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STUDIES ON THE CO-INFECTION OF HIV AND ATYPICAL *MYCOBACTERIA* IN MERCY SPECIALIST HOSPITAL AHIAEKE-NDUME, ABIA STATE, NIGERIA

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ABSTRACT

Tuberculosis (TB) and HIV/AIDS are major public health issues globally and the burden of these diseases is particularly significant in Nigeria. This study therefore determined the prevalence and distribution of co-infection of HIV and atypical mycobacteria among individuals in Mercy Specialist Hospital Ahiaeke-Ndume, Abia State, Nigeria. A total of the 115 individuals were enrolled into the study, 43.5% (50) males and 56.5% (65) females. The serum was screened for anti-HIV antibodies using Trinity Biotech Uni-Gold™ rapid test kit while the CD4+ cell count was determined using the flow cytometric method. Acid-fast bacilli (AFB) were detected using sputum smear microscopy. The study revealed that among the different age range between male and female individuals investigated for HIV positive, the >50 years age group had the highest HIV prevalence rate of 87.9%. The highest incidence of TB/HIV co-infection was seen in the 21-30 and 41-50 years age group, (83.3%) and 81.8% incidence rate each. The highest distribution of study participants diagnosed with HIV/TB Co-infection (83.3%) was seen in the female between 11-20 years age group. Among the 45 patients who tested positive for HIV/TB co-infection, 44.4% had a CD4+ cell count of fewer than 200 cells/l, 37.8% had a CD4 value of 200–399 cells/l, 6.67% had a CD4 count of 400–599 cells/l, and 11.1% had a CD4 count of less than 600 cells/l. The result indicated that HIV positive individuals have higher risk of getting primary infection with M. tuberculosis. Therefore, better public health education is required for the control of the HIV virus and the illness progression.

KEYWORDS: *Tuberculosis, Atypical Mycobacteria, Acid Fast Bacilli, Co-infection, HIV*

INTRODUCTION

The most common cause of mortality globally from a single infection is tuberculosis (TB). The illness is contagious and typically causes pulmonary TB in the lungs, but it can also affect the meninges, gut, skin, and other bodily parts (Emencheta *et al*., 2022). According to estimates, 13% of the 8.7 million persons who contracted TB worldwide in 2011 also had HIV co-infection (Gao *et al*., 2013). In another estimates, TB causes 25% of all AIDS-related deaths, and the 2016 worldwide TB/HIV co-infection figures show that co-infection caused 374,000 deaths

(Tesfaye *et al*., 2018). Because of rising immigration from areas with high endemicity and deteriorating socioeconomic conditions in densely populated cities, the rates of rise are considerably higher in developing nations (Akwafuo *et al*., 2020). Globally, the number of TB cases has dramatically increased due to the Human Immunodeficiency Virus (HIV) pandemic's deterioration of this scenario (Takhar *et al*., 2018).

It has long been recognized that TB and HIV are closely related and that their interactions may affect how each disease develops naturally. To describe their connection, the words "co-epidemic" or "dual epidemics" are frequently employed (Tesfaye *et al*., 2018). A growing global emergency is the TB-HIV twin pandemic, particularly in emerging and poor nations (Okechukwu *et al*., 2011). The TB epidemic has been significantly impacted by HIV. According to estimates from the World Health Organization (WHO), 9.6 million persons globally contracted TB in 2014, and 1.2 million HIV-positive individuals also contracted the disease. Over 1.5 million individuals died from TB in 2014, of whom 0.4 million had HIV (World Health Organization, 2015).

About 74% of the 1.2 million TB/HIV cases globally are in Africa (Teweldemedhin *et al*., 2018). In 2017, TB complications caused around 32% of AIDS-related fatalities, and 920,000 HIV-positive people were sick from TB during that time (WHO, 2015). 65% of HIV-positive patients in West and Central Africa are uninformed of their condition and are not receiving any kind of therapy as a result. Higher susceptibility to TB emerges from this (Akwafuo *et al*., 2020). Nigeria is now one of the 30 nations with the highest rates of TB/HIV coinfection (Onyedum *et al*., 2017). According to the 2014 Global TB Control Report, she is also the most heavily affected country by TB in Sub-Saharan Africa, with prevalence and incidence rates of 322 and 338 per 100,000, respectively (Atilola *et al*., 2018).

