



## **Knowledge, Attitude and Awareness about Anticancer Antibiotics among Dental Students**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author KN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author DG and managed the analyses of the study. Author RS managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Cancer is considered to be one of the major threats throughout the world. Treatment for cancer involves chemotherapy, radiation therapy, and surgeries. Different groups of drugs are used for chemotherapy. Anticancer antibiotics are such groups that act against tumor cells that are in a phase of continuous division and do not harm the cells in the resting phase. This study was a question-based survey. A questionnaire about anticancer antibiotics, its types, its uses, and the clinical scenario was administered to a group of dentists. The questionnaire had a set of questions and corresponding options, the participants had to choose one among the options. The questions were simple and easy. The results obtained were collected and tabulated. The participants were of equal ratio with 50 male and 50 female participants. About 57.1% of the participants were not aware about anticancer antibiotics. As dentists, it is important to know how to diagnose oral cancer, and the treatment options available for those patients. In this study, we could see that the participants' knowledge about anticancer antibiotics was less than adequate. Proper training and conferences should be conducted to improve their knowledge.

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**Keywords:** Anticancer drugs; anticancer antibiotics; anthracyclines; mitomycin.

## 1. INTRODUCTION

Cancer is considered to be one of the most important and dangerous threats to public health. In Central South Asia, cancer of the oral cavity ranks among the three most common types of cancer with an incidence rate of 12.6 per 100000 population [1]. The treatment for oral cancer has various approaches like chemotherapy, radiation therapy, and surgical approach. They are given one at a time, conjointly or on the beat. All of this can cause side effects like sore throat, dry mouth, etc. In the case of the surgical approach, the patient requires a prosthesis of full mouth rehabilitation. Prosthetic rehabilitation in patients who have undergone surgery are similar to the patients undergoing prosthetic treatment with severely resorbed ridges, yet there are certain challenges faced. There is an alteration in the mandibular function and deviation of the residual fragments [1].

Chemotherapy is the use of chemicals for the treatment of cancer. The common drugs used for the treatment of cancer include cisplatin, 5-fluorouracil, methotrexate, carboplatin etc. Anticancer antibiotics are a group of drugs used for the treatment of cancer. They are also called as antineoplastic antibiotics or antitumor antibiotics. Antibiotics are drugs that act on bacterial cells while anticancer antibiotics are drugs that act against neoplastic cells or tumor cells. The mechanism of action of anticancer antibiotics involves insertion into the DNA and destruction of the DNA by the production of superoxide. Platinum-based anticancer antibiotics are newer drugs used in the treatment of cancer [2,3].

Anthracycline antibiotics are the most commonly used antineoplastic antibiotics. They are a group of natural products obtained from certain microorganisms. They are used against breast cancer, leukemias, lymphomas, and sarcomas. The mechanism of action involves interaction with DNA and inhibition of cell division. It also forms metabolites that interact with intracellular substances. The drugs that are currently in use are daunorubicin, doxorubicin, idarubicin. Novel anthracycline antibiotics are valrubicin, pirarubicin, sabarubicin, and berubicin. These are under continuous trials [4].

Previously our team has conducted numerous studies that include clinical studies [5–9], reviews [10–13], case reports [14–16], survey [17,18], in

vitro study [19]. The aim of this study was to assess the knowledge, attitude, and awareness about anticancer antibiotics among dental students.

## 2. MATERIALS AND METHODS

### 2.1 Study Setting

A cross-sectional questionnaire study was conducted an online survey among dental professionals. The online survey is timesaving and a majority of the population can be covered. There were one hundred participants involved in this online survey.

### 2.2 Sampling

Simple random sampling was done as a sampling method. The number of people involved in this study includes 3 i.e guide, reviewer, and researcher. The questionnaire consisting of fifteen questions were posted for an online survey using google forms. The validity of the questionnaire was cross-verified by experts.

### 2.3 Graphs

The response of the participants and graphs were obtained through the online survey.

