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ORIGINAL ARTICLE

Clinical-Epidemiological Study of Measles Trends from 2019-2023 in Iraq

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ABSTRACT

Measles, a highly contagious viral infection, which belongs to the Morbilivirus genus, Paramyxoviridae family. Remains a significant public health challenge worldwide, despite the availability of an effective vaccine. The objective is to determine the outcome of measles cases in Iraq and determine of measles trend from 2019-2023. The study is an epidemiological retrospective cross-sectional study that included information on Measles disease from 2019/January/1st to 2023/December/31st. The duration of data collection continued for the period from 2024/October/17th to 2025/February /28th. The data of the whole Iraq was collected from: Iraqi Ministry of Health\ Department of Public Health\ Communicable Disease Control Center from section of epidemiological surveillance that locates in Baghdad Governorate and obtains the information from health departments in the Iraq. The study included 3,873 laboratory-confirmed measles cases out of over 20,000 suspected cases. Descriptive statistics were applied, and inferential tests including the independent t-test, ANOVA, and chi-square test were used for data analysis via SPSS software (version 29.0), with a significance level set at $p < 0.05$. The clinical information show that the highest number of patients were from hospitals with 80.17% of patients, in contrast to primary health centers with 19.83%, the clinical methods of diagnosis had the highest ratio of result than others methods with 55.38%,) 15607 patients had diagnosed at hospital Lab 2.13% with positive result ,while 97.87% of the patients had negative result , The most of the cases had ELISA IgM test with 99.95% and the rest cases had Tissue Culture with 0.05%.Its reappearance the outbreak of measles has been facilitated by dwindling vaccination rates, inadequate healthcare systems, and the dissemination of false information. Its prevalence is 4104,728,199,633 and 14571 cases for the years (2019-2023) respectively, in Iraq. Regard to outcome of measles cases 99.94 % was cured.

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1- INTRODUCTION

The measles is cause by virus, which is a highly contagious viral infection, belongs to the Morbilivirus genus, Paramyxoviridae family [1]. Despite the high effectiveness of an attenuated live virus vaccination, delivery errors have led to a rise in cases globally. While not getting vaccinated is the main reason why measles cannot be controlled, declining vaccine-induced immunity and the potential introduction of more deadly virus strains could also be factors [2]. To improve national vaccination campaigns and create efficient public health interventions, it is crucial to comprehend the epidemiological patterns and clinical features of measles in Iraq [3].

The illness is spread by respiratory droplets and causes symptoms like a high fever, cough, conjunctivitis, coryza, and a distinctive maculopapular rash that starts on the face and moves to other parts of the body [1]. The risk of contracting measles and its sequelae is higher in some groups. Pregnant women and unvaccinated small children are the most at risk, particularly those who are malnourished or have compromised immune systems, which makes them more vulnerable to deadly consequences. Since most measles-related fatalities take place in nations with weak healthcare systems or little funding, it is challenging to guarantee universal vaccination coverage [3]. When an infected person breathes, coughs, or sneezes, measles can spread quickly via the air. One measles patient can infect nine out of ten of their uninfected close contacts; the virus can stay active and spread for two hours in the air or on contaminated surfaces .An infected person can spread it between four days before the rash appears and four days after it does [4].

2- MATERIALS AND METHODS

2.1 Patients and Methods

The epidemiological trends and clinical features of measles cases in Iraq are evaluated in this study using a retrospective cross-sectional design. Data from the Communicable Diseases Control Center's national surveillance epidemiology system Section, Ministry of Health, Iraq, was used in the study. A thorough summary of measles cases throughout this period was provided by including data from January 2019 to December 2023. The period of data collecting lasted from October 17, 2024, to February 28, 2025. Information was taken from the database of the National Center for Communicable Diseases, which compiles primary data gathered from all medical facilities in Iraq. 3873 confirmed Measles patients, which were distributed into Iraq province. All measles cases recorded in Iraq between January 2019 and December 2023 were included in the analysis, as long as the full demographic and clinical data were available. Cases that were not verified as measles or had insufficient medical information were not included. In this analysis, every age group was included [3].

