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RESEARCH TRENDS IN LIFE SCIENCE VOLUME III

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PREFACE

In the vast expanse of the scientific realm, the field of Life Science stands as a beacon of curiosity, continually illuminating the mysteries of existence. As we embark on a journey through the pages of "Research Trends in Life Science," we find ourselves in the midst of a dynamic and ever-evolving landscape, where the boundaries of what we know are constantly pushed, reshaped, and expanded.

This compilation serves as a testament to the relentless pursuit of knowledge within the Life Sciences—a multidisciplinary domain that spans from the microscopic intricacies of cellular processes to the grand tapestry of ecosystems. Our exploration delves into the forefront of scientific inquiry, where researchers, scholars, and visionaries collaborate to unravel the complexities of life itself.

Within these pages, you will encounter a diverse tapestry of research trends, each thread weaving a narrative of discovery and innovation. From cutting-edge advancements in genomics and biotechnology to profound insights into ecological dynamics, this book encapsulates the pulse of contemporary Life Science research.

As we navigate through the chapters, we invite you to witness the convergence of traditional wisdom and modern methodologies, where technology and tradition dance in harmony to reveal the secrets of the living world. The preface sets the stage for a compelling odyssey, inviting readers to engage with the unfolding stories of breakthroughs, challenges, and the relentless pursuit of understanding life in all its forms.

Embark with us on this intellectual expedition, where the boundaries between the known and the unknown blur, and the pursuit of knowledge becomes a shared endeavor that transcends disciplinary confines. "Research Trends in Life Science" beckons you to join the exploration of the frontiers of life, where every discovery is a stepping stone toward a more profound comprehension of the intricate web of existence.

Editors

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STUDY OF BIRDS DIVERSITY AT PIPLOD DAM PANSEMAL, BARWANI (M.P.)

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Abstract:

The current investigation was conducted at Piplod dam Pansemal in Madhya Pradesh. During this study, various bird families were observed. The results of our study show that in 2018-19, we observed the species count was 46 and the total number of orders found here were 11. The checklist of all the species in 2019-20, shows that we have observed at Piplod dam Pansemal, the species count was 47 and the total number of orders found here were 11. Birds function as crucial bio-indicators, facilitating the evaluation of the well-being of ecosystems. They frequently manifest early indications of stress in reaction to shifts in the environment and fulfill vital functions as bio-indicators, pollinators, seed dispersers, and scavengers. Furthermore, they contribute to agricultural processes by assisting in the regulation of populations of detrimental pests, thereby mitigating potential adverse effects on productivity.

Keywords: Birds, Piplod dam Pansemal, Diversity, Family, Order.

Introduction:

The composition of species in a specific area is influenced by factors such as the availability and presence of bio-physical resources, as highlighted by Kumar and Sahu (2020). Urban environments, characterized by abundant and diverse food sources, favor an omnivorous diet (Dickman and Doncaster, 1987). Winter seasons further promote urbanization due to the ready availability of food near human settlements (Pulliainen *et al.*, 1963).

The diversity of bird species in a region is primarily shaped by ecological resources and the biological community of species present there (Pragasan and Madesh, 2018). Peri-urban areas, with fewer human settlements compared to urban areas, exhibit higher species diversity (Canedoli *et al.*, 2018). The rapid conversion of land to urban spaces has adversely impacted habitats and local climates (Seto *et al.*, 2001). Preserving green spaces in urban settings positively influences bird species diversity. Birds use songs as vital communication tools for defending territory and attracting mates, and their ability to navigate dense habitats like forests makes vocal signals advantageous (Catchpole and Slater, 2008).

Efforts should be directed towards protecting aquatic ecosystems, as bird populations play crucial roles as insect pest predators, pollinators, and scavengers (Padmavati, 2010).

Aquatic systems, closely linked to terrestrial environments, serve as rest breaks for land bird travelers, utilizing aquatic invertebrates (David *et al.*, 2011). Numerous global studies have explored avifaunal variation, emphasizing the potential of urban-dwelling birds as environmental bioindicators. This research lays the groundwork for further investigation into these aspects.

Materials and Methods:

Study Area: Piplod Dam, Pansemal of Barwani District of Madhya Pradesh (India) was selected for our study.

Figure 1: Study location: Piplod Dam, Pansemal

Methodology:

Line transect method was adopted.

1. **Classification of birds:** Birds were classified using the world database and nomenclature including their Common names, scientific names, family, order was written with the help of: Gill, F., D. Donsker, and P. Rasmussen (eds). 2020. IOC World Bird List (v10.2).
2. **Figure and table:** These were prepared by using Microsoft Excel 2019.
3. **Study design:** The present study was based on the following analysis –
4. **Checklists of all the species:** This was prepared for both the years 2018-19 & 2019-20. Their order and families were also tabulated.
5. **Percentage occurrence of all the species:** Family wise composition in percentage was calculated and presented from 2018-19 & 2019-20.
6. **Diet composition at each site:** Several bird species recorded have different food preferences. All bird species and their category were tabulated from all four sites from both years 2018-19 & 2019-20.
7. **Categories:** Insectivorous, Omnivorous, Frugivorous, Piscivorous, Carnivorous
8. **Species richness:** The species richness is calculated by simply counting the total number of bird species at that particular study location. The value of species richness can be different according to factors like total area, type of landscape, availability of food, vegetation, etc. Its value is the same as Alpha diversity of an area.
9. **Species abundance:** It is the abundance of bird species at a particular study area. Few bird species are present in the large population but few are present in less numbers.

10. **Frequency of species:** While doing regular studies, frequency of species can be estimated. If a bird species is observed regularly, it will have the highest frequency but if a bird species is observed occasionally, it will have the least frequency.
11. **Diversity indices:** Diversity indices are estimated for evaluating ecological health of that study area, and following indexes were calculated:
12. **Total species count:** In total species count, all bird individuals were counted on each visit. It varies with the type of landscape, food availability, temperature and vegetation.
13. **Simpson's index:** Simpson's index (D) is used to evaluate diversity in a particular community. Whenever the value of D increases, diversity decreases. It can be calculated with the help of following formula: D = Σ (ni * (ni - 1)) / (N * (N - 1)), where: ni — Number of individuals in the i-th species; and N — Total number of individuals in the community.
14. **Simpson's index of diversity:** We know that high value of D represents a community with low biodiversity but we can express Simpson's diversity index as 1 – D. It can be estimated by the following formula 1 - D = 1 - [Σ (ni * (ni - 1)) / (N * (N - 1))] ni — Number of individuals in the i-th species; and N — Total number of individuals in the community. This index is also called "The Gini-Simpson index (or Simpson's index of diversity)" Simpson's index of diversity measures the probability that if two individuals are randomly selected, they belong to different species.
15. **Simpson's Reciprocal index:** Simpson's Reciprocal Index is represented by 1/D. It accounts for richness and evenness both. Whenever the value of D is more the value of 1/D is less. High value of 1/D represents large diversity.
16. **Margalef's index:** Margalef's index focuses on species richness of study area. It shows the increasing number of species with more numbers of organisms in each species sampled, by dividing the total species count by the natural log (of the number of sampled organisms). This index is relatable to species diversity index and number of organisms which were sampled. It is calculated by the following formula: (S - 1) / Log (n); S = Total Number of Species, n = Total Number of Individuals in the Sample.
17. **Shannon's index:** The Shannon Index is a tool to evaluate the diversity of species of a community in an area. Species within a community. This index also gives information about the type of habitat and the index can be calculated by the following formula:

$$\text{Shannon Index (H)} = -\sum_{i=1}^{s} p_i \ln p_i$$

In the Shannon index, p refers to the proportion (n/N) of individuals of one specific species found (n) N is the total number of individuals found. S is the total number of species recorded. The value of Shannon Index is then multiplied by -1 to get a positive value.

