

Comparison of Cryotherapy and Immunotherapy in Warts Treatment

Yasir Ali¹, Mubashar Shahzad² and Ali Akbar³

^{1,2,3}Department of Computer Science and Engineering, University of Engineering and Technology, Lahore, Pakistan
¹yashh.aquarius@hotmail.com, ²mubashar.shahzad23@gmail.com, ³ali.akbar@kics.edu.pk

Abstract—Warts are the most common skin disease in medical science which appears on human body due to Human Papillomavirus (HPV) infection. There are many treatments to remove them from human body but two treatments are common and effective for the cure the human body from warts (cryotherapy and immunotherapy). Many researchers did their best to treat the warts using several treatments such as, intralesional injection, candida antigen, surgical removal, oral drugs and laser ablation treatments. They divided their data set into two groups named as group A, Group B or Cryotherapy group and Immunotherapy group and give both group two treatments and predict the effectiveness that, which treatment result is better than other. Mostly, results found that, treatment of immunotherapy is effective than cryotherapy. In our study, we divided the record of 180 patients into dataset equally named as Cryotherapy and Immunotherapy and pre-process it but not found any missing values, noise and outliers in our dataset. We apply some algorithms such as, K-Nearest Neighbor, Naïve Bayes and Decision Tree to show that which treatment is more effective from both. Results shows that, treatment of cryotherapy is more effective than immunotherapy after implementation in two algorithms but in one remain the same.

Keywords– Cryotherapy, Algorithms, Treatment, Comparison and Immunotherapy

I. INTRODUCTION

Data Mining and Machine learning algorithms are used to discover knowledge and analysis the large data sets from many fields such as banking, industries, insurance, marketing, health, and medical sciences fields.

In the field of medical sciences, there are many diseases but skin diseases are the most common diseases in humans. Warts are the common skin disease which can cause by human papillomavirus (HPV) infection in skin and mostly found in hands, face, foot and genital. There are several methods available for the treatment of warts such as, surgical removal, immunotherapy, laser ablation, cryotherapy and intralesional injection. As far as we know, no data mining research conducted in the field of warts treatment. There are several methods are available for the treatment of warts but no one shows the 100% results for the treatment of skin warts.

Immunotherapy is a treatment which is used by a patient to fight with warts by using own immune system. Many types of immunotherapy chemical treatments involve intralesional injection, diphenycprone (DCP), oral drugs to the warts. After implementation, an allergic reaction occurs around the applied warts, which can cause the removal of them.

On the other hand, Cryotherapy is the treatment of common warts, which can be found in children and adults. Cryotherapy is basically a freezing treatment of warts and it is not a too painful treatment. After implementation, it can be a reason of darks spots on skin or dark skins.

This research shows the treatment of 180 patients, which divided into two equal groups, one data set, included the 90 patient's record for cryotherapy treatment and second one included the 90's patient records for immunotherapy treatment. This data set included the plantar, common and both types of warts. We applied some data mining algorithms on this data set to check the effectiveness and results that, which one is the best one treatment from both.

II. LITERATURE SURVEY

Nofal and Nofal (2010) divided 135 patient's data into two random groups for the treatment of different size of warts. First group was given intralesional MMR vaccine and second given intralesional saline control group. Treatment was based on single was as it can be small of large surface area of wart. Intralesional injection was given of volume depend of the size of wart and both treatments were based on the size of wart. Period of treatment was for 2 weeks' interval up to 5 treatments. There were several types of response of cure as; complete response was shows if disappearance of wart from located area. Response consider partial if there was 50-99% reduction in the wart and no response consider if there was 0-49% decrease in the size of wart. Results shows the high significance between common warts of control group and MMR vaccine group of ($P < 0.001$). MMR vaccine shows 80% effective response with 84.6% patients have multiple warts. There were no side effects and no appearance of warts again on skin of this treatment. MMR vaccine considered as more effective treatment than saline control group.