2.2 Statistical analysis

The collected data were coded, entered, presented, and analyzed by computer using the available data base software program statistical package of IBM SPSS-29 (IBM Statistical Packages for Social Sciences- version 29, Chicago, IL, USA). Simple metrics such as frequency, percentage, mean, standard deviation, and range (minimum-maximum values) were used to display the data. The Pearson Chi-square test with Yate's adjustment or Fisher Exact test, if appropriate, was used to assess the significance of differences in various percentages (qualitative data). When the P value was equal to or less than 0.05, statistical significance was taken into consideration [5, 6].

3- RESULTS AND DISCUSSION

The clinical information show that the highest number of patients were from hospitals with 80.17% of patients, in contrast to primary health centers with 19.83% ,the initial diagnosis show that the ratio of suspect cases were 13.04% and the confirm cases were 15.38% and the clinical methods of diagnosis had the highest ratio of result than others methods with 55.38%, the result found that the 19.57% was positive ,while 11.62% was negative and 27.24% of suspect case that confirm by laboratory diagnosis. According to hospital decision 27.44 %, of patients that isolated and treat at home ,while 74.28%, of patients were isolated and treated at home according to PHC decision ,most of patients outcome was cure with 99.94% and the rest patients dead with 0.06% as show in Table (3-1)**.**

Table (1): Clinical characteristics of study sample

		No.	%
Health care facility	Hospital	16223	80.17
	PHC	4012	19.83
Initial diagnosis	Clinical Measles	17597	86.96
	Suspected Measles	2638	13.04
Clinical Type of initial diagnosis (n=17597)	Few Clinical Symptoms	5108	29.03
	Full Clinical Symptoms	9730	55.29
	Confirmed	2707	15.38
	Vaccine related	52	0.30
Method of Diagnosis	Clinical	9745	55.38
	Lab	4794	27.24
	EpiLink	3058	17.38
Lab Result (n=4794)	Positive	938	19.57
	Negative	557	11.62
	Pending	3299	68.82
Hospital Decision	Admitted to hospital	13408	72.56
	Isolated & treated at home	5071	27.44
PHC Decision	Referred to hospital	1756	25.72
	Isolated & treated at home	5071	74.28
Patients outcome	Cured	20223	99.94
	Dead	12	0.06

In Table (3-2) 15607 patients had diagnosed at hospital Lab 2.13% with positive result, while 97.87% of the patients had negative result. 20066 patients had PPHL test. 20.02% of them had positive result, while 79.98% of them had negative result. CPHL test. Results were 19.40% of the patient with positive result and 80.60% with negative result .The Final Diagnosis of CPHL test show 19.14% confirm cases of Measles and 79.25% non-confirm cases. The most of the cases had ELISA IgM test with 99.95% and the rest cases had Tissue Culture with 0.05%.

Table (2): Hospital lab results

		No.	%
Hospital Lab (n=15607)	Positive	333	2.13
	Negative	15274	97.87
Sampling	Yes	20066	99.16
	Not send	169	0.84
PPHL (n=20066)	Positive	4017	20.02
	Negative	16049	79.98
Kind of sampling (n=20066)	Tissue Specimen	11	0.05
	Blood	318	1.58
	Serum	19737	98.36
Kind of test (n=20066)	Tissue Culture	11	0.05
	ELISA IgM	20055	99.95
CPHL Results (n=20066)	Positive	3893	19.40
	Negative	16173	80.60
CPHL Final Diagnosis	Confirmed Measles	3873	19.14
	Non-Confirmed Measles	16036	79.25
	Rubella	189	0.93
	Congenital Rubella Syndrome	123	0.61
	Brucellosis	14	0.07