18. **Evenness index:** Species evenness refers to the similarity in number of individuals among all species that too mathematically. Generally, it is a measure of biodiversity which shows equality in number in a community. Species evenness considers the number of species and their relative abundance. To calculate Evenness, we have to Divide Shannon's diversity index H by the natural logarithm of species richness ln(S).

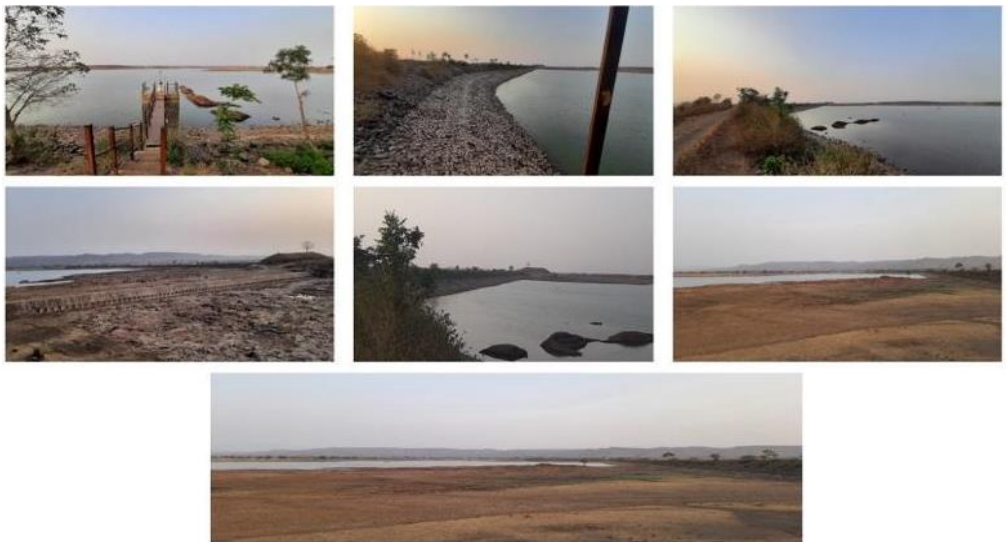

Figure 2: Some photographs of Piplod Dam, Pansemal

Results:

Checklist of all the species (2018-19):

At Piplod Dam, Pansemal we found a total 11 Orders, there were 47 species of the Birds.

Table 1: List of birds recorded in the Piplod Dam, Pansemal study location during 2018-19 Piplod Dam, Pansemal

S. No.	Order	Family	Common Name	Scientific Name
1	Anseriformes	Anatidae	Indian Spot-billed Duck	*Anas poecilorhyncha*
2	Columbiformes	Columbidae	Spotted Dove	*Streptopelia chinensis*
3	Charadriiformes	Laridae	Common Tern	*Sterna hirundo*
4	Pelecaniformes	Ardeidae	Black Bittern	*Ixobrychus flavicollis*
5	Pelecaniformes	Ardeidae	Grey Heron	*Ardea cinerea*
6	Pelecaniformes	Ardeidae	Great Egret	*Ardea alba*
7	Pelecaniformes	Ardeidae	Little Egret	*Egretta garzetta*
8	Pelecaniformes	Ardeidae	Indian Pond Heron	*Ardeola grayii*
9	Accipitriformes	Accipitridae	Black-winged Kite	*Elanus caeruleus*
10	Coraciiformes	Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis*
11	Passeriformes	Dicruridae	Black Drongo	*Dicrurus macrocercus*
12	Passeriformes	Hirundinidae	Dusky Crag Martin	*Ptyonoprogne concolor*
13	Passeriformes	Estrildidae	Red Munia	*Amandava amandava*

14	Passeriformes	Cisticolidae	Ashy Prinia	*Prinia socialis*
15	Passeriformes	Leiothrichidae	Common Babbler	*Argya caudata*
16	Pelecaniformes	Ardeidae	Cattle Egret	*Bubulcus ibis*
17	Pelecaniformes	Ardeidae	Striated Heron	*Butorides striata*
18	Pelecaniformes	Ardeidae	Black-crowned Night Heron	*Nycticorax nycticorax*
19	Coraciiformes	Alcedinidae	Common Kingfisher	*Alcedo atthis*
20	Coraciiformes	Alcedinidae	Pied Kingfisher	*Ceryle rudis*
21	Piciformes	Megalaimidae	Coppersmith Barbet	*Psilopogon haemacephalus*
22	Passeriformes	Dicruridae	Ashy Drongo	*Dicrurus leucophaeus*
23	Coraciiformes	Meropidae	Blue-tailed Bee-eater	*Merops philippinus*
24	Psittaciformes	Psittaculidae	Alexandrine Parakeet	*Psittacula eupatria*
25	Psittaciformes	Psittaculidae	Rose-ringed Parakeet	*Psittacula krameri*
26	Passeriformes	Pittidae	Indian Pitta	*Pitta brachyura*
27	Passeriformes	Monarchidae	Indian Paradise-flycatcher	*Terpsiphone paradisi*
28	Passeriformes	Corvidae	House Crow	*Corvus splendens*
29	Passeriformes	Phylloscopidae	Green Warbler	*Phylloscopus nitidus*
30	Passeriformes	Muscicapidae	Indian Robin	*Copsychus fulicatus*
31	Passeriformes	Muscicapidae	Little Forktail	*Enicurus scouleri*
32	Passeriformes	Muscicapidae	Taiga Flycatcher	*Ficedula albicilla*
33	Passeriformes	Muscicapidae	Pied Bushchat	*Saxicola caprata*
34	Passeriformes	Muscicapidae	Brown Rock Chat	*Oenanthe fusca*
35	Passeriformes	Passeridae	House Sparrow	*Passer domesticus*
36	Passeriformes	Motacillidae	Citrine Wagtail	*Motacilla citreola*
37	Cuculiformes	Cuculidae	Asian Koel	*Eudynamys scolopaceus*
38	Suliformes	Phalacrocoracidae	Great Cormorant	*Phalacrocorax carbo*
39	Accipitriformes	Accipitridae	Shikra	*Accipiter badius*
40	Accipitriformes	Accipitridae	Brahminy Kite	*Haliastur indus*
41	Coraciiformes	Meropidae	Green Bee-eater	*Merops orientalis*
42	Passeriformes	Oriolidae	Indian Golden Oriole	*Oriolus kundoo*
43	Passeriformes	Aegithinidae	Common Iora	*Aegithina tiphia*
44	Passeriformes	Acrocephalidae	Moustached Warbler	*Acrocephalus melanopogon*
45	Passeriformes	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus*
46	Cuculiformes	Cuculidae	Pied Cuckoo	*Clamator jacobinus*

Checklist of all the species (2019-20):

The checklist of all the species for next year (2019-20) are mentioned below At Piplod Dam, Pansemal we found a total of 11 Orders, there were 47 species of the Birds.