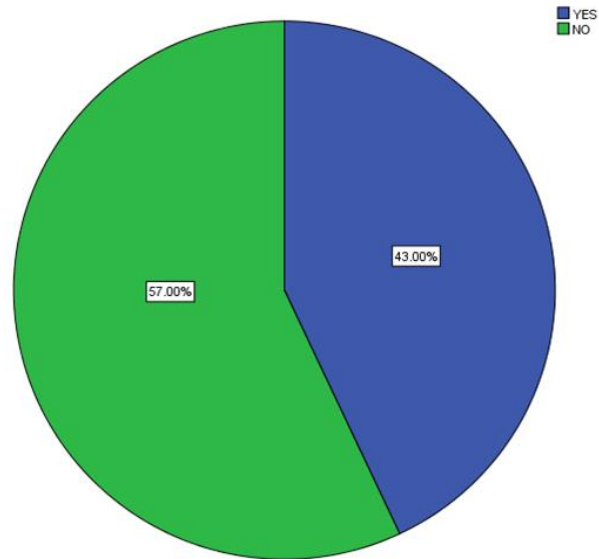
### 2.4 Questionnaire

1. Do you know about anticancer antibiotics?
2. If yes, how do you know about anticancer antibiotics?
3. Anticancer antibiotics are administered through?
4. Bleomycin, Mitomycin are anticancer antibiotics drugs derived from?
5. The action of anticancer antibiotic?
6. These anticancer antibiotics are used in cases of
7. Anticancer antibiotics drugs act on?
8. Severe side effects of anticancer antibiotics?
9. Newer anticancer antibiotics that cause less toxicity and inhibits RNA synthesis more strongly than DNA.
10. Which is a mixture of glycopeptides antibiotics with cytotoxic properties obtained from *Streptomyces verticillus*?
11. Which anticancer antibiotic is obtained from *Streptomyces caespitosus*?
12. Combining which drug with nisin is known to improve treatment efficiency if skin cancer?

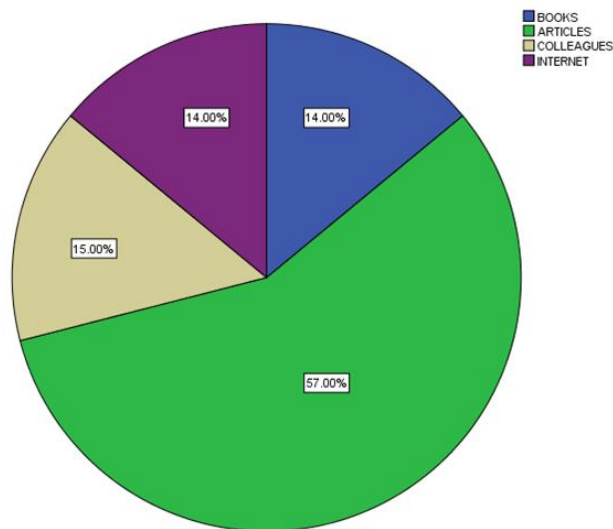
### 3. RESULTS

The participants were of equal ratio with 50 male and 50 female participants. About 57.1% of the participants were not aware about anticancer antibiotics. A majority of the participants, that is 57.1% knew about anticancer antibiotics through research articles while the rest of the participants were categorized as 3 groups-through books,

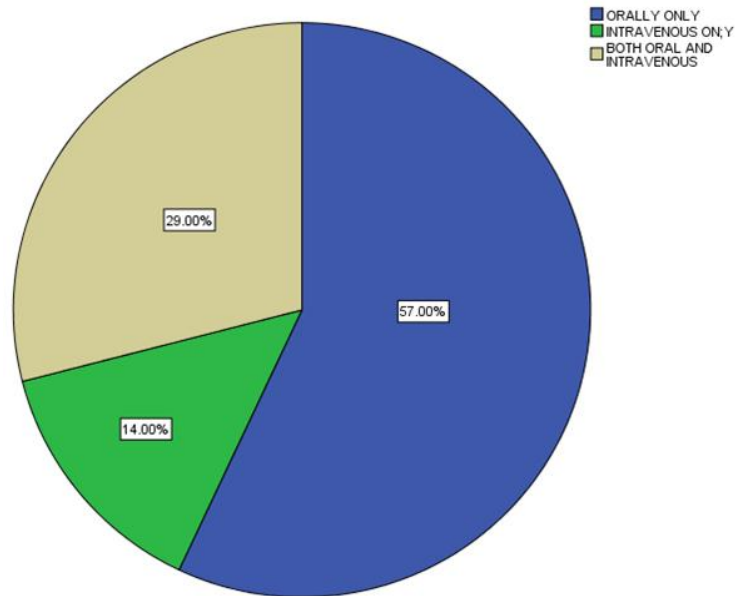
colleagues, and through the internet. Most of the participants were not aware that the anticancer antibiotics are administered only through intravenous routes. Only 28.6% of the participants were aware that Bleomycin and mitomycin are obtained from Streptomyces species. A majority of the respondents-42.9% thought anticancer antibiotics are drugs used in case of multidrug-resistant bacterial infections.