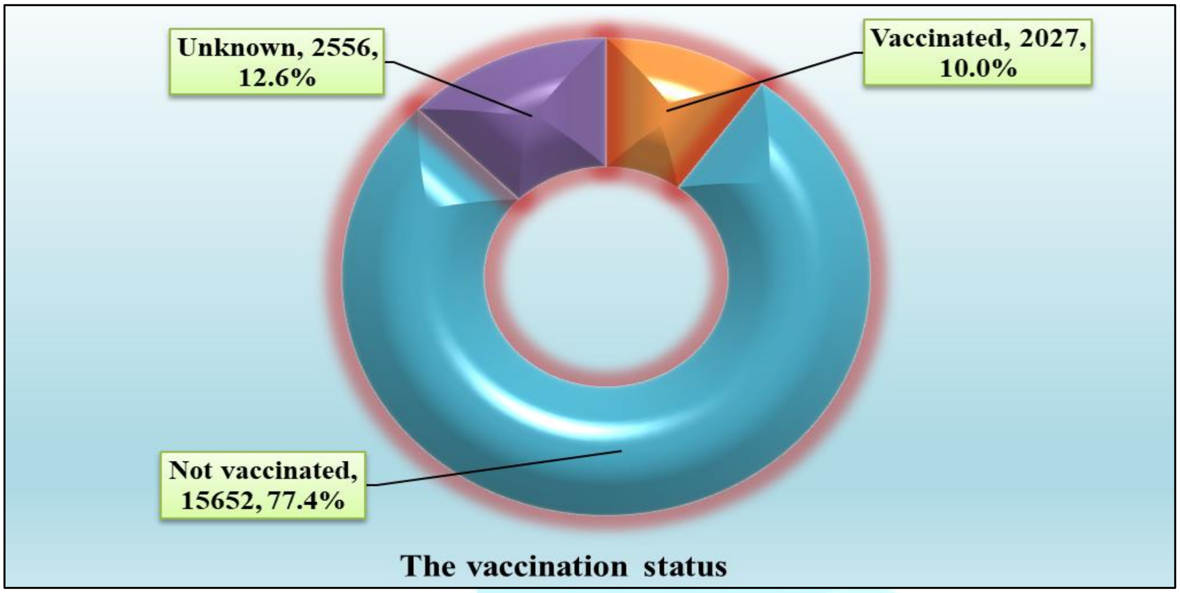

Figure (1): Vaccination status of study sample

Figure (1) show the distribution of Measles cases regarding to vaccination status, the highest percentage is 77.4% were not vaccinated, follow by 12.6%were unknown .A smaller proportion, 10.0% were vaccinated.

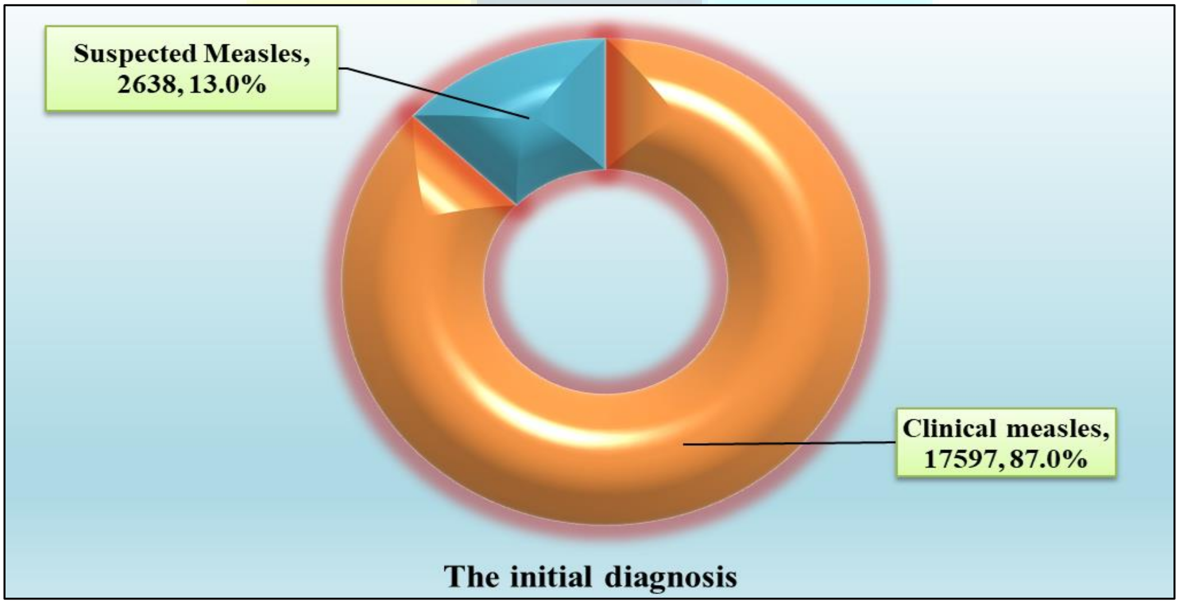

Figure (2): The initial diagnosis of Measles cases

According to Figure (3-2) ,the initial diagnosis of the cases show that the suspect Measles cases had overall ratio of 13.0% and 87.0% for clinical Measles cases.