Table 2: List of birds recorded in the Piplod Dam, Pansemal study location during 2019-20 Piplod Dam, Pansemal

S. No.	Order	Family	Common Name	Scientific Name
1	Anseriformes	Anatidae	Indian Spot-billed Duck	*Anas poecilorhyncha*
2	Columbiformes	Columbidae	Spotted Dove	*Streptopelia chinensis*
3	Charadriiformes	Laridae	Common Tern	*Sterna hirundo*
4	Pelecaniformes	Ardeidae	Black Bittern	*Ixobrychus flavicollis*
5	Pelecaniformes	Ardeidae	Grey Heron	*Ardea cinerea*
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8	Pelecaniformes	Ardeidae	Indian Pond Heron	*Ardeola grayii*
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10	Coraciiformes	Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis*
11	Passeriformes	Dicruridae	Black Drongo	*Dicrurus macrocercus*
12	Passeriformes	Hirundinidae	Dusky Crag Martin	*Ptyonoprogne concolor*
13	Passeriformes	Estrildidae	Red Munia	*Amandava amandava*
14	Passeriformes	Cisticolidae	Ashy Prinia	*Prinia socialis*
15	Pelecaniformes	Ardeidae	Cattle Egret	*Bubulcus ibis*
16	Anseriformes	Anatidae	Common Teal	*Anas crecca*
17	Passeriformes	Leiothrichidae	Common Babbler	*Argya caudata*
18	Passeriformes	Acrocephalidae	Moustached Warbler	*Acrocephalus melanopogon*
19	Pelecaniformes	Ardeidae	Striated Heron	*Butorides striata*
20	Pelecaniformes	Ardeidae	Black-crowned Night Heron	*Nycticorax nycticorax*
21	Coraciiformes	Alcedinidae	Common Kingfisher	*Alcedo atthis*
22	Coraciiformes	Alcedinidae	Pied Kingfisher	*Ceryle rudis*
23	Piciformes	Megalaimidae	Coppersmith Barbet	*Psilopogon haemacephalus*
24	Passeriformes	Dicruridae	Ashy Drongo	*Dicrurus leucophaeus*
25	Coraciiformes	Meropidae	Blue-tailed Bee-eater	*Merops philippinus*
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40	Suliformes	Phalacrocoracidae	Great Cormorant	*Phalacrocorax carbo*
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42	Accipitriformes	Accipitridae	Brahminy Kite	*Haliastur indus*
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44	Passeriformes	Oriolidae	Indian Golden Oriole	*Oriolus kundoo*
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46	Passeriformes	Nectariniidae	Purple Sunbird	*Cinnyris asiaticus*
47	Cuculiformes	Cuculidae	Pied Cuckoo	*Clamator jacobinus*

Order wise species distribution in 2018-19:

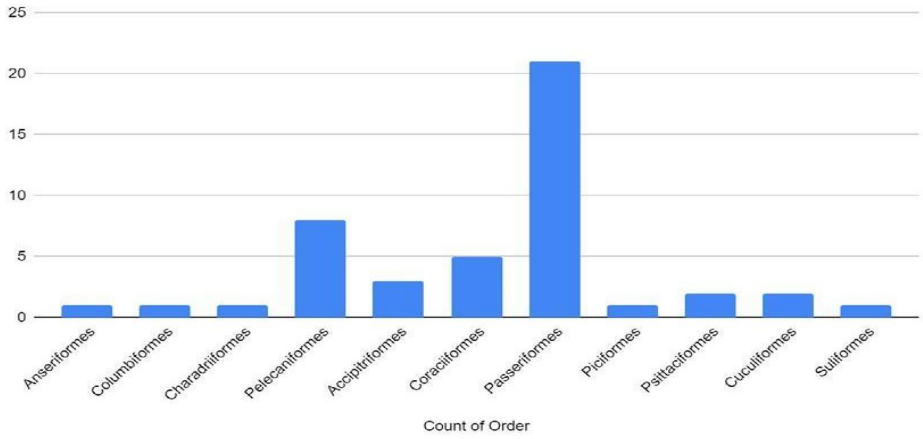

Figure 3: Order wise species distribution at Piplod Dam, Pansemal

At Piplod Dam, Pansemal, order Passeriformes was the most dominant. While 5 orders Anseriformes, Columbiformes, Charadriiformes, Piciformes and Suliformes were the least dominant.

Order wise species distribution in 2019-20

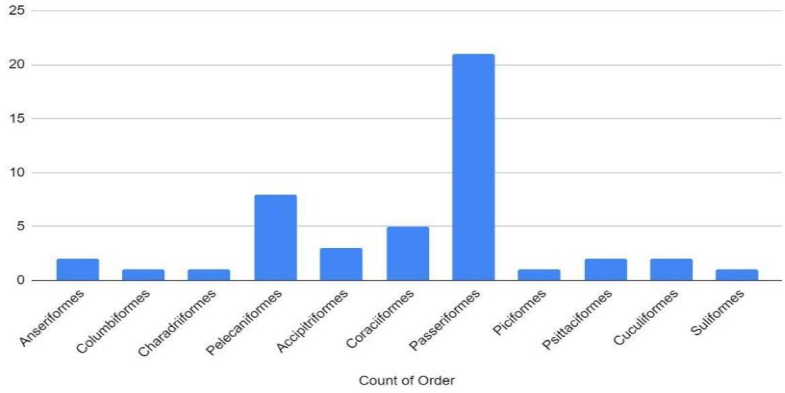

Figure 4: Order wise species distribution at Piplod Dam, Pansemal

Out of the 11 orders at Piplod Dam, Pansemal the most dominant order was again Passeriformes. Columbiformes, Charadriiformes, Piciformes and Suliformes were the orders which had the least species in their category.

Order wise species distribution in 2018-19:

At Piplod Dam, Pansemal, order Passeriformes was the most dominant. While 5 orders Anseriformes, Columbiformes, Charadriiformes, Piciformes and Suliformes were the least dominant.

Order wise species distribution in 2019-20:

Out of the 11 orders at Piplod Dam, Pansemal the most dominant order was again Passeriformes. While Columbiformes, Charadriiformes, Piciformes and Suliformes were the least dominant.

Family-wise family distribution in 2018-19:

