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Respiratory tract infection incidence and its relationship to C-reactive protein level among patients attending Misurata Medical Center

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نسبة الإصابة بالتهابات الجهاز التنفسي وعلاقتها بمستوى بروتين سي التفاعلي لدى المرضى المراجعين لمركز مصراتة الطبي

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Abstract:
Lower respiratory tract infection is an umbrella term used for a group of diseases that affect the bronchioles and lungs. Diseases classified under this infection are pneumonia and acute exacerbation of the disease causing chronic obstructive pulmonary disease. therefore, the current study addressed the isolation and identification of pathogenic microbes, the importance of C-reactive protein for early detection of inflammation, and the identification of commonly used antibiotics, the study conducted on patients attending Misurata Medical Center, the beginning of 1 January 2023 to 31 May 2024. The total number of patients was 143 patients of both sexes. The age groups were between (2 – 95) years, including 46% female and 54% men. The isolated bacteria in which 65% of the Gram-negative bacteria were more than 35% of the Gram-positive bacteria. Gram-positive bacteria were represented by 15 *Streptococcus* spp isolates, 8 *Staphylococcus aureus* isolates, and 4 *Bacillus* spp isolates, while the Gram-negative bacteria represented 11 isolates of *Pseudomonas* spp, one isolate of *Proteus mirabilis*, 28 isolates of *Klebsiella* spp, 3 isolates of *E. coli*, 2 isolates of *Citrobacter* spp, and 5 isolates of *Acinetobacter* spp. We conclude from the current study that lower respiratory tract infections are dangerous and lead to serious complications and that the most responsive antibiotics for inflammation are: (IMP, CIP, CN). While is not relationship between respiratory infection and C-reactive protein.

Keywords: Respiratory tract infection, Sputum sample, C-reactive protein, Bacteria isolates, Misurata Medical Center.

الملخص:

تُعدّ العدوى التنفسية السفلى مصطلحًا شاملًا يُستخدم للإشارة إلى مجموعة من الأمراض التي تصيب القصيبات الهوائية والرئتين. وتندرج تحت هذا التصنيف أمراض مثل الالتهاب الرئوي والتفاقم الحاد للمرض المسبب لمرض الانسداد الرئوي المزمن. لذا، تناولت الدراسة الحالية عزل وتشخيص الميكروبات المسببة للمرض، وأهمية بروتين سي التفاعلي (C-reactive protein)في الكشف المبكر عن الالتهاب، وتحديد المضادات الحيوية الأكثر استخدامًا. أُجريت الدراسة على مرضى يقصدون المركز الطبي بمصراتة، من بداية 1 يناير 2023 إلى 31 مايو 2024. بلغ العدد الإجمالي للمرضى 143 مريضًا من كلا الجنسين، وتراوحت الفئات العمرية بين (2–95) سنة، من بينهم 46% إناث و54% ذكور. بلغت البكتيريا المعزولة 65% من البكتيريا سالبة الغرام، مقابل 35% من البكتيريا موجبة الغرام. مثّلت البكتيريا موجبة الغرام بـ 15 عزلة من أنواع المكوّرات العقدية(*Streptococcus* spp.) ، و8 عزلات من المكوّرات العنقودية الذهبية(*Staphylococcus aureus*) ، و4 عزلات من أنواع العصيات(*Bacillus* spp.) ، بينما مثّلت البكتيريا سالبة الغرام بـ 11 عزلة من أنواع الزائفة(*Pseudomonas* spp.) ، وعزلة واحدة من المتقلّبات العجيبة (*Proteus mirabilis*)، و28 عزلة من أنواع الكلبسيلا(*Klebsiella* spp.) ، و3 عزلات من الإشريكية القولونية (*Escherichia coli*)، وعزلتين من أنواع السيتروباكتر(*Citrobacter* spp.) ، و5 عزلات من أنواع الأسينيتوباكتر (*Acinetobacter* spp.) نستنتج من الدراسة الحالية أن العدوى التنفسية السفلى خطيرة وتؤدي إلى مضاعفات جسيمة، وأن المضادات الحيوية الأكثر استجابة للالتهاب هي: الإيميبينيم(IMP) ، والسيبروفلوكساسي (CIP)، والجنتاميسين .(CN) في حين لا توجد علاقة بين العدوى التنفسية وبروتين سي التفاعلي.