Table (3) illustrates the association between Measles cases management and distribution of the cases during the years of the study. A significant association between reported health care facilities ,final diagnosis ,clinical type ,method of diagnosis ,lab result ,hospital decision and PHC decision with the prevalence of the cases during the years of the study (p-value <0.05),notably there is no significant association between the Measles cases outcome and distribution of the cases during the years of the study (p-value >0.05).

Table (3): Association between Measles case management and distribution of the cases during the years of the study

		2019 (n=4104)		2020 (n=728)		2021 (n=199)		2022 (n=633)		2023 (n=14571)		P value
		No.	%	No.	%	No.	%	No.	%	No.	%	
Health care facility	Hospital	3593	87.55	673	92.45	94	47.24	292	46.13	11571	79.41	0.0001*
	PHC	511	12.45	55	7.55	105	52.76	341	53.87	3000	20.59	
Final diagnosis	Clinical Measles	4104	100	728	100	79	39.70	142	22.43	12544	86.09	0.0001*
	Suspected Measles	-	-	-	-	120	60.30	491	77.57	2027	13.91	
Clinical Type (n=17597)	Few Clin. Symptoms	3997	97.39	560	76.92	13	16.46	52	36.62	486	3.87	0.0001*
	Full Clin. Symptoms	107	2.61	168	23.08	60	75.95	78	54.93	9317	74.27	
	Confirmed	-	-	-	-	6	7.59	12	8.45	2689	21.44	
	Vaccine related	-	-	-	-	-	-	-	-	52	0.41	
Method of Diagnosis	Clinical	107	2.61	168	23.08	60	75.95	87	61.27	9323	74.32	0.0001*
	Lab	1556	37.91	306	42.03	14	17.72	51	35.92	2867	22.86	
	EpiLink	2441	59.48	254	34.89	5	6.33	4	2.82	354	2.82	
Lab Result (n=4794)	Positive	828	53.21	73	23.86	-	-	16	31.37	21	0.73	0.0001*
	Negative	536	34.45	14	4.58	-	-	4	7.84	3	0.10	
	Pending	192	12.34	219	71.57	14	100	31	60.78	2843	99.16	
Hospital Decision	Admitted to hospital	2345	58.13	484	67.22	88	60.27	224	51.85	10267	78.09	
	Isolated & home-treated	1689	41.87	236	32.78	58	39.73	208	48.15	2880	21.91	
PHC Decision	Referred to hospital	70	3.98	8	3.28	53	47.75	201	49.14	1424	33.09	
	Isolated & home-treated	1689	96.02	236	96.72	58	52.25	208	50.86	2880	66.91	
Patients outcome	Cured	4104	100	727	99.86	199	100	631	99.68	14562	99.94	0.035*
	Dead	-	-	1	0.14	-	-	2	0.32	9	0.06	

***Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level**

3.1 Laboratory results

In this study's results show that clinical diagnosis accounted for the majority of measles cases (55.38%), followed by laboratory testing (27.24%) and epidemiological Link(17.38%). 68.82% of the laboratory findings were still pending at the time of analysis, indicating a high confirmation delay. Laboratory-confirmed cases accounted for just (19.14%) of all cases, suggesting a strong reliance on clinical diagnosis that could result in over reporting of suspected cases. Limited laboratory capacity was reflected in the low laboratory confirmation rates (19.57%) positive among examined samples and the large percentage of pending results (68.82%). When these findings were compared to data from related research, laboratory-confirmed cases in different regions varied from 14.88% in the Somali region to 73.42% in Oromia, with an average of 27.51% of all confirmed cases [7]. This number is more than the confirmation rate (19.14%) of our investigation, indicating regional or national variations in laboratory capacity and efficiency as well as variations in sample collecting and diagnostic techniques. In terms of sample type and testing procedure, the present examination revealed that ELISA IgM was utilized in 99.95% of the cases, and that 98.36% of the samples were serum. This is in line with standard measles diagnostic procedures and the comparison studies, which used PCR and IgM testing and showed that PCR using urine and oropharyngeal swab samples had a high degree of accuracy [7].