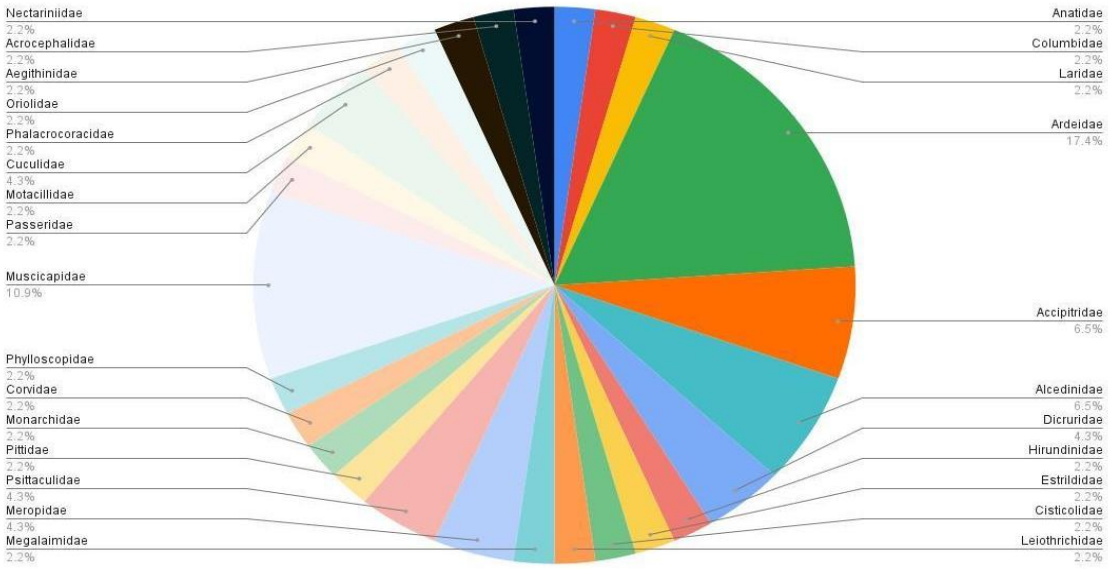

Figure 5: Family wise species distribution at Piplod Dam, Pansemal. 2018-19

At Piplod Dam, Pansemal Family Ardeidae was the most dominant. While Necatariniidae, Acrocephalidae, Aegithinidae, Oriolidae, Phalacrocoracidae, Passeridae, Phylloscopidae, Corvidae, Monarchidae, Pittidae, Megalaimidae, Anatidae, Columbidae, Laridae, Hirundinidae, Estrildidae, Cisticolidae and Leiothrichidae were the least dominant families.

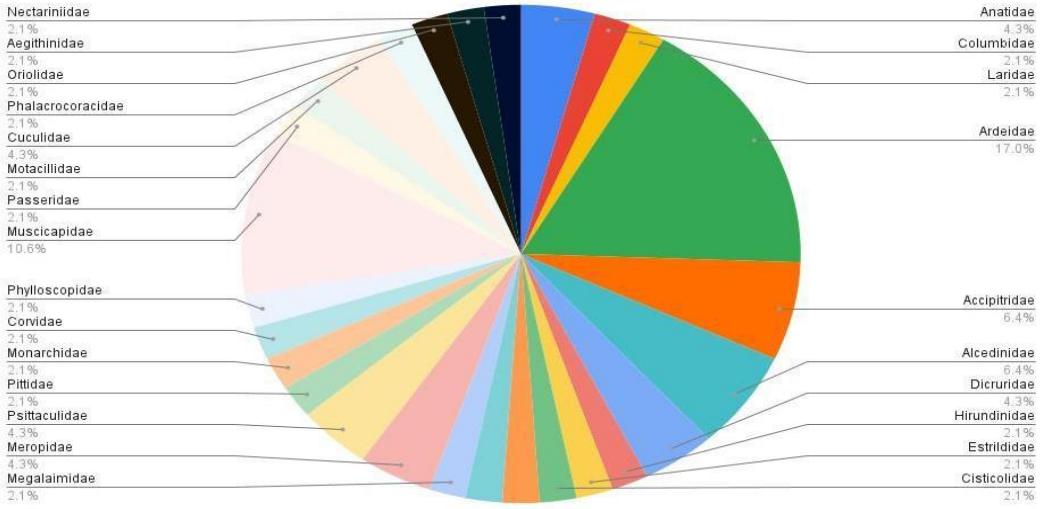

Figure 6: Family wise species distribution at Piplod Dam, Pansemal 2019-20

At Piplod Dam, Pansemal, Ardeidae was the most dominant family. On the other hand, Nectariniidae, Aegithinidae, Oriolidae, Phalacrocoracidae, Motacillidae, Passeridae, Phylloscopidae, Corvidae, Monarchidae, Pittidae, Megalaimidae, Columbidae, Laridae, Hirundinidae, Estrilididae and Cisticolidae were the least dominant families.

Table 3: Tabular representation of Family count and frequency of all the species at Piplod Dam, Pansemal (2018-19)

S.No.	Family Name	Count	Frequency	S.No.	Family Name	Count	Frequency
1	Accipitridae	3	6.5	15	Leiothrichidae	1	2.2
2	Acrocephalidae	1	2.2	16	Megalaimidae	1	2.2
3	Aegithinidae	1	2.2	17	Meropidae	2	4.3
4	Alcedinidae	3	6.5	18	Monarchidae	1	2.2
5	Anatidae	1	2.2	19	Motacillidae	1	2.2
6	Ardeidae	8	17.4	20	Muscicapidae	5	10.9
7	Cisticolidae	1	2.2	21	Nectariniidae	1	2.2
8	Columbidae	1	2.2	22	Oriolidae	1	2.2
9	Corvidae	1	2.2	23	Passeridae	1	2.2
10	Cuculidae	2	4.3	24	Phalacrocoracidae	1	2.2
11	Dicruridae	2	4.3	25	Phylloscopidae	1	2.2
12	Estrildidae	1	2.2	26	Pittidae	1	2.2
13	Hirundinidae	1	2.2	27	Psittaculidae	2	4.3
14	Laridae	1	2.2				

Relative diversity:

2019-20: At Piplod Dam, Pansemal (2019-20) the percent composition was as follows: Accipitridae 6.4%, Acrocephalidae 2.1%, Aegithinidae 2.1%, Alcedinidae 6.4%, Anatidae 4.3%, Ardeidae 17.0%, Cisticolidae 2.1%, Columbidae 2.1%, Corvidae 2.1%, Cuculidae 4.3%, Dicruridae 4.3%, Estrildidae 2.1%, Hirundinidae 2.1%, Laridae 2.1%, Leiothrichidae 2.1%, Megalaimidae 2.1%, Meropidae 4.3%, Monarchidae 2.1%, Motacillidae 2.1%, Muscicapidae 10.6%, Nectariniidae 2.1%, Oriolidae 2.1%, Passeridae 2.1%, Phalacrocoracidae 2.1%, Phylloscopidae 2.1%, Pittidae 2.1% and Psittaculidae 4.3%.

Table 4: Tabular representation of Family count and frequency of all the species at Piplod Dam, Pansemal (2019-20)

S.No.	Family Name	Count	Frequency	S.No.	Family Name	Count	Frequency
1	Accipitridae	3	6.4	15	Leiothrichidae	1	2.1
2	Acrocephalidae	1	2.1	16	Megalaimidae	1	2.1
3	Aegithinidae	1	2.1	17	Meropidae	2	4.3
4	Alcedinidae	3	6.4	18	Monarchidae	1	2.1
5	Anatidae	2	4.3	19	Motacillidae	1	2.1
6	Ardeidae	8	17.0	20	Muscicapidae	5	10.6
7	Cisticolidae	1	2.1	21	Nectariniidae	1	2.1
8	Columbidae	1	2.1	22	Oriolidae	1	2.1
9	Corvidae	1	2.1	23	Passeridae	1	2.1
10	Cuculidae	2	4.3	24	Phalacrocoracidae	1	2.1
11	Dicruridae	2	4.3	25	Phylloscopidae	1	2.1
12	Estrildidae	1	2.1	26	Pittidae	1	2.1
13	Hirundinidae	1	2.1	27	Psittaculidae	2	4.3
14	Laridae	1	2.1				

Checklist of birds based on diet: 2018-19:

2018-19: At Piplod Dam, Pansemal percent according to diet was seen by insectivorous bird species which is 30% of the total diversity. Omnivorous species constituted 28% of the total bird diversity; carnivorous species were 23%, frugivorous species were 16% and Piscivorous species were only 3% of the total bird diversity recorded. The dominant species belonged to insectivorous bird species and the least number was found by fish eating Piscivorous birds which is equal to 3% only. Hence the bird composition showed that these species are equally exploiting the available resources as their food.