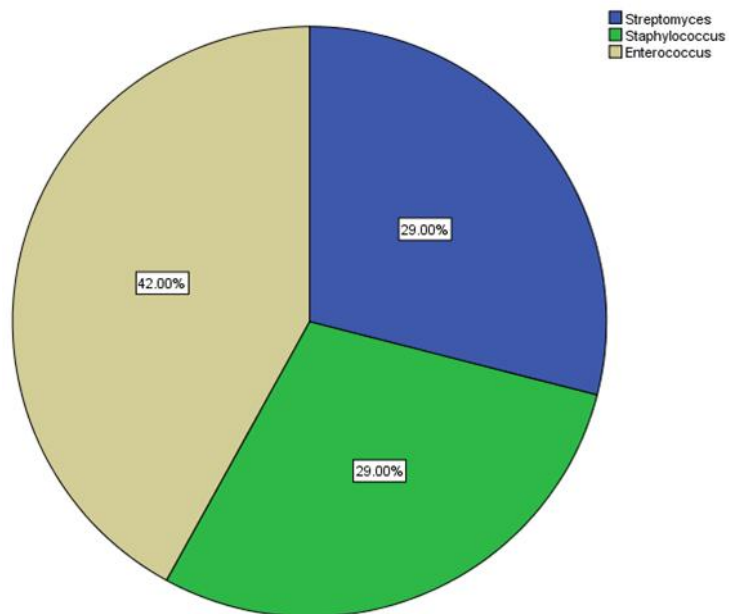
**Fig. 1. Represents the response of the participants regarding their awareness on anticancer antibiotics. 57% of the respondents were aware of anticancer antibiotics (green) and 43% were not aware about anticancer antibiotics (blue)**



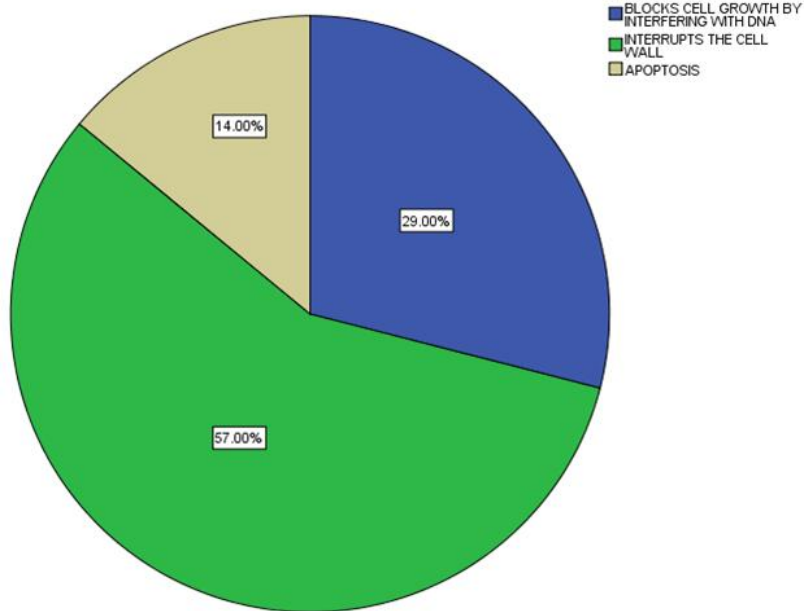
**Fig. 2. Represents the response of the participants regarding their source of knowledge about anticancer antibiotics. 57% of the respondents depended on articles to know about anticancer antibiotics (green)**