Gamil *et al.*, (2010) collected plantar warts of 40 patients with recalcitrant and non-recalcitrant warts of different size

and gives the MMR vaccine treatment method. Data was collected of one-year study and some patient excluded from this study. MMR vaccine injected to the single size of wart as it was small or large size but with a 3 weeks' interval time period for a period of 3 treatments. Response considered as complete when complete disappearance of warts, partial if 50 to 99% reduction in size and no response if 0 to 49% patients have warts on there skin. Study was based on 23 patients. From them, 20 patients have complete clearance of warts, 1 patient show partial response and 2 shows no response of treatment in them. Complete response was found in recalcitrant plantar warts and sites warts than soles with 75% and 83.3% respectively. A significance relationship found between therapeutic response and duration of warts. Study shows, MMR vaccine method is simple, safe and effective treatment method.

Khurshid *et al.*, (2016) did interventional research in Mayo Hospital, Lahore for the period of six months by giving 3 doses of candida antigen or placebo 4 weeks. Patients with facial warts, pregnancy, genital and who have been treated already from last month, excluded from this study. 60 patients above the age of 2 years was divided into two groups equally named as group A and group B. Group A was based on study and given dose of 0.1ml candida antigen and group B for control group given 0.1ml of intralesional and saline intradermal but both groups given maximum of 1ml dose. No of doses was three and given each in one month. Result shows that, almost 67% patients with candida antigen and 20% with control group shows an improvement of method ($P < 0.05$). Treatment of candida antigen is easy, safe, inexpensive and more effective.

Khozeimeh *et al.*, (2017) collected data set of one year of 60 patients from dermatology clinic information consent from them. From the age of 15 years' patients with common and plantar warts included while, some of them excluded like, less than 15 years' people, pregnant, HIV infection, allergic skin order and patients treated already from previous one month. Patients divided into two random computer base equal groups as group A and group B. Group A treated with immunotherapy with intralesional injection with candida antigen or group B treated with liquid nitrogen on ellipse and circle shape warts. Response consider as reduction of the size of the wart. Three responses were considered as positive, negative and partial. Positive response is when; more than 75% removal of the size of warts, partial response is when 25-75% reduction in the size of wart and negative response is when less than 25% reduction in the size of warts. For statistical analysis, T-test and chi-square is used in this study. Result shows, a significant response of immunotherapy to cryotherapy ($P = 0.023$). Patients with 76.7% with immunotherapy and 56.7% with cryotherapy completely cured. There was no significant difference shows between group A and group B. Immunotherapy shows better treatment and therapeutic response than cryotherapy.

Khozeimeh *et al.*, (2017) divided 180 patients with common and plantar warts into two equal groups. Group 1 given treatment of immunotherapy with candida antigen and

group 2 given the cryotherapy treatment with liquid nitrogen. Group 1 completed its treatment in 3 sessions with intralesional injection vaccine and group 2 covered in 10 sessions and have one-week time interval between sessions. Both groups covered their sessions in 0-12 months. Fuzzy logic rule-based system was implemented to check the efficiency of the treatment method. Result shows, accuracy rate of immunotherapy was 83.33% and of cryotherapy was 80.7% after implementation of fuzzy logic rule-based method. Fuzzy logic method has several benefits as it can save time for physicians and can save cost, better treatment results and improve the quality of treatment for patients.

III. DATASET

Basically, there are two types of datasets collected for this study, one for cryotherapy and other for immunotherapy treatment methods. Dataset consist of 180 patients with equal division into two groups. Data collected from several patients with plantar, common and both types of warts.

First dataset demonstrated with cryotherapy treatment method with 90 patients and having seven attributes in it with multiple values in it. Seven attributes are; gender of the patients, age of the patients, in how many months a patient be treated, no of warts on patient's skin, which type of warts are there, area of skin covered by warts and treatment result after implementation of the cryotherapy treatment. Data presents for cryotherapy treatment in Table I.

Table I: Attributes of Cryotherapy

Attribute Name	Value	Mean \pm S.D
Gender	47-Male 43-Female	
Age in years	15-67	28.60 \pm 13.361
Treatment Months	0-12	7.67 \pm 3.407
Number of warts	1-12	5.51 \pm 3.567
Type of warts	1-Common (54) 2-Plantar (9) 3-Both (27)	
Area of warts (mm ²)	4-750	85.83 \pm 131.733
Result of treatment	48-Yes 42-No	

Second dataset demonstrated with immunotherapy treatment method also consist of 90 patients and having eight attributes in it with several values in it. No of attributes consist on; gender of the patients, age of the patients, in how many months a patient be treated, no of warts of patient, which type of warts are there, area of skin covered by warts, induration diameter (mm²) of warts and treatment result after implementation of the immunotherapy treatment. Data presents for immunotherapy treatment in Table II.