As a result, there are 39,000 fatalities among co-infected people and 115,000 deaths from TB infections per year (Akwafuo *et al*., 2020). It is concerning that just 104,904 cases—out of an expected 407,000 cases—were discovered in 2017, indicating a treatment coverage rate of only 25.8%. Controlling TB is almost hard; this is because only one in four estimated cases are diagnosed each year. Fighting the TB pandemic in Nigeria is led by the National Tuberculosis and Leprosy Control Program (NTBLCP) (Akwafuo *et al*., 2020). It oversees the delivery of fundamental care, including Directly Observed Treatment Short-course (DOTS) and Multi-Drug Therapy, as well as testing, preventative, and control measures (MDT). Moreover, it works with affiliated organizations to offer patients the proper case management services.

Both adaptive and innate cell-mediated immunity are necessary for the immune control of M. tuberculosis (O'Garra *et al*., 2013). HIV infection has been proven to weaken the immune system when left untreated, either by drastically reducing CD4 cells or by causing CD4 T cells to malfunction as seen by decreased IL-2 or IFN-c production (Mehandru *et al*., 2004). As a result, diseases such as TB become more

likely to develop (Kalsdorf *et al*., 2009). As a result, the degree of immunosuppression is directly connected to the frequency of TB in HIV-infected individuals (Lee *et al*., 2000). Due to this unique clinical appearance, significantly reduced diagnostic accuracy of chest radiography and sputum smear microscopy, TB diagnosis in HIV-infected individuals is notoriously difficult. Additionally, the lack of Polymerase Chain Reaction (PCR) test capabilities, other more modern diagnostic techniques, and other resource-constrained environments make it challenging to diagnose such instances (Lawn and Wood, 2011). Hence this study, aims to determine the prevalence and distribution of co-infection of HIV and atypical mycobacteria among individuals in Mercy Specialist Hospital Ahiaeke-Ndume, Abia State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out at Mercy Specialist Hospital, Abia State, Nigeria. The capital of Abia State is Umuahia. It is comprised of a total population of about 4,112,230 (Owoh, 2023). Mercy Specialist Hospital is located at Ahiaeke-Ndume, Umuahia, Abia State, latitude 5^{o} 30' 37" N longitude 7^{o} 31' 37" E and altitude 167.7m.