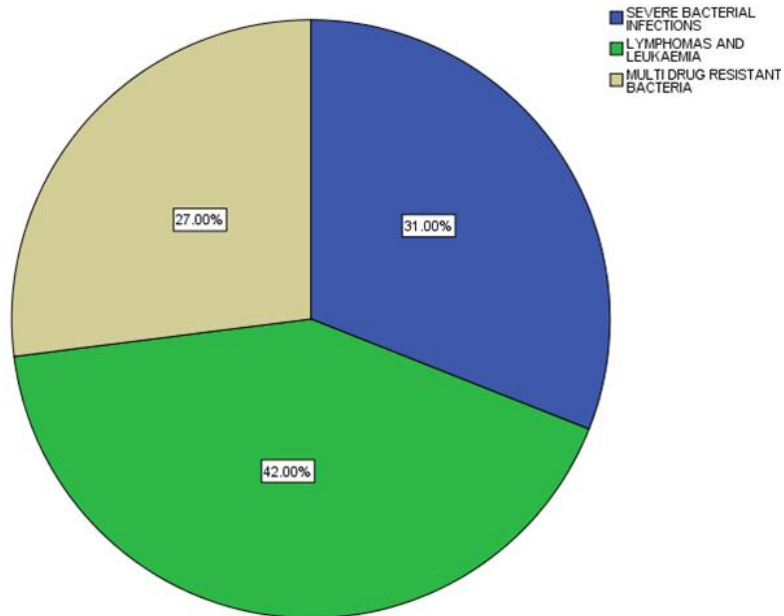
**Fig. 3. Shows the response of participants regarding the administration of anticancer antibiotics. Only 29% of the respondents were aware that anticancer antibiotics can be administered both orally and intravenously**



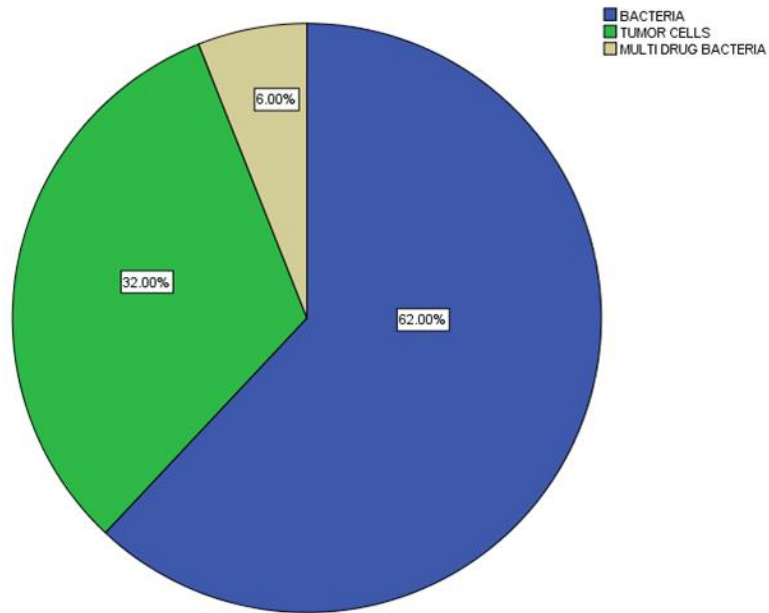
**Fig. 4. Shows the response of the participants regarding the derivation of anticancer antibiotics. Only 29% of the respondents were aware that the drugs were obtained from *Streptomyces* sp**



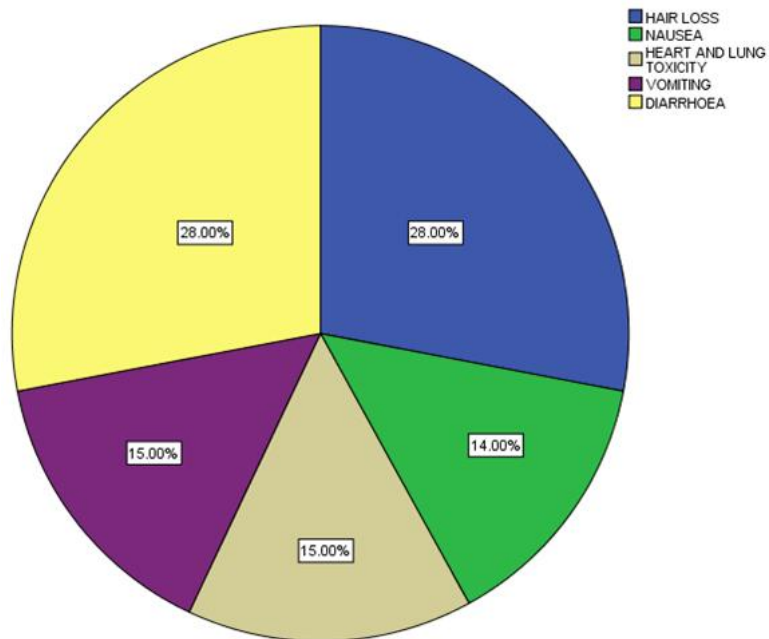
**Fig. 5. Shows the response of the participants regarding the action of anticancer antibiotics. 57% of the participants responded, it acts by interrupting the cell wall**