الكلمات المفتاحية: العدوى التنفسية السفلى، عينة البلغم، بروتين سي التفاعلي، العزلات البكتيرية، المركز الطبي بمصراتة.

Introduction:

Lower respiratory tract infection is an umbrella term used for a group of diseases that affect the bronchioles and lungs. Diseases classified under this infection are pneumonia and acute exacerbation of the disease causing chronic obstructive pulmonary disease. According to studies conducted, which makes the global burden of diseases, respiratory infections are the fourth leading cause of death and loss of health worldwide for both sexes(Mahale, Sheth, & Murthy, 2024).

Pneumonia is an acute respiratory infection that generally affects the alveoli and the airway and causes high mortality and morbidity in all age groups, as is the case for most patients who suffer from bed rest for long periods. The patient may need to remain in the hospital and may be exposed to an acquired infection associated with ventilation. Clinical symptoms can be diagnosed as fever, cough, shortness of breath with the presence of purulent sputum(Indah, Widyantara, Putra, & Tini, 2024)**.**

Sputum is the most easily collected respiratory specimen for isolation of pathogenic microbes. The quality of isolation of the pathogen depends on the quality of the sample. Focusing on accurate sample collection is essential to achieve identification of the causative agent. Although sputum may be contaminated with oropharyngeal microbes, it represents the upper respiratory tract microbes. To avoid this, systems are used to evaluate the quality of sputum, such as the Bartlett, Murray, and Washington system(Chintaman, Ghadage, & Bhore, 2017; Shah, Singh, Naik, & Dhobi, 2010)**.**

The quality of sputum is assessed by the presence of squamous epithelial cells and inflammatory cells, which can be observed under microscope(Mahale et al., 2024).

Respiratory infection is the main cause of illness and death, especially in patients aged 65 years and over, due to their exposure to chronic diseases associated with old age, as well as weak immunity(Millett, Quint, Smeeth, Daniel, & Thomas, 2013).

According to the World Health Organization, more than 65 million people suffer from pneumonia worldwide, with an increasing prevalence that will become the third leading cause of death in the world by 2030(Rouzé et al., 2020).

Therefore, we currently need rapid diagnostic methods that help in early detection of the presence of inflammation and to use antibiotics more quickly to control the disease and obtain supporting tests such as bacteriological tests such as culture, which require a long period for the result to appear. Recently, C-reactive protein has been used, as some studies have linked its importance to the rapid detection of the presence of inflammation in the patient. Yamazoe et al. (2017) showed that C-reactive protein is an independent predictor of bacteria and that high levels of more than 20 mg/dL were seen in patients with positive cultures(Indah et al., 2024).

C-reactive protein is a stable marker of acute inflammation. It is an acute phase protein that is cleared in the liver. It was first described by Tillett and Francis in 1930 as a factor responsible for the deposition of C from the lung cell wall. It was named after the polysaccharide. It is an aerobic protein

with a molecular weight ranging from 120-140 thousand. It consists of 5 identical monocotyledonous subunits arranged in a simple periodic symmetry. It plays two main biological roles, it is known that it is active in increasing the number of white blood cells as a result of responding to the presence of inflammation, but the increase in C-reactive protein is not specific to a type of inflammation. It helps the doctor in diagnosing and monitoring the development of the disease as well as the therapeutic response(Lee et al., 2019; Wussler et al., 2019)**.**

Therefore, the current study addressed the isolation and identification of microbe's Lower respiratory tract infection, the importance of C-reactive protein for early detection of inflammation, and the identification of commonly used antibiotics**.**

Materials and Methods:

Place of study: The study conducted on patients attending Misurata Medical Center.

Study periods: The beginning of 1 January 2023 to 31 May 2024.