Table II: Attributes of Immunotherapy

Attribute Name	Value	Mean \pm S.D
Gender	1-Male (41)	
	2-Female (49)	
Age in years	15-56	31.04 \pm 12.235
Treatment Months	1-12	7.23 \pm 3.098
Number of warts	1-19	6.14 \pm 4.212
	1-Common (47)	
Type of warts	2-Plantar (22)	
	3-Both (21)	
Area of warts (mm ²)	6-900	95.70 \pm 136.615
Induration diameter of warts(mm)	2-70	14.33 \pm 17.218
Result of treatment	71-Yes	
	19-No	

III. MATERIAL AND METHOD

There were 180 patients, which divided randomly into two equal groups containing 90 patients in each. A patient sends to first group when rather a male came to clinic or female. Same procedure followed by the second group until 90 patients covered by this group (Khozeimeh *et al.*, 2017). There are seven attributes in first dataset and eight in second dataset. Each record in the dataset contain several features such as, gender, age, and type of warts, treatment months, no of warts, area, induration diameter and response to treatment which can be seen in above Table I and Table II. Response to treatment, considered as label for data or result of treatment as yes or no and other all features considered as regular attributes. We apply pre-processing on data and there were no missing value and were no outliers in it. Also, we split our dataset into two subgroups, 70% considered as training data and 30% consider as test data. We applied some important algorithms known as Decision Tree, Naive Bayes and K-Nearest Neighbor (KNN) algorithms to check that, which method is more accurate and effective among cryotherapy and immunotherapy treatment methods. We analysis dataset using data mining tool called rapid miner. These methods are described below in detail.

A) Decision Tree

Decision Tree (DT) is supervised learning system in which classification rules are constructed from the given dataset. It is tree like a graph used to elaborate every possible outcome of a decision. It is most powerful classification algorithm used to predict possible outcome of a branch or tree. Classification is done by tree and leave nodes are generated on the basis of results on nodes in it. We apply DT on cryotherapy and immunotherapy methods. Parameters on the dataset when applying DT set as criterion was gain ratio, maximal depth of the tree considered as 20. We also applied pruning as confidence=0.25 and pre-pruning techniques on DT as by setting minimal gain=0.1, minimal leaf size=2, minimal size of split=2 and number of pruning alternates considered as 3 in

both datasets. We split data in DT as 70% training data and 30% as test data and apply model to show outcome and performance to check effectiveness and accuracy of both treatments.

Decision tree shows the overall accuracy for both treatments as 85.19% and show that, both models have the same accuracy after implementation, which can be seen in Table III.

Table III: Accuracy of Decision Tree

Cryotherapy				Immunotherapy			
Accuracy 85.19%				Accuracy 85.19%			
	True No	True Yes	Class precision		True Yes	True No	Class precision
pred. No	13	4	76.47 %	pred. Yes	20	3	86.96%
Pred. Yes	0	10	100.00%	Pred. No	1	3	75.00%
Class recall	100.00%	71.43 %		Class recall	95.24 %	50.00 %	

B) Naive Bayes

Naive Bayes basically based on base theorem which is used to predict the probability theory. It uses the probability theory for the classification of data. In it, there is need of class type feature in it which is also called as label of given dataset. It applies the conditional probabilities such as if a coin is tossed, then who will toss the coin (a girl or a boy). Basically, Bayes probabilities are conditional probabilities and applied on cryotherapy and immunotherapy datasets.

Naive Bayes shows the overall accuracy for cryotherapy and immunotherapy as 74.60% and 68.25% respectively. It shows that, accuracy of cryotherapy is more effective than immunotherapy after implementation of the model. So, in this model, treatment of cryotherapy is better than immunotherapy. Results can be seen in Table VI of Naive Bayes model.