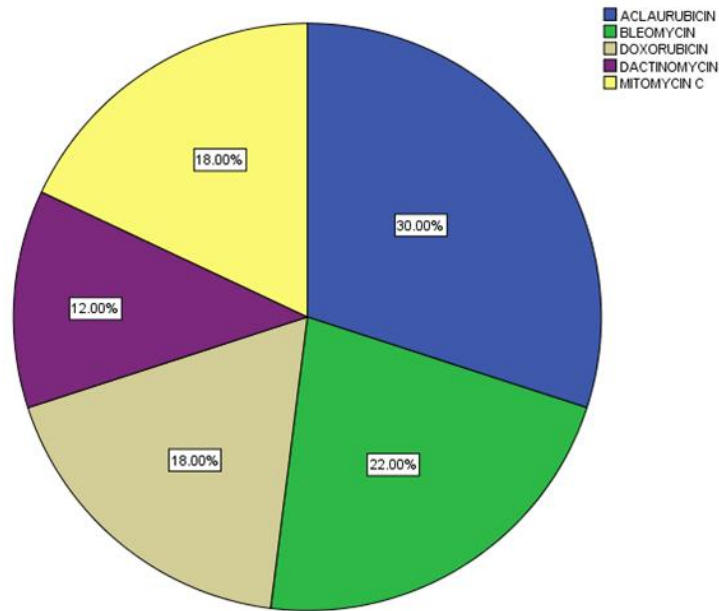
**Fig. 6. Shows the responses of the participants regarding the use of anticancer antibiotics. Only 425 of the patients were aware that it is used for the treatment of lymphomas and leukemias**



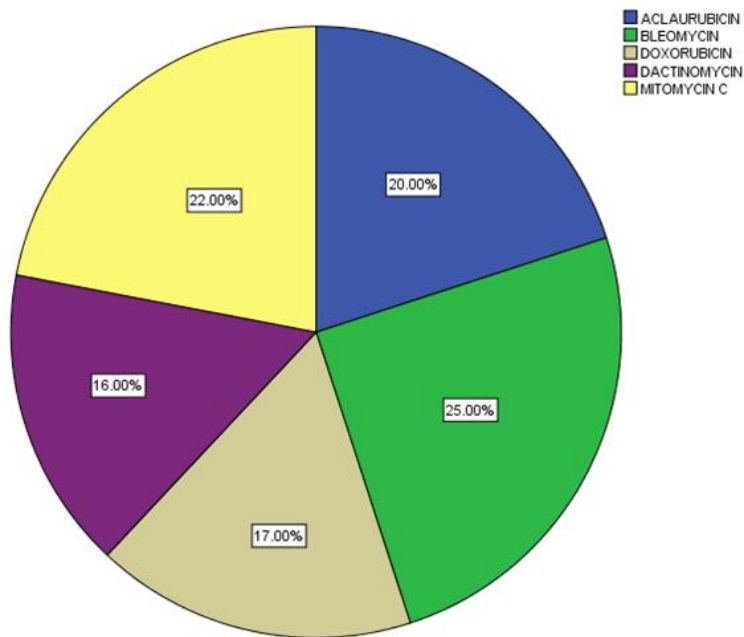
**Fig. 7. Represents the responses of participants regarding the action of anticancer antibiotics. Only 32% if the respondents were aware that anticancer antibiotics act against tumor cells**