2019-20: At Piplod Dam, Pansemal percent according to diet was seen by insectivorous bird species which is 31% of the total diversity. Omnivorous species constituted 29% of the total bird diversity; carnivorous species were 24%, frugivorous species were 12% and Piscivorous species

were only 4% of the total bird diversity recorded. The dominant species belonged to insectivorous bird species and the least number was found by fish eating Piscivorous birds which is equal to 3% only. Hence the bird composition showed that these species are equally exploiting the available resources as their food.

Total Species Number

2018-19:279 & 2019-20:328

Simpson index (D) & Simpson index of diversity:

This is used to measure diversity of a study area. It is used for quantification of diversity. Its value lies between 0 to 1

2018-19 Piplod Dam, Pansemal: 0.0700342

2019-20 Piplod Dam, Pansemal: 0.0559036

Simpson index of diversity

2018-19 Piplod Dam, Pansemal: 0.929965705

2019-20 Piplod Dam, Pansemal: 0.944096368

Simpson reciprocal index

2018-19 Piplod Dam, Pansemal: 14.27871

2019-20 Piplod Dam, Pansemal: 17.887925

Margalef index

This index is used to interpret two types of species richness values which is their evenness and dominance at that particular location.

2018-19 Piplod Dam, Pansemal: 18.809257

2019-20 Piplod Dam, Pansemal: 18.681381

Shannon index(H')

This index is a measure of diversity that combines species richness which is generally their relative abundance in that area.

2018-19 Piplod Dam, Pansemal: 1.3902542

2019-20 Piplod Dam, Pansemal: 1.4670239

Evenness Index

This index shows how species of various birds are numerically distributed among that community.

2018-19 Piplod Dam, Pansemal: 0.8361134

2019-20 Piplod Dam, Pansemal: 0.8773553

Discussion:

The results of our study show that in 2018-19, At Piplod Dam, Pansemal we found a total 11 Orders, there were 47 species of the Birds. Kumar and Sahu (2019) reported 103 species of birds which belonged to 44 families and 15 orders at an agricultural landscape of Panipat Haryana. The checklist of all the species in 2019-20 shows that we have observed At Piplod Dam, Pansemal we found a total of 11 Orders, there were 47 species of the Birds. Satose *et al*.

(2018) reported 208 species of Birds in Amboli Ghat of Sindhudurg district which belonged to 64 different families. Bhonsle and Gaherwal (2018) adopted time species count method to prepare a checklist at a wildlife sanctuary in Indore. We estimated the relative diversity of all the bird species at all the sites. The line transect approach was used to conduct the field surveys. At Piplod Dam, Pansemal (2018-19) the percent composition was as follows: Accipitridae 6.5%, Acrocephalidae 2.2%, Aegithinidae 2.2%, Alcedinidae 6.5%, Anatidae 2.2%, Ardeidae 17.4%, Cisticolidae 2.2%, Columbidae 2.2%, Corvidae 2.2%, Cuculidae 4.3%, Dicruridae 4.3%, Estrildidae 2.2%, Hirundinidae 2.2%, Laridae 2.2%, Leiothrichidae 2.2%, Megalaimidae 2.2%, Meropidae 4.3%, Monarchidae 2.2%, Motacillidae 2.2%, Muscicapidae 10.9%, Nectariniidae 2.2%, Oriolidae 2.2%, Passeridae 2.2%, Phalacrocoracidae 2.2%, Phylloscopidae 2.2%, Pittidae 2.2% and Psittaculidae 4.3%.

At Piplod Dam, Pansemal (2019-20) the percent composition was: Accipitridae 6.4%, Acrocephalidae 2.1%, Aegithinidae 2.1%, Alcedinidae 6.4%, Anatidae 4.3%, Ardeidae 17.0%, Cisticolidae 2.1%, Columbidae 2.1%, Corvidae 2.1%, Cuculidae 4.3%, Dicruridae 4.3%, Estrildidae 2.1%, Hirundinidae 2.1%, Laridae 2.1%, Leiothrichidae 2.1%, Megalaimidae 2.1%, Meropidae 4.3%, Monarchidae 2.1%, Motacillidae 2.1%, Muscicapidae 10.6%, Nectariniidae 2.1%, Oriolidae 2.1%, Passeridae 2.1%, Phalacrocoracidae 2.1%, Phylloscopidae 2.1%, Pittidae 2.1% and Psittaculidae 4.3%. Soni *et al*. (2019) evaluated species diversity at Punjab in a pond and concluded that at site A the diversity was 2.83 followed by at site C with value 2.40 and least was found at site B which was 2.40.

At Piplod Dam, Pansemal, according to diet, was seen by insectivorous bird species which is 31% of the total diversity. Omnivorous species constituted 29% of the total bird diversity; carnivorous species were 24%, frugivorous species were 12% and Piscivorous species were only 4% of the total bird diversity recorded at the study area. The dominant species belonged to insectivorous bird species and the least number was found by fish eating Piscivorous birds which is equal to 3% only. Hence the bird composition showed that these species are equally exploiting the available resources as their food. Few Piscivorous species are Asian Openbill, Grey Heron, Striated Heron and Indian Pond Heron. Few Carnivorous species are Indian Peafowl, Black Bittern, Shikra and Black-winged Stilt.

At Piplod Dam, Pansemal (2018-19), order Passeriformes was the most dominant. While 5 orders Anseriformes, Columbiformes, Charadriiformes, Piciformes and Suliformes were the least dominant. Menon and Mohanraj (2015) studied the effect of temperature on species diversity in Southern cities of India. Order Passeriformes was dominant with 37 Bird species in its frequency. Menon and Mohanraj (2016) studied temporal variation of bird species with respect to variations in temperature. The recorded most dominant species (House crow) and least dominant species.

The species richness of all the four sites were estimated by counting the total no. of species in both the year. In 2018-19, Piplod Dam, Pansemal: 46. Rawal *et al*. (2016) found 22

species of birds which are from 15 families and family Columbidae and Ardeidae was dominant along with 4 other orders. In 2019-20, Piplod Dam, Pansemal: 47. Results of Simpson index shows that in 2018-19, Piplod Dam, Pansemal: 0.0700342. In 2019-20, Piplod Dam, Pansemal: 0.0559036. Adhikari *et al*. (2019) estimated Simpson species dominance index was highest in Block A (0.248) and Block D (0.2431). The species evenness was quite low in Block E of the threatened species which was 0.49. After evaluating the Simpson index of Diversity in 2018-19, the values were Piplod Dam, Pansemal: 0.929965705. Adhikari *et al*. (2019) estimated Simpson species dominance index was highest in Block A (0.248) and Block D (0.2431). In 2019-20, Piplod Dam, Pansemal: 0.944096368.

Results of Simpson reciprocal index showed in 2018-19, Piplod Dam, Pansemal: 14.27871. In 2019-20, Piplod Dam, Pansemal: 17.887925. The reason for such values can be Local species of an area migrate to other regions during the summer season in order to protect themselves from intense sunlight as there is a lack of permanent water source in the area. Also, during the summer season many trees that have dense foliage shed their leaves. Adhikari *et al*. (2019) evaluated Simpson diversity index at Chitwan National Park. Factors like rainfall, humidity and temperature act as a vital role in disrupting and supporting bird populations annually. Therefore, the present study showed that with a slight change in temperature (seasonal) the birds' richness varied. There has been a reduction in population of wetlands birds because of lack of resources and dense presence of predators in the region. Parseen and Llyas (2019) they studied Birds in 2 habitats i.e., In Teak forest/ Miscellaneous forest, Bamboo forest, Grassland and shrubland areas in the whole Pench Tiger Reserve. The result showed that the Dominant order was Passeriformes with a composition of 51.58% and the highest number of species count was observed in Falconiformes (9.50%). Parseen and Llyas (2019) conducted a survey of Pench Tiger Reserve, M.P. and discovered 221 birds' species. These species belonged to 26 orders and 61 different families.