Date collection:

After approval from the Scientific Research Committee at the Center, data were collected from the Medical Laboratories Department at Misurata Medical Center for samples that had sputum culture and C-reactive protein analyses. The data included cases visiting the outpatient clinics, the pediatric intensive care department, and the internal medicine department, men and women of all age groups, during the aforementioned time period**.**

Sample collection:

The samples were received at the microbiology laboratory of Misurata Medical Center. They were distributed according to the planning method on three nutritional media: Blood agar, MacConkey agar, and Chocolate agar. They were incubated in an incubator for 24-48 hours at a temperature of 37°C, except for Chocolate agar, which was incubated in an anaerobic medium. and collected blood samples of tube contained heparin for analyzing C-reactive protein (CRP), using the Mindray BS-430 device**.**

Testing the sensitivity of bacterial isolates to commonly used antibiotics:

A bacterial suspension was made and its turbidity was adjusted with McFarland solution (0.5 w/v) using a cotton swab, taken from suspension and used Mueller Hinton agar and left for 5 minutes to dry. The most commonly used antibiotics were added as in the table (1).

Table (1): Antibiotics used. antibiotic company (Fortress, Bio analyses, Oxoid).

Antibiotic	Concentration
Ciprofloxacin (CIP)	5 mcg
Imipenem (IMI)	10 µg
Amikacin (AK)	30mcg
Cefuroxime (CXM)	30mcg
Augmentin (AUG)	30mcg
Cefotaxime (CTX)	30mcg
Ceftazidime (CAZ)	30mcg
Gentamycin (CN)	10µg
Ceftriaxone (CRO)	30µg

Statistical Analysis:

Use Microsoft Excel 16 to create appropriate tables and figures for the results obtained, and used Package of Social Sciences (SPSS, version 25.0) software. A descriptive analysis of sample results was presented. Utilizing the Chi-square goodness-of-fit test, the association between research variables was assessed. The agreed significance level has been set below ($p<0.05$).

Results and Discussion:

The current study included patients visiting the outpatient clinic where their percentage was 29%, while the men's section was 27%, the women's section was 24%, the pediatric care section was 2%, and the intensive care section was 18%. Most of the patients were from the outpatient departments and medicine department, while the pediatric department had the lowest percentage, as shown in the Figure (1).

Intensive care unit (ICU), Out Patient Department (OPD), Female Medicine Department (FMD), Male Medicine Department (MMD), Pediatric Intensive Care Unit (PICU**).**

The total number of patients was 143 patients of both sexes. The age groups were between 2 and 95 years, including 46% female and 54% men as demonstrated in Figure (2). This is similar to studies (Indah et al,. 2024). (Simanjuntak, Sakdiah, Sitanggang, & Maharani, 2023).

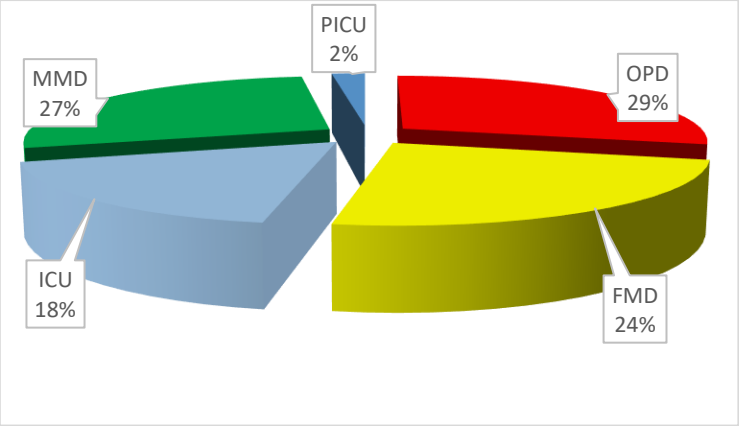


Figure (1): Distribution of patients according to departments.

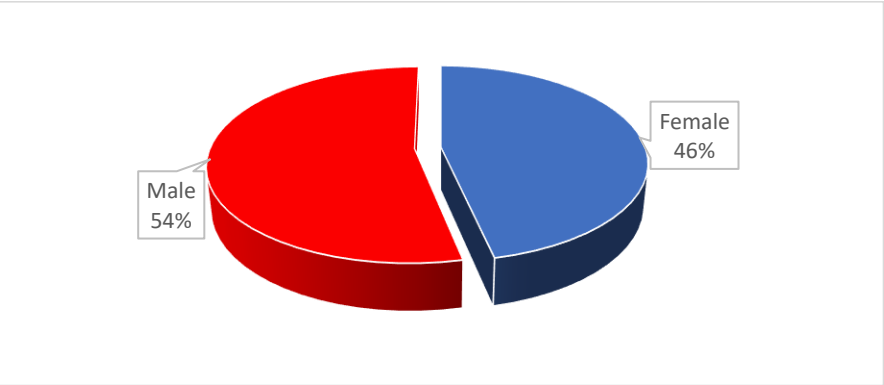


Figure (2): Percentage of men to female.