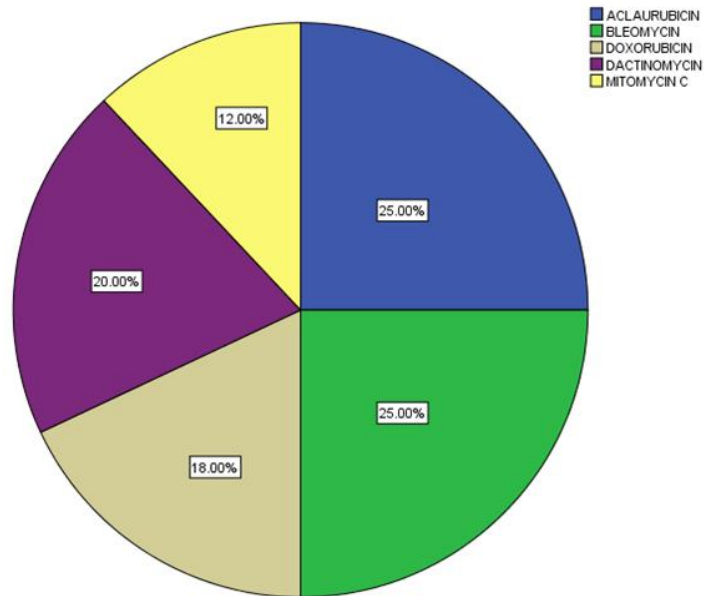
**Fig. 8. Shows the responses of the participants regarding the severe side effects of anticancer antibiotics. Only 15% of the participants were aware that it causes heart and lung toxicity**



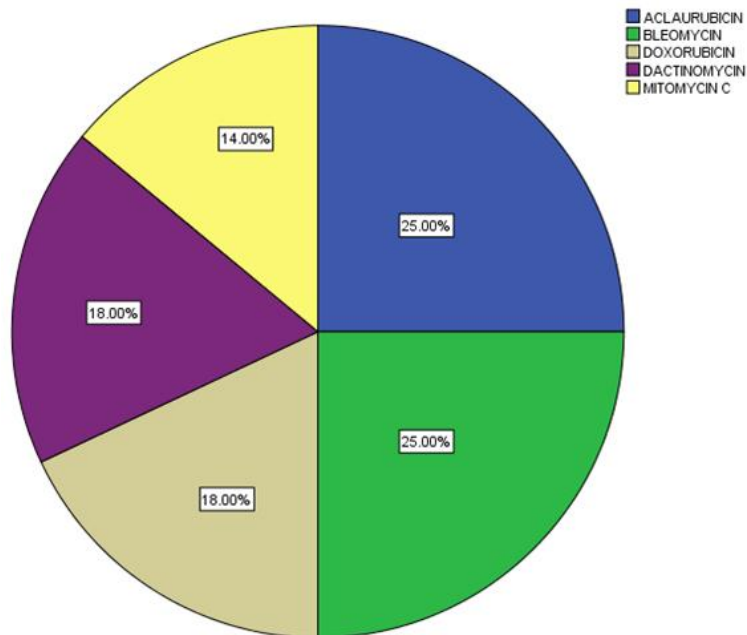
**Fig. 9.** Shows the response of the participants regarding the newer anticancer antibiotics that are less toxic. 30% of the respondent were aware that aclarubicin is less toxic



**Fig. 10.** Shows responses of the participants regarding the anticancer antibiotics which are a mixture of glycopeptide antibiotics with cytotoxic properties that are obtained from *Streptomyces verticillus*. 25% of the respondents were aware that bleomycin is obtained from *Streptomyces verticillus*



**Fig. 11.** Represents the responses of the participants regarding the anticancer antibiotics that are obtained from *Streptomyces caespitosus*. Only 12% of the respondents were aware that mitomycin was obtained from *Streptomyces caespitosus*



**Fig. 12.** Shows the responses of the participants regarding the anticancer antibiotics that are known to improve the treatment efficacy of skin cancers when combined with nisin. Only 18% of the respondents were aware that doxorubicin in combination with nisin improves the treatment efficacy of skin cancers



#### 4. DISCUSSION

Cancer therapy is as debilitating as the disease because of the toxicities associated with the disease [20]. The ultimate purpose of cytotoxic chemotherapeutics is to reduce the gap between the growth and death of cancer cells [21]. There are various factors that affect cancer and its treatment that involve lifestyle, genetics, environmental exposure, different types of infections, and chemicals like tobacco and alcohol. Anticancer antibiotics are a group of drugs used for the treatment of cancer and are obtained from active microorganisms [22]. Only 43% of the participants were aware of these drugs. 31% of the respondents thought these are drugs used in case of severe bacterial infections, while 27% of the respondents thought it was used for the treatment of multidrug-resistant bacterial infections. Since the name antibiotic the respondents thought these are drugs that act on bacteria. Only 42% of the respondents knew these were drugs used for chemotherapy.