Margalef index: This index is used to interpret two types of species richness values which is their evenness and dominance at that particular location. 2018-19, Piplod Dam, Pansemal: 18.809257. Menon and Mohanraj (2015) estimated species evenness at Southern city of India, their value was 0.65 ± 0.18. In 2019-20, Piplod Dam, Pansemal: 18.681381. Shannon index (H') This index is a measure of diversity that combines species richness which is generally their relative abundance in that area. In 2018-19 Piplod Dam, Pansemal: 1.3902542. In 2019-20 Piplod Dam, Pansemal: 1.4670239.

Evenness index: This index shows how species of various birds are numerically distributed among that community. In 2018-19 Piplod Dam, Pansemal: 0.8361134. In 2019-20 Piplod Dam, Pansemal: 0.8773553. Lodhi *et al*. (2017) adopted line transect and point count method to collect data on diversity of birds at a wetland site in Tighra Reservoir Gwalior. Harsh climate conditions urge these birds to move to other areas. With the onset of winter season there is rapid growth in the shrubs and grasses besides the wetland area, it provides a hiding place for wetland birds and

wader (shore birds). This change in the wetland habitat supports a high number of aquatic birds during winters and it also attracts a large number of migratory birds to thrive in this area. Lodhi *et al*. (2017) studied the status of wetland birds at Tighra Reservoir Gwalior district Madhya Pradesh. They reported 56 wetland birds which belonged to 17 different families and 8 orders.

Conclusion:

Bird species checklist: Several species were recorded in these two years at all of our study sites. Total number of species in 2018-19 data shows that at Piplod Dam, Pansemal we found a total 47 species of 11 Orders. In 2019-20 data showed that at Piplod Dam, Pansemal we found a total of 11 Orders, there were 47 species of the Birds. Order wise species composition at all the sites: In the year 2018-19, At Piplod Dam, Pansemal, order Passeriformes was the most dominant. While 5 orders Anseriformes, Columbiformes, Charadriiformes, Piciformes and Suliformes were the least dominant. Order wise species distribution in 2019-20: Out of the 11 orders at Piplod Dam, Pansemal the most dominant order was again Passeriformes. While Columbiformes, Charadriiformes, Piciformes and Suliformes were the least dominant.

Relative diversity: Relative diversity at all the sites concludes that, 2018-19, At Piplod Dam, Pansemal (2018-19) the percent composition was highest in the family Ardeidae 17.4%. In 2019-20: At Piplod Dam, Pansemal (2019-20) the percent composition showed that Ardeidae 17.0% was dominant at our study site. Checklist of birds based on diet: In 2018-19: At Piplod Dam, Pansemal the dominant species belonged to insectivorous bird species and the least number was found by fish eating Piscivorous birds which is equal to 3% only. Hence the bird composition showed that these species are equally exploiting the available resources as their food.

2019-20: Piplod Dam, Pansemal percent according to diet was seen by insectivorous bird species which is 31% of the total diversity and Piscivorous species were only 4% of the total bird diversity recorded. The dominant species belonged to insectivorous bird species and the least number was found by fish eating Piscivorous birds which is equal to 3% only. Few names are also given here Few Insectivorous species are: Rock Pigeon. Citrine Wagtail, Ashy Prinia, Black Drongo. Few Frugivorous species are: Rose-ringed Parakeet, Alexandrine Parakeet, Plum-headed Parakeet, Rufous Treepie. Few Omnivorous species are: Green Warbler, Common Babbler, Asian Pied Starling, and Common Myna. Few Piscivorous species are: Asian Openbill, Grey Heron, Striated Heron, and Indian Pond Heron. Few Carnivorous species are: Indian Peafowl, Black Bittern, Shikra, and Black-winged Stilt. Species Richness: The species richness of site in 2018-19: Piplod Dam, Pansemal: 46. In 2019-20, Piplod Dam, Pansemal: 47.

Simpson index (D): In 2018-19, Piplod Dam, Pansemal: 0.0700342, in 2019-20 and Piplod Dam, Pansemal: 0.0559036. Simpson index of diversity: In 2018-19; Piplod Dam, Pansemal: 0.929965705, in 2019-2, Piplod Dam, Pansemal: 0.944096368. Simpson reciprocal index: In 2018-19, Piplod Dam, Pansemal: 14.27871, in 2019-20, Piplod Dam, Pansemal: 17.887925.

Margalef index: This index is used to interpret two types of species richness values which is their evenness and dominance at that particular location. In 2018-19, Piplod Dam, Pansemal:

18.809257. In 2019-20, Piplod Dam, Pansemal: 18.681381. Shannon index (H'): This index is a measure of diversity that combines species richness which is generally their relative abundance in that area. In 2018-19, Piplod Dam, Pansemal: 1.3902542. In 2019-20, Piplod Dam, Pansemal: 1.4670239.

Evenness index: This index shows how species of various birds are numerically distributed among that community. In 2018-19, Piplod Dam, Pansemal: 0.8361134. In 2019-20, Piplod Dam, Pansemal: 0.877355. Birds are one of the most prominent species on the earth. They are the bio-indicators which can be used to assess the health of any ecosystem. If there is any harmful change in the environment birds are the first to get affected and to show any signs of stress in the environment change. They play an important role in any ecosystem as they are potential bio-indicators, pollinators, seed-dispersers and scavengers and are also beneficial to humans in agriculture by checking the population of harmful pests which adversely affect productivity. Water pollution is a critical point in India. Almost all water bodies are facing the problem of pollution in India. Water bodies are qualitatively and quantitatively affected by industrialization, urbanization and anthropogenic activities. The aquatic diversity is affected by many physicochemical parameters. These physicochemical factors influenced the ecosystem of the river.

While adopting the point count method several avian species were seen preying on several insects. Such instances were listed and we also concluded about the insectivorous nature of several avian species based on sightings. Insect population and the avian population have a slight relation in each other's sustentation. The above data shows a close relationship between the insects' diversity and the insectivorous bird population.

The present study highlights the importance of water bodies in cities. These areas are species-rich and require regular monitoring and development to increase its existing biodiversity.