Comparable According to a study conducted in Japan, using sophisticated methods including rRT-PCR and antibody testing (IgM and IgG), the confirmation rates were comparatively higher. Discordant cases, however, were noted as a result of co-infections or the effects of vaccination. The study concentrated on laboratory testing (rRT-PCR and IgM), and rRT-PCR was utilized to diagnose measles in 17.2% of cases. 24 cases, however, had contradictory results (IgM-positive but rRT-PCR-negative), underscoring difficulties in laboratory diagnosis [8].

All studies draw attention to the difficulties in diagnosing measles, especially the significant dependence on clinical diagnosis and the constraints of laboratory testing. The linked investigation uncovered more complications pertaining to co-infections and vaccination effects, whereas the current study concentrated on high clinical diagnosis rates and delayed lab results. These results support one another and highlight the necessity of better diagnostic techniques to avoid incorrect reporting or misdiagnosis. Regarding patient outcomes, the majority of patients were either treated at home or sent to hospitals from primary health facilities, indicating varying approaches to case management depending on the severity of the situation. This emphasizes how crucial it is to increase laboratory confirmations' speed and precision in order to support sensible clinical judgments.

3.2 Methods of diagnosis

According to present research, laboratory diagnosis (27.24%) and epidemiological linkage (17.38%) were used less frequently than clinical diagnosis (55.38%) for measles cases. However, 93.7% of cases were laboratory-confirmed using IgM tests and/or PCR in the other report studies in Spain that were included of the comparison, indicating a significantly greater emphasis on laboratory confirmation [9].

Regarding laboratory test performance, although ELISA IgM (99.95%) was the most commonly used method in our study, only 19.57% of samples tested positive for measles-specific IgM. Conversely, the comparison investigations showed much greater positivity rates, with 21.1% of cases confirmed by IgM alone, 38.8% by PCR alone, and 40.1% by both positive IgM and PCR [9]. With 68.82% of test results still pending, there was a notable delay in this study's laboratory results. In contrast to the other studies, which did not report such high pending rates and showed improved sample processing performance, this reveals a weakness in laboratory service efficiency. Regarding patient outcomes, current research revealed a very low death rate (0.06%) and a very high recovery rate (99.94%). On the other hand, the comparative studies showed significantly better laboratory performance, with 93.7% of cases being confirmed in the lab using sophisticated methods like RT-PCR and other IgM assays including ELISA and CLIA [11]. Although the other studies did not specifically address patient outcomes (mortality or recovery), the information that is currently available indicates that prompt and precise diagnosis aided in efficient case management, which is consistent with this study's conclusions. About the kinds of samples that were gathered: The majority of the samples in present analysis (98.36%) were serum. In contrast, the comparative studies collected two types of specimens (PCR and IgM) in 57.9% of cases, using a range of samples (serum, throat swab, and urine) to reach more thorough diagnosis. Additional observations: While this study's strong reliance on clinical diagnosis may result in an overestimation of suspected cases, which could compromise the epidemiological reliability of case reporting when compared to other investigations, the comparative studies' use of multiple diagnostic methods (PCR and IgM) helped reduce the likelihood of false-positive or false-negative results.

Furthermore, this investigation did not use the comparison studies' sophisticated methods, such as measles-specific IgG avidity testing, to distinguish between recent infections and previous exposures or vaccinations. Summary of the Discussion: The comparison shows that this study's shortcomings, in contrast to the other studies' superior accuracy and efficiency shown by integrated and various laboratory procedures, are the substantial reliance on clinical diagnosis and the notable delays in laboratory confirmations. However, the current study's extremely high recovery rate and low death rate indicate that clinical care worked well in the conditions.

There are notable variations in diagnostic techniques and laboratory performance quality between the findings of current study and those of earlier investigations. Of the cases in this analysis, 55.38% had a clinical diagnosis, 27.24% had laboratory confirmation, and only 19.57% had laboratory-positive results. Significant issues with laboratory efficiency and turnaround times were also shown by the fact that 68.82% of laboratory findings were still awaiting at the time of analysis.