The biggest limitation of chemotherapy is the side effects caused by drugs. The dosage at which the drugs should be administered is still a serious question. When drugs are administered at a very low dose they are ineffective, whereas when administered excessively leads to immense toxicity and side effects [23]. In our study, around 15% of the participants were aware that these drugs can cause severe heart and lung toxicity. The primary target of these drugs is DNA, yet different drugs have different modes of action. Some of them act as intercalating agents while some act as DNA damagers. Very few drugs are known to have an effect on the human immune system and target tumor cells [24]. 57% of the respondents were aware of the mechanism of action of anticancer antibiotics.

Anthracyclines are anticancer compounds that were derived from *Streptomyces* in the 1960s [25]. Doxorubicin and Daunorubicin were the first anthracyclines discovered. These were obtained from the bacterium *Streptomyces peucetius*. Daunorubicin, another anthracycline antibiotic that is similar to doxorubicin. They are used in the treatment of leukemia. Doxorubicin which is a hydroxyl derivative of daunorubicin, is another anthracycline antibiotic that acts by the formation of free radical and altering the membrane function. These are used in the treatment of solid cancers like breast cancer, lung cancer, and ovarian cancer [26]. Bleomycin, another class of

antibiotics which include bleomycinic acid, these are a family of glycopeptide derived antibiotics isolated from the *Streptococcus verticillius* species and are essentially used with other agents for treating tumors like squamous cell carcinomas and malignant Lymphomas [27,28]. Only 25% of the respondents were aware that bleomycin is derived from *Streptomyces* sp.

Mitomycin, a class of antibiotics is a broad-spectrum antibiotic and in contrast to others form covalent linkages to DNA and function as bioreductive alkylating agents in the absence of oxygen. They were isolated from the broth culture of *Streptomyces caespitosus* [29]. Only 12% of the participants were aware that mitomycin was obtained from *Streptomyces caespitosus*. Aclarubicin is an anticancer antibiotic that has less cardiotoxicity and inhibits RNA synthesis more than DNA. Only 28.6% of the participants were aware about aclarubicin. Doxorubicin in combination with nisin is known to improve the treatment efficiency of skin cancers. 18% of the respondents were aware of this.

Recent advances in anticancer antibiotics include Chromomycin A3 which is an anthraquinone antibiotic is produced by the fermentation of *Streptomyces griseus* is known to block macromolecule synthesis through a reversible interaction with DNA in the presence of divalent metal ions such as Mg [30]. Mithramycin, also called plicamycin, was a DNA-binding, anti-tumor antibiotic which had been used as a chemotherapeutic agent acts through the inhibition of replication and transcription [31]. Dynemicin, is another anticancer antibiotic, a natural product derived out of microbial fermentation of the indigenous bacteria *Micromonospora chersina* is found to be a potent antitumor antibiotic that cleaves double-stranded DNA [32]. Dexrazoxane, which is a cardioprotective agent for use in conjunction with doxorubicin has shown the ability to prevent the devastating tissue necrosis after anthracyclines use and hence is the first and only proven antidote in anthracycline extravasation [33]. Ascofuranone, an antibiotic produced by the fungus *Ascochyta viciae* has also been reported to have anti-tumor activity [34].

#### 5. CONCLUSION

Antibiotics anticancer drugs clearly form an important part of chemotherapeutics with extensive curative properties. In this study, we

could see that the participants' knowledge about anticancer antibiotics was less than adequate. It is important that they know about the recent advances in the synthesis of new drugs and also their side effects at different dosages. Proper training, Conferences should be conducted to provide them adequate knowledge. Also, their importance in the diagnosis and treatment of cancer should be emphasized to change their attitude.

## CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

## ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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