Table IV: Accuracy of Naive Bayes

Cryotherapy				Immunotherapy			
Accuracy 74.60%				Accuracy 68.25%			
	True No	True Yes	Class precision		True Yes	True No	Class precision
pred. No	20	7	74.07 %	pred. Yes	41	11	78.85 %
Pred. Yes	9	27	75.00 %	Pred. No	9	2	18.18 %
Class recall	68.97 %	79.41 %		Class recall	82.00 %	15.38 %	

For Cryotherapy:

- Class Yes (0.519) -> 6 distributions
- Class No (0.481) -> 6 distributions

For Immunotherapy:

- Class Yes (0.778) -> 7 distributions
- Class No (0.222) -> 7 distributions

C) K-Nearest Neighbor (KNN)

K-Nearest Neighbor (KNN) is supervised learning algorithm used for classification of data. K means to select points from given dataset that how much data will be selected of nearest neighbor. This algorithm selects data on the basis of K value to nearest Neighbor and decide that this point is similar to given sample. We apply KNN on both datasets with K value to 3. First, we make label to results of the treatment and split data into 70%, 30% as training and test records respectively, and then we make 10-fold of cross validation by giving sampling as automatic to the split data value and apply KNN on the given data. We set measured type as mixed and mixed measure into Euclidean Distance of K value which was 3.

K-Nearest Neighbor shows that, treatment of cryotherapy is better than immunotherapy as can be seen in Table V and Fig. 6. Overall treatment of cryotherapy is effective than other, after implementation of K-NN model. Overall accuracy for cryotherapy and immunotherapy as 80.71% and 75.00% respectively.

Table V: Accuracy of KNN

Cryotherapy				Immunotherapy			
Accuracy 80.71%				Accuracy 75.00%			
	True No	True Yes	Class precision		True Yes	True No	Class precision
pred. No	22	5	81.48 %	pred. Yes	46	12	79.31 %
Pred. Yes	7	29	80.56 %	Pred. No	4	1	20.00 %
Class recall	75.86 %	85.29 %		Class recall	92.00 %	7.69 %	

IV. RESULTS

Summary of performance and results can be seen in below figures (cryotherapy and immunotherapy) treatment methods. We performed experiments on dataset using three algorithms as Decision Tree, Naïve Bayesian and K-Nearest Neighbor (KNN).