In table 2, we found that most of the patients were in the age group (27-51) (52-75) years, respectively (46) (60). The reason may be that the older the patient gets, the more susceptible he becomes to chronic diseases that accompany respiratory diseases due to immunodeficiency. This is similar to study (Nwadike et al., 2013).

Table (2): Age groups.

		Frequency	Percent	Valid Percent	Cumulative Percent
Age	2-26	17	11.9	11.9	11.9
	27-51	46	32.2	32.2	44.1
	52-75	60	42.0	42.0	86.0
	76-100	20	14.0	14.0	100.0
	Total	143	100.0	100.0	

Figure 3, which represents microbial isolates from sputum samples, 77 bacterial isolates, 16 *Candida albicans* isolates, and one spore isolate were identified, while 47 isolates were sterile, one isolate was contaminated, and one isolate was from a deceased patient, the identification of the microbe was not completed**.**

Figure 4 shows the isolated bacteria in which 65% of the Gram-negative bacteria were more than 35% of the Gram-positive bacteria. This is similar to a study in India in 2024(Mahale et al., 2024), Gram-positive bacteria were represented by 15 *Streptococcus* spp isolates, 8 *Staphylococcus aureus* isolates, and 4 *Bacillus* spp isolates, while the Gram-negative bacteria represented 11 isolates of *Pseudomonas* spp, one isolate of *Proteus mirabilis*, 28 isolates of *Klebsiella* spp, 3 isolates of *E. coli*, 2 isolates of *Citrobacter* spp, and 5 isolates of *Acinetobacter* spp. The isolated bacterial species were similar to several studies, including the studies in India and Indonesia (Indah et al., 2024; Mahale et al., 2024).

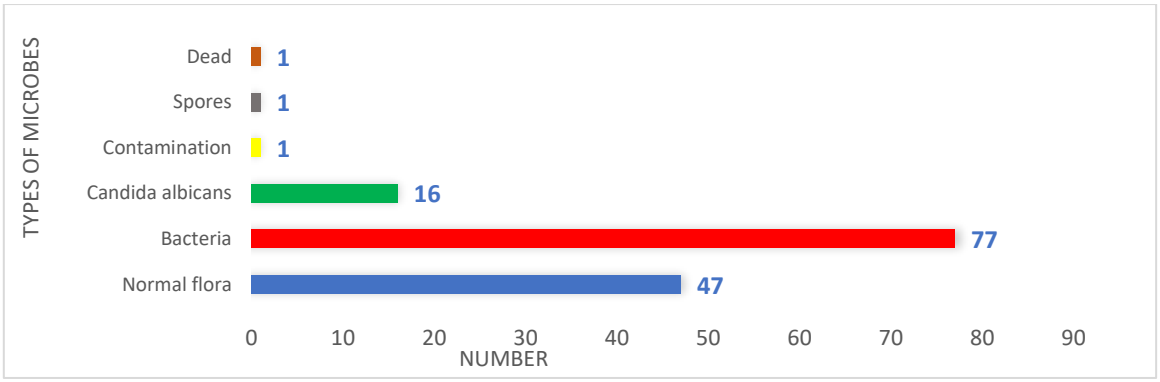


Figure (3): Types of microbes isolated from sputum samples.