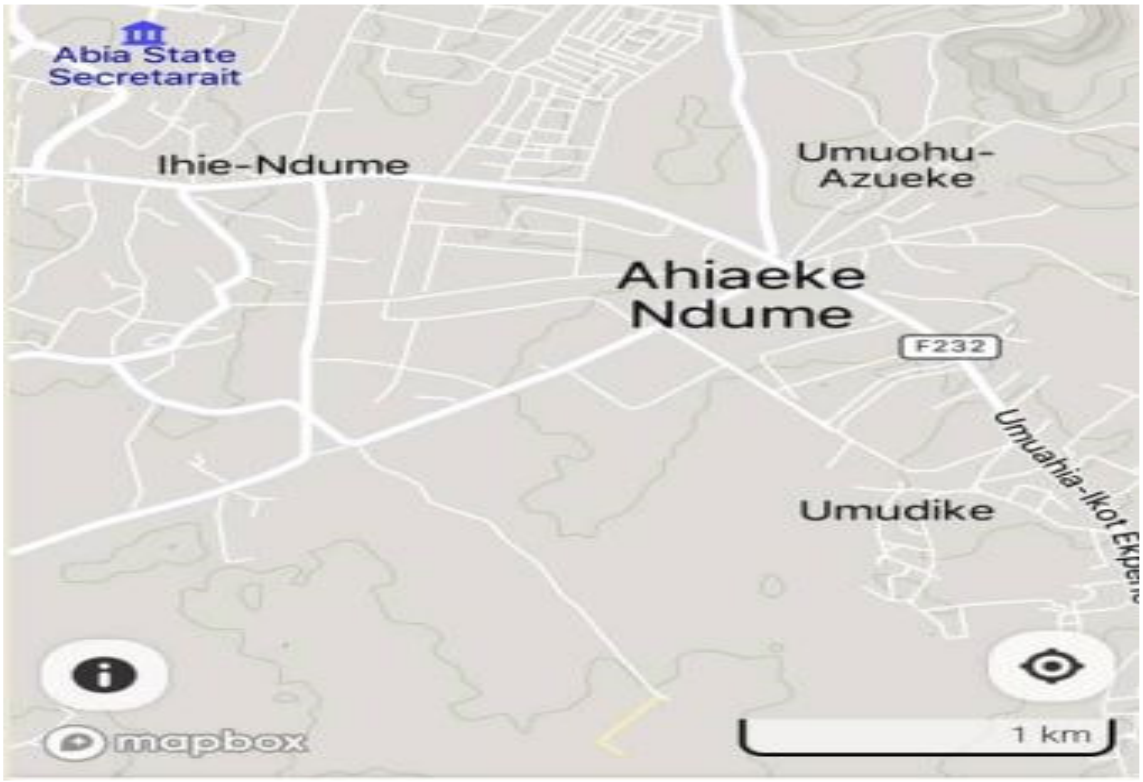

Fig. 1: Map showing the location of the study area (Ahiaeke)

Population of Study

A total of one hundred and fifteen (115) apparently sick patients of different ages and socioeconomic status attending special treatment at Mercy Specialist Hospital, Abia State, Nigeria served as the study population. The study was carried out over a period of 11 months.

Inclusion and Exclusion Criteria

All participants who gave informed consent were included in the study. Individuals with diabetes mellitus, primary immunological deficits, long-term steroid usage, and other immune-suppressing factors, and those who refused to provide their consent were excluded from the study (Nwankwo *et al*., 2022).

Sample collection for sputum microscopy

Participants in Mercy Specialist Hospital Ahiaeke-Ndume, Abia State, Nigeria who were suspected of having pulmonary TB had at least 2 ml of each of the three specimens (spot, early morning, and spot) taken, under the direction of skilled and knowledgeable medical professionals. The suspects were instructed to cough as deeply as possible in order to produce expectoration, and then spit into a sterile 50 ml blue cap tube. The samples were stored at 4^{o}C before transporting in an ice pack to Microbiology laboratory, Michael Okpara University of Agriculture, Umudike.

Sample collection for HIV screening and CD4+ cell count

The consenting participants had phlebotomy for HIV testing, and the complete blood was drawn, transferred into a sterile inner EDTA (K3) collecting tube from the vacutainer brand, and then chilled to –20°C before processing. The samples were sent to the microbiology lab in an ice pack.

Screening for HIV1 and 2 antibodies

The serum was screened for anti-HIV antibodies using Trinity Biotech Uni-Gold^{TM} rapid test kit, according to manufacturer's instruction as described by Emencheta *et al*., (2022). Plasma from the patient was administered in the amount of 50µl to sample pads with the relevant labels. The findings were read after 15 minutes of sample application and the results verified by the kit's built-in quality control. HIV seropositive response is shown by two visible red lines in the test and control regions, whereas the test kit is validated by one red line in the control region. Red line absence in the test area indicates an HIV seronegative response. Enzyme linked immunosorbant assay (ELISA) was further used to confirm the positive tests (Emencheta *et al*., 2022).

Determination of CD4+ count

The CD4+ count was determined using flow cytometric method as described by Alexander *et al*. (1998). In this method, a small amount of blood was collected from the study participants and treated with a fluorescently-labeled antibody that binds specifically to the CD4 receptor on T-cells. The blood samples were then run through a flow cytometer to identify and count individual cells as they pass through a narrow channel. The CD4 positive T-cells in the samples were identified by the fluorescence emitted by the labeled antibody and were counted by the flow cytometer. The results were then analyzed by a computer program to calculate the absolute number and

percentage of CD4 positive T-cells in the blood.

Microscopic examination of the sputum specimen

Using an applicator stick, sputum smears were formed on grease-free slides. The smear was heat-fixed by running it three times over a blue flame after letting it air dry for at least an hour. The sputum sample was examined microscopically after the specimens were stained with carbol-fuchsin using the common Ziehl Neelsen staining procedure (Mokobi, 2022). The three sputum samples from the TB suspects were examined and recorded accordingly. A Ziehl Neelsen smear result was deemed positive for TB if at least one of the three specimens revealed pink/red rod-shaped bacteria under a microscope.