Additionally, in order to improve diagnostic accuracy and enable a more focused public health response, laboratory assessments in comparison studies included not only the diagnosis of measles but also the exclusion of infections caused by other related viruses (e.g., HHV-6, CMV).

Even though present study showed a good recovery rate (99.94%) and a low case fatality rate (0.06%), strengthening laboratory capabilities and relying more on laboratory-confirmed diagnoses are still urgently needed. Enhancing infectious disease control tactics and more precisely estimating the actual burden of disease depend on such advancements.

3.3 Outcome of the patients

This Study on Mortality and Recovery Rates: only 12 deaths (0.06%) and an unusually high recovery rate of 99.94%, demonstrating the need of early diagnosis, care, and medical assistance. Three deaths out of 800 confirmed cases was reported in another study conducted in the United States, which had a higher mortality rate (3.8 deaths per 1,000 cases, or 0.38%) [11]. This implies that the comparison study's fatality rate was roughly six times greater than present study, perhaps as a result of variations in the standard of healthcare or the disease's prevalence among unvaccinated people.

According to current study, 72.56% of cases required hospitalization, with the remaining instances being managed at home. This suggests that the majority of cases were severe enough to necessitate hospital care. Comparative examination: Only 11% of patients required hospitalization, which might be a result of variations in hospitalization guidelines or the severity of the illness. However, the fact that 66% of hospitalized patients lacked a vaccination highlights how important immunization is in lessening the severity of sickness. The present study highlighted the value of early intervention in attaining a high rate of recovery, but it also pointed out the drawbacks of depending solely on clinical diagnosis as opposed to laboratory testing.

In the American study it is well established that not getting vaccinated increases the chance of infection and hospitalization, and that unvaccinated people die. Additionally, it emphasized how crucial laboratory confirmation is to reliable epidemiological data [11] and reported variations in laboratory markers, such as unvaccinated patients' decreased hemoglobin levels (P=0.006), revealed that the age and geographic distributions of confirmed and unconfirmed cases differed significantly (P=0.0001).

With a remarkably high recovery rate (99.94%) and a low fatality rate (0.06%), this study demonstrated the efficacy of early detection and treatment. Compared to present study, a similar study reported a lower recovery rate and a greater mortality rate (1.8%) [12]. Hospital stays for deceased patients were noticeably longer (11 days compared to 4 days for survivors). They shows that unvaccinated patients tended to have higher mortality rates (3% vs. 0% in vaccinated) and were younger (median age 12 months vs. 36 months for vaccinated). While different study recorded a significantly higher mortality rate (4.47%), a smaller percentage of patients (20.8%) needed hospitalization, with a focus on severe cases (94.6% due to severe respiratory symptoms [13]. This could be due to differences in demographic factors, diagnostic techniques, or healthcare quality between the two studies. Laboratory results (such as IgM) were given more weight, and a positive result was linked to an increased risk of death. It highlighted immunological and demographic factors (such as test findings and vaccinations) as important determinants of outcomes but did not go into detail on treatment settings [13]. A considerably higher CFR of 7.15% (7 deaths out of 98 cases) was reported in a related investigation, suggesting a more serious outbreak or possible gaps in healthcare availability. Although the recovery rate was not stated clearly, the high CFR points to lower recovery rates than those seen in this study. Only 8.2% of cases were admitted to the hospital; this could be because of variations in case severity or the facility's limited capacity. The majority of cases (91.8%) were treated as outpatients [14]. 38 measles cases and 1 death (4.3%) were reported in another investigation, suggesting a greater fatality rate than in the first. Females and those aged 5–14 years had a higher attack rate (AR), which could be a result of variations in healthcare circumstances or the standard of medical care. A lack of health awareness or access to high-quality medical care may be the reason why 71.1% of cases did not think measles had a medical treatment [15]. Finally the Differences in death rates may be due to differences in the populations under study (e.g. case severity) or the standard of care received. Early detection or better treatment techniques may have contributed to our study's excellent recovery rate.
Although not thoroughly examined in this investigation, the results of related studies point to the possibility that immunization could enhance clinical outcomes. Future studies may be conducted in this area. Hospitalization rates may differ between studies due to differences in case severity or treatment policies.

