires complete data on mortality, hospitalization, complications, and long-term disability data that were incomplete during the pandemic. Under the pressure of COVID-19, some deaths or severe complications may not have been recorded, directly limiting burden estimation. These shortcomings highlight the need to strengthen the surveillance system, particularly in terms of data completeness, timeliness, and monitoring of critically important cases.

Conclusion.

The assessment of the leptospirosis surveillance system in the Adjara region, based on data from 2020–2024, demonstrates that the surveillance system plays a crucial role in the timely identification of cases and in forming an accurate epidemiological picture. The technical platform EIDSS operates stably, data collection is structured, and the system formally covers all municipalities; however, the analysis revealed several important challenges that limit the system's effectiveness. Timeliness and sensitivity are generally low. PPV and sensitivity could not be assessed due to incomplete data and the limited number of laboratory confirmations. Representativeness is limited geographically. Human and technical resource deficiencies are particularly evident in high-mountain municipalities, where infrastructural limitations and restricted laboratory access hinder the timely and accurate transmission of data. Based on the above, it can be concluded that the leptospirosis surveillance system in Adjara currently functions with moderate effectiveness.

Recommendations.

To strengthen the effectiveness of the leptospirosis surveillance system and in alignment with the WHO Preparedness and Response Framework principles, the following measures are recommended:

Data Quality: to conduct regular internal audits of EIDSS records through random case selection to prevent duplicates, omissions, and structural errors, ensure uniform completion of Forms 60/A and 60/B through targeted training (learning-strengthening cycle), according to the WHO Surveillance Quality Assurance Manual.

Timeliness: to introduce a flexible laboratory referral model, strengthen rapid communication channels in high-mountain municipalities and conduct quarterly analysis of notification and laboratory confirmation time intervals (dashboard monitoring).

Sensitivity: to introduce an additional mechanism for identifying FN cases (clinic audit, chart review, laboratory cross-checking), following WHO approaches for zoonotic diseases.

Positive Predictive Value: to establish regular coordination between epidemiological services and laboratories for data verification, increase access to Microscopic Agglutination Testing (MAT).

Representativeness: to monitor equal data generation across municipalities to reduce geographic imbalance, conducting periodic visits by field epidemiology teams in high-mountain regions.

Stability: to upgrade the EIDSS platform and ensure continuous IT support, including backup servers and real-time downtime monitoring, stabilize human resources at the municipal level.

Strengthening Preparedness and Resilience: to strengthen surveillance system resilience ensuring continuity of operations during crises, introduce an adaptive (flexible) model automatic prioritization and rapid response to critical cases.

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