RESULTS

Table 1 show the gender-age distribution of HIV positive individuals in Mercy Specialist Hospital Ahiaeke-Ndume, Abia State, Nigeria. A total of the 115 individuals were enrolled into the study, 43.5% (50) being males and 56.5% (65) females. Among the different age range between male and female individuals investigated for HIV positive, the >50 years age group had the highest HIV prevalence rate of 87.9%, followed by the 31-40 years age group with 84.0% prevalence. The least prevalence of 64.7% was recorded for individuals aged 41-50 years. In total, 79.1 % of the investigated population was HIV positive.

The result of the incidence of HIV/TB and non-HIV/TB co-infection among HIV patients is presents in table 2. The result showed that out of the 91 samples, 45 (49.6%) was positive for HIV/TB co-infection while 46 (50.5%) were negative HIV/TB co-infection. The highest incidence of TB/HIV co-infection (83.3%) was seen in the 21-30 years age group, followed by the 41-50 years age group with 81.8% incidence. The least incidence was seen in patients aged 50 years and above with 31.0% incidence.

Table 3 show the gender-age distribution of study participants diagnosed with HIV/TB Co-infection. The result showed that out of the 45 participants positive for HIV/TB co-infection, 27 (60.0%) were female while 18 (40.0%) were male. The highest distribution of study participants diagnosed with HIV/TB Co-infection (83.3%) was seen in the female between 11-20 years age group, followed by the 21-30 and 41-50 years age group with 66.6% each in distribution. The least distributed was recorded for the male participants between the ages 21-30 and 41-50 at 33.3% each.

The CD4+ cell count of HIV patients at Mercy Specialty Hospital Ahiaeke-Ndume, Abia State, Nigeria is shown in Table 4 below. Thirty-seven (37) patients had CD4+ counts below 200 cells/l, twenty-two (22) had levels between 200 and 399 cells/l, nineteen (19) had levels between 400 and 599 cells/l, and thirteen (13) had levels over 600 cells/l among the 91 HIV patients who were examined for TB co-infection. Among the 45 patients who tested positive for HIV/TB co-infection, 44.4% had a CD4+ cell count of fewer than 200 cells/l, 37.8% had a CD4 value of 200–399 cells/l, 6.67% had a CD4 count of 400–599 cells/l, and 11.1% had a CD4 count of less than 600 cells/l.

Table 1: Gender-age distribution of HIV positive patients

Age range	No. Screened	Male (%)	Female (%)	Total +ve (%)
0-10	0	0 (0.0)	0 (0.0)	0 (0.0)
11-20	18	5 (27.7)	7 (38.9)	12 (66.7)
21-30	22	8 (36.4)	10 (45.5)	18 (81.8)
31-40	25	15 (60.0)	6 (24.0)	21 (84.0)
41-50	17	4 (23.5)	7 (41.2)	11 (64.7)
>50	33	9 (27.3)	20 (60.6)	29 (87.9)
Total	115	50 (43.5)	65 (56.5)	91 (79.1)

Table 2: Incidence of HIV/TB and Non-HIV/TB Co-infection among HIV patients

Age range	No of HIV patients	HIV/TB co-infection (%)	Non-HIV/TB co-infection (%)
0-10	0	0 (0.0)	0 (0.0)
11-20	12	5 (41.7)	7 (58.3)
21-30	18	15 (83.3)	3 (16.7)
31-40	21	7 (33.3)	14 (66.7)
41-50	11	9 (81.8)	2 (18.2)
>50	29	9 (31.0)	20 (68.9)
Total	91	45 (49.6)	46 (50.5)

Table 3: Gender-age distribution of study participants diagnosed with HIV/TB Co-infection

Age range	HIV/TB co-infection	Male (%)	Female (%)
0-10	0	0 (0.0)	0 (0.0)
11-20	5	1 (20.0)	4 (80.0)
21-30	15	5 (33.3)	10 (66.6)
31-40	7	4 (57.1)	3 (42.9)
41-50	9	3 (33.3)	6 (66.6)
>50	9	5 (55.6)	4 (44.4)
Total	45	18 (40.0)	27 (60.0)