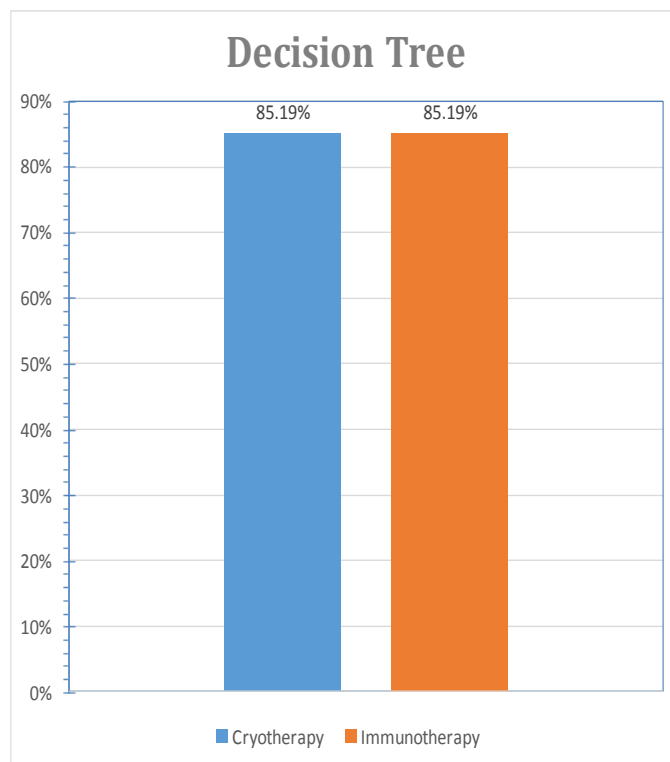


Fig. 1: Decision Tree's Results

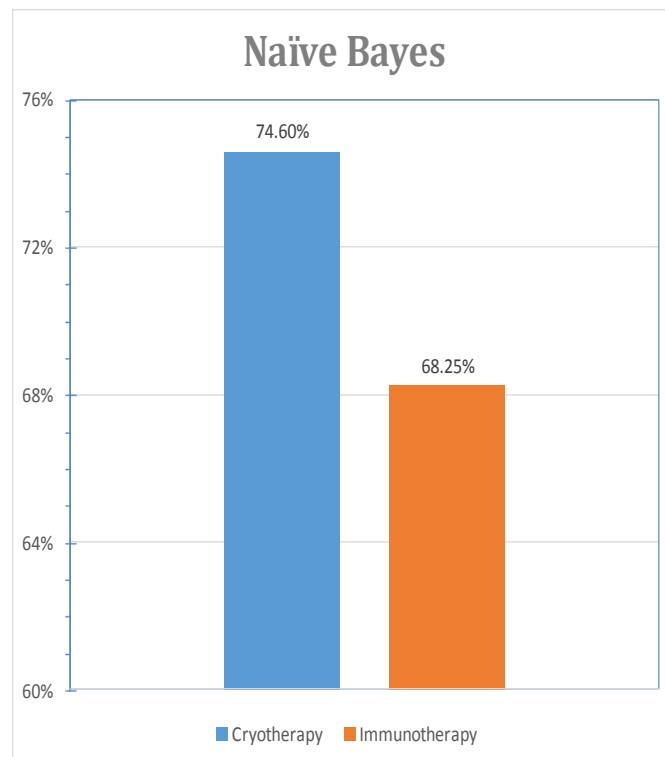


Fig. 2: Naïve Bayes' Results

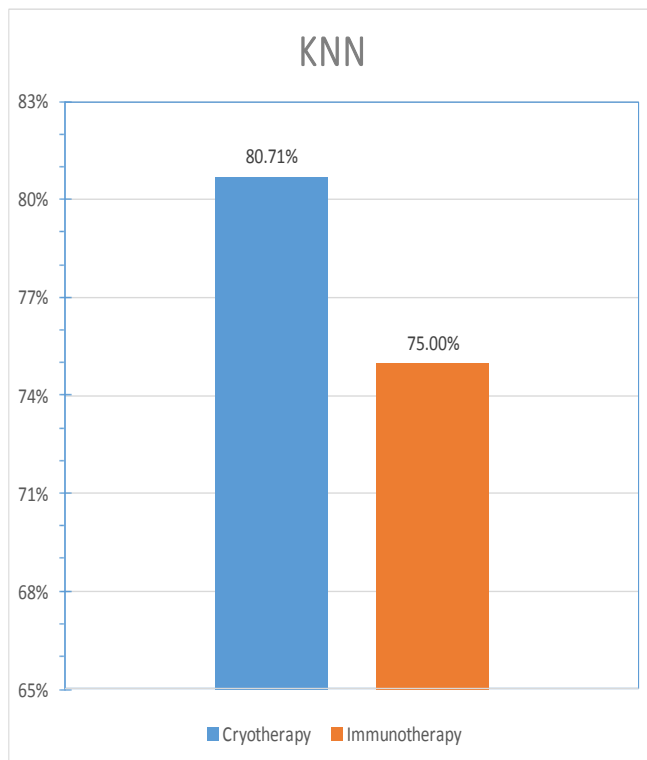


Fig. 3: KNN's Results

All the results show that, overall results of cryotherapy treatment are better than immunotherapy so, treatment of cryotherapy is more effective for physicians and can save time, cost and can improve the quality of patient's treatment is better in cryotherapy that second one.

REFERENCES

- [1]. Gamil, H., Elgharib, I., Nofal, A., & Abd-Elaziz, T. (2010). RETRACTED: Intralesional immunotherapy of plantar warts: Report of a new antigen combination.
- [2]. Khozeimeh, F., Alizadehsani, R., Roshanzamir, M., Khosravi, A., Layegh, P., & Nahavandi, S. (2017). An expert system for selecting wart treatment method. *Computers in biology and medicine*, 81, 167-175.
- [3]. Khozeimeh, F., Jabbari Azad, F., Mahboubi Oskouei, Y., Jafari, M., Tehranian, S., Alizadehsani, R., & Layegh, P. (2017). Intralesional immunotherapy compared to cryotherapy in the treatment of warts. *International journal of dermatology*, 56(4), 474-478.
- [4]. Khurshid, K., Ali, U., & Pal, S. S. (2016). Role of Candida antigen in treatment of viral warts: a placebo-controlled study. *Journal of Pakistan Association of Dermatology*, 19(3), 146-150.
- [5]. Nofal, A., & Nofal, E. (2010). Intralesional immunotherapy of common warts: successful treatment with mumps, measles and rubella vaccine. *Journal of the European Academy of Dermatology and Venereology*, 24(10), 1166-1170.