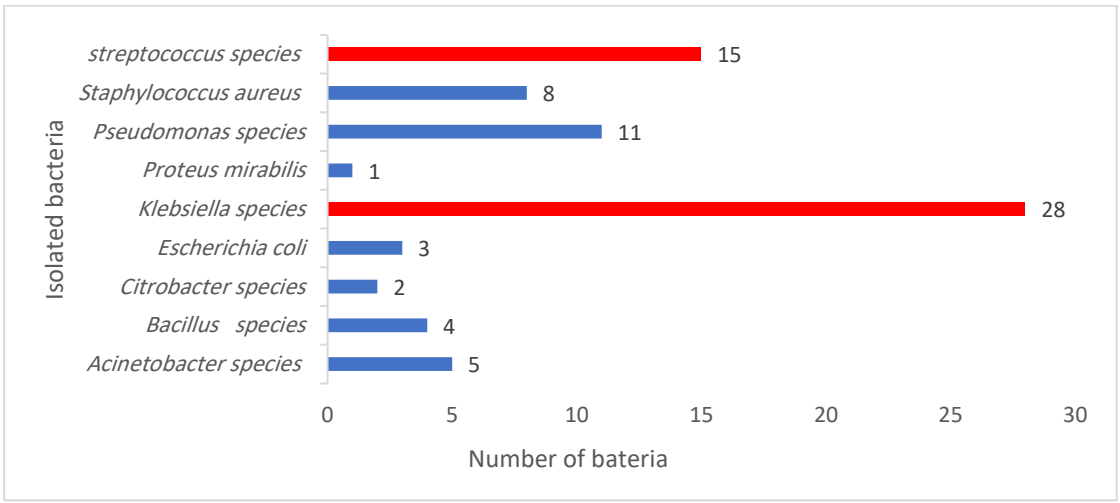
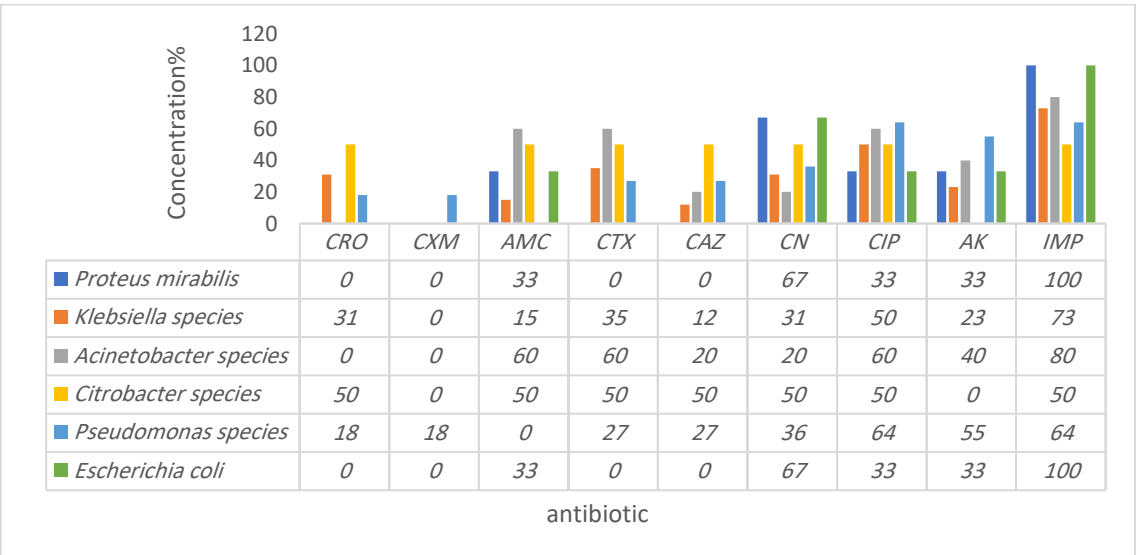


Figure (4): Types of bacteria isolated from sputum samples.

The data obtained from the effect of antibiotics on Gram-negative bacteria, it was found that *E. coli* and *Proteus mirabilis* have an effect on antibiotics (CN, IMP), while *Citobacter* spp and *Acinetobacter* spp have an effect on antibiotics (AMC, CTX, CIP,IMP), and *Klebsiella* spp, *Pseudomonas* spp have an effect on antibiotics (CIP,AK,IMP) , as shown in the figure(5), While the study was similar in terms of the effect of antibiotics on *Pseudomonas* spp, while *Klebsiella* spp and *Acinetobacter* spp were resistant to antibiotics(Singh, Sharma, Nag, & care, 2020). While another study found that the effect of antibiotics on the same bacterial species was similar to the current study (Mahale et al., 2024).



	CRO	CXM	AMC	CTX	CAZ	CN	CIP	AK	IMP
Proteus mirabilis	0	0	33	0	0	67	33	33	100
Klebsiella species	31	0	15	35	12	31	50	23	73
Acinetobacter species	0	0	60	60	20	20	60	40	80
Citrobacter species	50	0	50	50	50	50	50	0	50
Pseudomonas species	18	18	0	27	27	36	64	55	64
Escherichia coli	0	0	33	0	0	67	33	33	100

Figure (5): Sensitivity of Gram-Negative bacteria to antibiotics used.