Table 4: CD4+ cell count of the HIV patients

$CD4^+$ range	No screened	No of co-infection with TB (%)	No of non co-infection with TB (%)
<200	37	20 (44.4)	17 (36.4)
200-399	22	17 (37.8)	5 (25.2)
400-599	19	3 (6.67)	16 (21.5)
$\geq$ 600	13	5 (11.1)	8 (7.5)
Total	91	45 (100)	46 (100)

Discussion

Although HIV co-infection alters the natural history and clinical appearance of TB and negatively influences its prognosis, tuberculosis is a dangerous opportunistic illness that affects persons with HIV/AIDS globally (Schutz *et al*., 2010). The association between HIV and

tuberculosis is widely known (which is a transmissible infection that usually attacks the lungs) (UNAIDS, 2017). Due to the high prevalence of co-infection between these two diseases, they are sometimes referred to as co-epidemics (or dual epidemics) (Ugochukwu, 2010). This study therefore determined the prevalence and distribution of co-infection of HIV and atypical mycobacteria among individuals in Mercy Specialist Hospital Ahiaeke-Ndume, Abia State, Nigeria.

In this study, most of the study participants are female (56.5%), however the male to female ratio in DRC is normal, i.e., 99.7% (Konoema, 2021). This may be because women are more likely to be concerned about their health and to seek medical attention at the first sign of illness. This opposes results from other research on TB by Oshi *et al*., (2014) Duru *et al*, (2016) and Garedew and Nemera, but is similar to findings by Ebuenyi *et al*., (2016). (2017). This may be connected to a report released by the National Agency for the control of AIDS in 2019 that stated that, according to data from the Nigeria HIV/AIDS indicator and impact survey (NAIIS), there were more females (1.9%) than males (0.9%) living with HIV/AIDS in Nigeria (NACA-AIDS-UNAIDS, 2019). According to some studies, women are more likely to contract HIV in developing nations, especially in sub-Saharan Africa, which is home to at least 50% of all HIV-positive people worldwide (Harling *et al*., 2014). Despite the fact that similar studies may target more women than males for a variety of reasons, it's possible that social and cultural factors such as gender that affect healthcare-seeking behavior have had an impact (Shah *et al*., 2021). In Africa and Nigeria, men's delayed health-seeking behavior continues to be a significant problem. There might be negative effects if males with HIV wait too long to seek care.

Of ninety-one (91) samples that tested positive for HIV, the incidence of TB in HIV patients showed that 49.6% also tested positive for HIV/TB co-infection. This is greater than the prevalence of active TB among HIV-positive patients in the Nigerian cities of Ibadan and Ilorin, which were estimated to be 40% and 32.8%, respectively (Salami and Katibi, 2006; Awoyemi *et al*., 2002). Moreover, it exceeds both the 10.5% observed in Northern Nigeria (Zubairu and Musa, 2009) and the United States by a significant margin (Albalak *et al*., 2007). Although it partially coincides with their research in that the infection was more prevalent among younger HIV patients and in contrast to a previous publication by Aliyu *et al*. (2013). Kooffreh *et al*. (2016) theorized that the rising TB rate seen in Calabar, Nigeria, may be due to HIV/AIDS coinfection. While TB is the primary cause of mortality for HIV patients, Corbett *et al*. (2006) claim that rising HIV prevalence rates are to blame for increased TB notification rates. Edike (2008) claims that there is a correlation between the rising prevalence of HIV/AIDS and the high prevalence rate of TB in Enugu State, which is 37.9%.

In addition, the prevalence of TB among HIV patients in this study may be attributed the lower standard of living in Nigeria compared to the other regions. It is well documented that poverty and low standard of living are risk factors for TB infection (Reward *et al*., 2021).

Overcrowding in most of the households in Nigeria encourages the spread of TB (Okechukwu and Okechukwu, 2011). Furthermore, variation in prevalence may be attributed to the differences in monitoring systems and international cooperation on TB/HIV control initiatives (Tesfaye *et al*., 2018). The high prevalence of TB/HIV coinfection in Nigeria can also be ascribed to the high HIV seroprevalence in the country (accounting for the 7th country with HIV epidemic in the world) (UNAIDS, 2020).