3.4 Vaccination Status

Other studies in the Republic of Congo reported an unvaccinated rate of roughly 39.6% (RoC 2019–2022), and an overall vaccination coverage rate of 44.8% with a highly significant difference across years (P=0.0001)[16]. In current study, 77.35% of cases were unvaccinated, whereas only 10.02% were vaccinated and 12.63% had unknown status. In the Afghan investigation, there were notable differences before and during the outbreak (P < 0.001), with 97.1% of cases having no documented immunization (17). The effects of measles vaccination in high-burden nations like India, Nigeria, and Pakistan were the subject of a related study. The findings indicated that while the second dosage (MCV2) and supplemental immunization actions (SIAs) helped sustain low transmission levels, the first regular dose (MCV1) had the largest contribution to burden reduction (66%).and offered a numerical evaluation of the effects of: MCV1 alone itself: 66% fewer instances. MCV1 + MCV2: 78% fewer instances. MCV1 + MCV2 + SIAs: 90% fewer instances.

Additionally, it reveals that death predictions were impacted by assumptions regarding mixing patterns (such as proportionate or uniform mixing) by 7.3% to 26% highlighted the fact that: MCV1 is the most important, but SIAs and MCV2 are also crucial. The high penetration of both MCV2 and SIAs is expected to reduce measles incidence to less than 1 case per million by 2050 in nations like Ethiopia and Pakistan [18]. According to earlier studies conducted in the African region, Ethiopia had a 58.5% coverage rate for the first dose of the measles vaccination (MCV1), with significant regional variations. The Somali (30.9%) and Afar (29.6%) regions had the lowest percentages. Although these findings also show coverage gaps, they are not as bad as those found in this study. Higher vaccination rates were linked to factors including maternal education (87% of children whose mothers had secondary or higher education were vaccinated), facility-based birth (74.6%), and urban location (78.1%). There were notable regional differences, with rural areas trailing behind with a vaccination rate of 50 percent and Addis Ababa having the highest rate at 90.6%. Additionally, vaccination rates were higher in wealthier households (74.7%) [19]. According to a study conducted in European nations, the average MCV1 vaccine coverage from 2000 to 2022 was high (93.65%), with little variance (SD = 1.4%). Nonetheless, some nations saw significant drops in coverage, including Bosnia and Herzegovina (58%) and Montenegro (33%), while others saw extremely high coverage (99%). For MCV2, there were more notable differences in the second dose of vaccination, as the average was lower (80.7%) with larger variation (SD = 11.0%) [20]. Additionally, in Japan, research practices Those who got two doses of the vaccine had a longer incubation period (14–20 days) than those who were not vaccinated (7–10 days), with strong statistical significance (P=0.005), demonstrating that immunization changes the features of the disease. This implies that immunization might lessen the severity of the illness or postpone the start of symptoms [21].
This may be explained by: the current study provides compelling evidence that low vaccination coverage is a significant contributing factor to measles outbreaks. However, every study demonstrates that young children are the most vulnerable to contracting measles. Outbreak dynamics, like the one that occurred in present research population in 2023, are significantly influenced by social factors (such as membership in marginalized populations) and low vaccination coverage. These results indicate a significant vaccination coverage gap, and they are consistent with other data that indicate inadequate vaccination coverage is the main cause of measles outbreaks. Although all research agreed on the significance of routine vaccinations and supplemental campaigns, the similar studies provided insights on how to optimize policies through modeling. However, the other studies provided more focused suggestions based on long-term modeling.

4- CONCLUSION

The clinical information show that the highest number of patients were from hospitals with 80.17% of patients, in contrast to primary health centers with 19.83%, the clinical methods of diagnosis had the highest ratio of result than others methods with 55.38%,) 15607 patients had diagnosed at hospital Lab 2.13% with positive result ,while 97.87% of the patients had negative result , The most of the cases had ELISA IgM test with 99.95% and the rest cases had Tissue Culture with 0.05%.Its reappearance has been facilitated by dwindling vaccination rates, inadequate healthcare systems, and the dissemination of false information. Its prevalence is 4104,728,199,633 and 14571 cases for the years (2019-2023) respectively, in Iraq. More than 50% of the case had been diagnosis clinically while 17.38% had Epilink diagnosis Regard to outcome of measles cases 99.94 % were cured and about three quarter of measles cases were not vaccinated.

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