While the data obtained from the effect of antibiotics on Gram-positive bacteria, *Staphylococcus aureus* was sensitive to antibiotics (CN, IMP), while *Streptococcus* spp was sensitive to (AMC, CTX, CIP, IMP), while *Bacillus* spp was sensitive to (CRO, CN, CIP, AK, IMP), as represented in the Figure(6), this is similar to both studies in terms of the sensitivity of *Staphylococcus aureus* to CN(Mahale et al., 2024; Singh et al., 2020), while not similar to the study that showed the sensitivity of *streptococcus* spp to the antibiotic just(CIP) (Mahale et al., 2024).

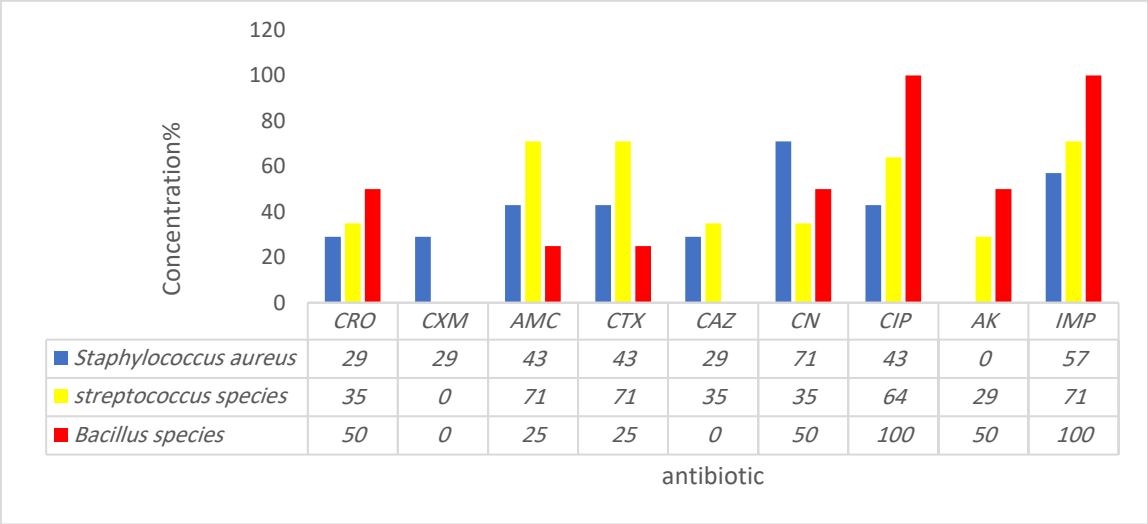


Figure (6): Sensitivity of Gram-positive bacteria to antibiotics used.

When studying the extent of the association between pneumonia and C-reactive protein, we found that there was no association and it was higher than 0.01 , as shown in the table (3), this is not similar to several studies(Anusha & Mahesh, 2023; Köseoğlu et al.) ,this is similar to study (Rouzé et al., 2020).

Table (3): Association between pneumonia and C-reactive protein

Chi-Square Tests			
	Value	**df**	**Significance**
Pearson Chi-Square	16.000[a]	15	.382
Likelihood Ratio	19.875	15	.177
N of Valid Cases	16		

p value < 0.05 is considered statistically significant and less than 0.01 is highly statistically significant
*Indicates statistically significant difference

Conclusion:

We conclude from the current study that lower respiratory tract infections are dangerous and lead to serious complications and that the most responsive antibiotics for inflammation are: (IMP, CIP, CN). There is no relationship between respiratory infection and C-reactive protein**.**

Acknowledgment:

Thanks, and appreciation to the Human Resources Development Department at Misurata Medical Center for facilitating the collection of data from the Medical Laboratories Department, and thanks to everyone who helped with this study**.**

Recommendations:

- Follow up the patient and take blood and sputum samples immediately after entering the department**.**
- Specify the age group over 40 years old because they are more susceptible to respiratory diseases**.**
- Procalcitonin analysis, according to previous studies, is considered more accurate than C-reactive protein**.**

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