The study also revealed that HIV/TB co-infection cases were more in ages between 21-30 years, followed by the 41-50 years age group. According to research by Onipede *et al*. (1999) at Ile-Ife and Emencheta *et al*. (2022) at Nsukka, Nigeria, the participants are in the economically and sexually productive age range of 21 to 50 years, which may account for this disparity. In addition, the result obtained in this study is similar but slightly higher than the findings from the Imo (Duru *et al*., 2016), Ebonyi (Oshi *et al*., 2014), and Niger Delta studies (Ebuenyi *et al*., 2016). The majority of the participants in this research were over 50, which suggests that a sizable portion of the workforce was impacted, aggravating the catastrophic cost associated with TB and HIV co-infection and resulting socioeconomic hardship. Being the age group that is most economically productive, this can have a major detrimental impact on the socioeconomic state of a nation. According to several research, those who are single, divorced, or widowed have a higher chance of contracting TB in addition to being married people (Molaeipoor *et al*., 2014). In this study, married people were shown to have higher rates of HIV/TB co-infection.

The highest distribution of study participants diagnosed with HIV/TB Co-infection (83.3%) was observed in the female between 11-20 years age group compared to their male counterparts (57.1%) between the ages of 31-40. This result differs from one by Okonko et al. (2018), which found that men were more frequently diagnosed with HIV/TB illness than women. The findings of this study are also in conflict with those of Kooffreh *et al*. (2016), who claimed that in Calabar, Nigeria, males were more likely to be co-infected with HIV than females. Moreover, in Ikot Ekpene, Akwa Ibom State, Nigeria, Ita and Udofia (2005) noted that men had a greater incidence than females. According to a study by Lawson *et al*. (2008), women are more likely than men to get HIV/TB, although Odaibo *et al*. (2013) contend that gender has no bearing on the prevalence of HIV/TB co-infection. Given that women make up the majority and that this is an urban region, where patients are more likely to be educated than those in rural areas and so more likely to seek medical care, it is possible to attribute the high frequency of TB-HIV co-infection to these two factors (Asuke *et al*., 2020).

Furthermore, the result from this study demonstrated that 44.4% of the 45 patients with HIV/TB co-infection had a CD4 level below 200 cells/l. This demonstrates that TB risk may rise with a low CD4 level. There isn't a definite CD4 count cutoff over which the risk of developing TB is reduced in the medical literature. In research conducted in the Nsukka Local Government Area of

Enugu State in 2022, Emencheta *et al*. (2022) confirmed similar findings, reporting that 45.8% of the 24 co-infected subjects had CD4 counts lower than 200 cells/l. According to Lee *et al*. (2000), most patients had advanced HIV infection; 93% had CD4 cell counts under 200/mm^3. The frequency of HIV/TB co-infections was higher among those with CD4 counts of 200-399 cells/l and > 600 cells/l (37.8% and 11.1%, respectively) than it was among people with 400-599 cells/l (6.67%). This is greater than the results found by Okonko *et al*. (2020) in research to assess the HIV/TB co-infection rate that modulates HIV disease state in ART-experienced HIV-1 infected individuals in old Cross River State, Nigeria (200-349 cells/l and 500 cells/l with 1.9%, 350-499 cells/l with 1.1%). The majority of the patients in this research had low CD4 cell counts, which might have been caused by a combination of HIV and TB infections. HIV is well known to deplete and impair CD4 cells, while TB may speed up this process.

CONCLUSION

This study confirmed the presence of HIV/TB co-infection in Mercy Specialist Hospital Ahiaeke-Ndume, Abia State, Nigeria. Although the prevalence rate was not too high and the presence alone makes it a source of concern. The result also indicated that HIV positive individuals and other immunosuppression have higher risk of getting primary infection with *M. tuberculosis* and rapid advancement to active disease. Such individual have up to 50% chances of developing TB at some point in their lives. The findings indicate a correlation between age, level of education, and employment with the infection pattern of HIV and TB co-infection. This might suggest that individuals in a certain age range who engage in heavy sexual activity are the carriers of the infection.

RECOMMENDATION

- The results of this study show that managing co-infection requires a well-structured approach that takes into account both the social and medical components of the issue.
- In order to increase voluntary testing and encourage early treatment initiation for the effective management of these co-infections, intense and better public health education is required.
- In the control of the HIV virus and the illness progression, immediate deployment of public health education and testing of at-risk groups, early disease identification, and early start of treatment for infected people should be helpful.

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