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A SHORT REVIEW ON BENEVOLENT ROLE OF BACTERIA IN HUMAN BODY

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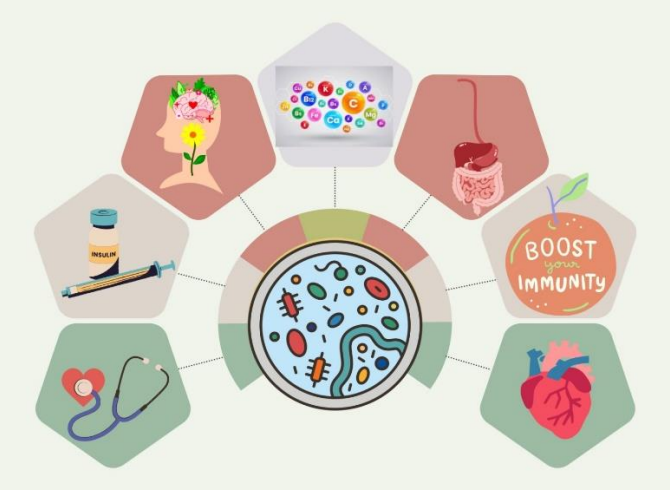
Abstract:

Microorganisms are not only ubiquitous on Earth but also abundant in animals and humans. It's important to note that the majority of bacteria are beneficial and do not cause diseases; in fact, they play crucial roles in various ecosystems, as well as in the well-being of animals and humans. Recent scientific research has significantly expanded our understanding of the gut microbiome and its connection to maintaining health and its influence on a range of human health issues, spanning from metabolic conditions to mental well-being. This growing body of evidence offers significant opportunities for innovation in the food and pharmaceutical industries to develop therapeutic solutions for the health challenges of contemporary society. Potential strategies may involve the use of probiotics and prebiotics as complementary nutritional therapies. Probiotics are generally acknowledged for their ability to help control harmful intestinal microorganisms, enhance digestion and nutrient absorption, and support immune function. They are known to promote a balanced microbial environment in the gut and aid in restoring the normal microbial community after disturbances like antibiotic therapy. Both dysbiosis and a decrease in the diversity of gut flora have been associated with insulin resistance, weight gain, inflammation, obesity, inflammatory bowel disease, and colorectal cancer.

Keywords: Microorganisms, human health, Diabetes, heart health, Immune system, gastrointestinal tract



Introduction:

The concept that specific types of bacteria can enhance our well-being dates back to the early 20th century, when Russian biologist Elie Metchnikoff, a Nobel laureate, initially suggested that consuming bacteria resembling those residing in the human body could confer health advantages. More recently, companies have begun promoting products known as probiotics (meaning "for life"), which contain these beneficial bacteria.

The human micro biota consists of bacteria and other microorganisms, including fungi and viruses, that are present in the body. While the largest concentration is situated in the gastrointestinal tract, various surfaces that come into contact with the external environment, such as the skin, upper respiratory tract, and genital tract, are also inhabited by bacteria. These microorganisms coexist harmoniously with the human host and play numerous essential roles. Bacteria have earned a negative reputation, and rightfully so. They are responsible for a range of severe illnesses, such as pneumonia (caused by Streptococcus pneumoniae), meningitis (linked to Haemophilus influenzae), strep throat (caused by Group A Streptococcus), food poisoning (attributed to Escherichia coli and Salmonella), and various other infections. Bacteria are microscopic, single-celled organisms that cannot be seen with the naked eye [1-3]

Many types of bacteria are present both inside and outside of living organisms, including humans. They can also be found on various surfaces and in substances like water, soil, and food, playing significant roles in Earth's ecosystems. Bacteria are classified based on their shape and can exist as single cells or in clusters. For example, staphylococcus aureus bacteria are spherical and tend to group together, while Clostridium bacteria are elongated and typically found alone. Throughout our evolutionary history, we have coevolved with microorganisms that reside both inside and on our bodies. Each person possesses a unique collection of these microorganisms, known as micro biota. The most extensively studied and abundant microbiota is located in the gut, with bacterial populations reaching 10*11–10*12 cells per gram in the lower human colon. It has been suggested that the number of bacteria in the human gut could surpass the count of somatic cells in the body by an order of magnitude, and the collective biomass of the gut micro biota might weigh as much as 1.5 kilograms. Consequently, one could regard the gut micro biota as a multicellular organ of comparable size to the liver, and it's sometimes referred to as our "forgotten organ."

Additionally, the combined genetic material of the gut microbiota, referred to as the microbiome, contains approximately 150 times more genes than the human genome. These genes complement the human genome and play a significant role in human physiology and metabolism. It's estimated that there are over 1,000 bacterial species inhabiting a healthy human bowel, with at least 160 species commonly shared among individuals. Trillions of microorganisms exist primarily inside your digestive tract and on your skin. The majority of these microbes in your

intestines reside in a specific region of your large intestine known as the cecum, collectively referred to as the gut microbiome.

While a variety of microorganisms coexist within you, bacteria have been the most extensively studied. Additionally, the human gut microbiome can comprise up to 1,000 different species of bacteria, each playing a unique role in your body. The majority of these bacteria are critically important for your health, although some may be associated with disease. Collectively, these microbes may weigh as much as 2 to 5 pounds (1 to 2 kilograms), roughly equivalent to the weight of your brain. They function as an additional organ in your body and have a substantial impact on your overall health. Despite their small size, bacteria exhibit remarkable complexity and resilience. They can thrive in harsh conditions due to a sturdy protective outer layer that boosts their resistance to white blood cells in the body. Some bacteria possess a tail-like structure called a flagellum, which enables them to move, while others have hair-like appendages that are adhesive and help them stick to each other or to solid surfaces. Both an imbalance in gut microbiota (dysbiosis) and a decrease in the diversity of gut flora have been associated with conditions such as insulin resistance, weight gain, inflammation, obesity, inflammatory bowel disease, and colorectal cancer.

The gut micro biota has the ability to generate anti-inflammatory substances, pain-relieving compounds, antioxidants, and vitamins, which serve to shield and support the body. Moreover, they can thwart the attachment and activities of harmful bacteria that produce toxins leading to chronic diseases. Their intimate and targeted interaction with human cells, involving the exchange of nutrients and metabolic by products, essentially classifies symbiotic bacteria as a vital component of the human body, akin to an organ [1-6].

Effect of micro-biota on different system

1. Effect on CVS

The gut microbiome can have a significant impact on heart health. A recent study involving 1,500 people revealed that the gut microbiome plays a crucial role in promoting beneficial "good" HDL cholesterol and triglycerides. On the flip side, specific harmful species in the gut microbiome may contribute to heart disease by producing a substance called trimethylamine N-oxide (TMAO). TMAO is a chemical that is associated with the development of blocked arteries, which can increase the risk of heart attacks or strokes. Certain bacteria in the microbiome can convert nutrients like choline and L-carnitine, commonly found in red meat and other animal-based foods, into TMAO, potentially elevating risk factors for heart disease. However, some bacteria within the gut microbiome, particularly Lactobacilli, may help reduce cholesterol levels when used as a probiotic [7-10].

2. Effect on blood sugar level

The gut microbiome may also play a role in regulating blood sugar levels, which can impact the risk of both type 1 and type 2 diabetes. In a recent study involving 33 infants who had a genetically high risk of developing type 1 diabetes, it was observed that the diversity of their microbiome decreased abruptly before the onset of type 1 diabetes. Additionally, levels of several unhealthy bacterial species increased just before the development of type 1 diabetes. Furthermore, another study indicated that even when individuals consumed the exact same foods, their blood sugar levels could vary significantly. This variation may be attributed to the types of bacteria residing in their gut [11-13].

3. Effect on CNS

The gut microbiome can have a positive impact on brain health through several mechanisms. Firstly, certain bacterial species are capable of producing neurotransmitters in the brain. For instance, serotonin, a neurotransmitter associated with mood regulation and often considered an antidepressant neurotransmitter, is predominantly synthesized in the gut. Secondly, the gut is directly linked to the brain through a vast network of nerves. Consequently, the gut microbiome may influence brain health by helping regulate the transmission of messages sent to the brain via these nerves.

Numerous studies have shown that individuals with various psychological disorders exhibit differences in the species of bacteria present in their gut compared to healthy individuals, suggesting a potential connection between the gut microbiome and brain health. However, it remains uncertain whether these differences are solely a result of distinct dietary and lifestyle habits. Furthermore, a limited number of studies have indicated that specific probiotics can ameliorate symptoms of depression and other mental health disorders, suggesting a potential role for micro biota-based interventions in improving mental well-being [14-16].

4. Effect on nutrition

The gut micro biota plays a vital role in enhancing the nutritional status of the host by contributing to the synthesis of specific vitamins and bioactive compounds. One such example is the production of short-chain fatty acids (SCFA), including acetate, propionate and butyrate. These SCFAs are then made available to the host, thereby promoting better nutritional health. The symbiotic relationship between the micro biota and the host is highlighted when observing germ-free mice. These mice need continuous supplementation with vitamins like K and certain B vitamins, such as folate, B12, and biotin, as these vitamins are products derived from microorganisms and are absent in the gut of germ-free animals. Several intestinal genera, including Bacteroides, Eubacterium, Propionibacterium, and Fusobacterium, are responsible for synthesizing these essential vitamins.

Moreover, the gut microbiome produces various small molecules that facilitate interactions between the microbiota and the host, contributing to the stability and dynamics of microbial communities. These molecules include bacteriocins, oligosaccharides, glycolipids, and terpenoids. In addition, certain probiotics, like Lactobacillus bulgaricus or acidophilus found in yogurt, can alleviate lactose intolerance by producing the enzyme lactase during gastric passage. However, the primary metabolic function of the colonic microflora is the fermentation of indigestible carbohydrates, which serve as crucial energy sources in the colon. These carbohydrates encompass large polysaccharides like resistant starches, pectins, and cellulose, as well as some oligosaccharides that resist digestion, along with unabsorbed sugars and alcohols. The primary result of this fermentation process is the generation of SCFAs, which play a key role in the overall well-being of the host [17-19]

5. Effect on gastrointestinal system

The indigenous intestinal microbiota serves as a line of resistance to colonization by exogenous microbes such as *Clostridium difficile* and *Helicobacter pylori*, and thus assists in competitive exclusion of pathogens preventing the potential invasion, termed colonisation resistance. Indeed, antibiotic-associated diarrhoea occurs when antibiotic treatment disturbs the natural balance of the gut microbiota causing harmful bacteria (i.e., *Clostridium difficile*) to proliferate and multiply. Probiotics may reduce antibiotic-associated diarrhoea by up to 60%, when compared with a placebo. Controlled trials have shown that *Lactobacillus* GG can shorten the course of infectious diarrhoea in infants and children. This effect may due to the ability of probiotics to restore the natural balance of bacteria in the gastrointestinal tract [20-22].

6. Effect on immunity system

Commensal bacteria have the ability to interact with the host's immune system in ways that can influence the host's immune response and counteract the development of diseases. These complex interactions are made possible by the presence of the mucosa-associated immune system, which is typically organized into lymphoid aggregates, known as Peyer's patches. This cross-talk interaction enhances the cellular immune response, marked by the activation of macrophages, antigen-specific cytotoxic T-lymphocytes, and the release of various cytokines. Certain probiotic strains, such as Lactobacillus salivarius and Bifidobacterium breve, are known to play crucial immunomodulatory roles that support a healthy immune system. Moreover, some probiotics, like Lactobacillus plantarum, Bifidobacterium infantis, or Lactobacillus rhamnosus, may be effective in preventing and/or alleviating allergies and autoimmune diseases, such as irritable bowel syndrome and inflammatory bowel diseases like Crohn's disease and ulcerative colitis. Although the exact causes of these diseases are not fully understood, a prevalent hypothesis is that they result from an exaggerated immune response to endogenous bacteria, particularly in genetically predisposed individuals [23-25].

Ways to enhance gut microbiome [26, 27]

1. Diverse diet: Consume a wide variety of foods to promote a diverse microbiome. Foods rich in fiber, such as legumes, beans, and fruits, can foster the growth of healthy Bifidobacteria.

2. Fermented foods: Include fermented foods like yogurt, sauerkraut, and kefir in your diet. These foods contain beneficial bacteria, mainly Lactobacilli, which can reduce the presence of disease-causing species in the gut.

3. Limit artificial sweeteners: Evidence suggests that artificial sweeteners like aspartame may promote unhealthy bacterial growth, such as Enterobacteriaceae, and increase blood sugar.

4. Prebiotic foods: Incorporate prebiotic-rich foods, such as artichokes, bananas, asparagus, oats, and apples. Prebiotics are a type of fibre that stimulates the growth of beneficial bacteria.

5. Breastfeeding: If possible, breastfeed for at least six months, as it plays a crucial role in developing a healthy gut microbiome in infants. Breastfed children tend to have more beneficial Bifidobacteria.

6. Whole grains: Consume whole grains that are high in fibre and beneficial carbohydrates like beta-glucan, which can support weight management and reduce the risk of diseases such as cancer and diabetes.

7. Plant-based diet: Consider a plant-based diet, as vegetarian diets may help lower levels of disease-causing bacteria like E. coli, reduce inflammation, and lower cholesterol.

8. Polyphenol-rich foods: Include foods rich in polyphenols, such as red wine, green tea, dark chocolate, olive oil, and whole grains. These compounds can be broken down by the microbiome to promote the growth of healthy bacteria.

9. Probiotic supplements: Consider taking probiotic supplements, which contain live bacteria that can help restore a healthy gut microbiome, particularly after experiencing dysbiosis.

10. Antibiotics: Use antibiotics only when medically necessary, as they can disrupt the balance of both harmful and beneficial bacteria in the gut, potentially leading to weight gain and antibiotic resistance.

Conclusion:

This review presents the current knowledge regarding the role of gut bacteria in human well-being and ailments. Gut bacteria have been implicated in various conditions, including cardiac diseases, obesity, diabetes, gastro intestinal protection and depression. Imbalances in gut bacteria can lead to the development of several diseases, with their primary function being immune regulation in the progression of these ailments. Disruption of the gut microbiota due to dietary factors can affect susceptibility to diseases such as IBD, diabetes, and obesity. In recent times, prebiotics and probiotics have gained significant use in treating certain conditions and have demonstrated considerable effectiveness. To gain a better understanding of the precise mechanisms underlying gut bacteria-related diseases and the role of gut bacteria in these

conditions, further research is necessary. Furthermore, it is crucial to emphasize the importance of gut microbiomics for a deeper understanding of the relationship between gut microbiota and human health, offering insights into personalized gut micro biota management and bacteriotherapy.

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BIODEGRADABLE SUSTAINABLE PACKAGING: AN ECO-FRIENDLY REVOLUTION

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Abstract:

Packaging plays a crucial role in modern society, preserving and presenting a wide range of products. However, the environmental impact of conventional packaging materials, especially single-use plastics, has raised sustainability concerns. Biodegradable sustainable packaging materials have emerged as a promising solution to reduce waste and minimize our carbon footprint. These materials are designed to break down naturally, originating from renewable resources like plant-based polymers. They address environmental responsibility in both production and disposal stages, offering a holistic approach to packaging. This innovative approach reduces plastic waste and lessens the reliance on fossil fuels.

Keywords: Biodegradable material, Biocompatible, Edible packaging, Chitosan

Introduction:

Packaging plays an indispensable role in our modern world, serving to protect, preserve, and present a wide range of products, from food and consumer goods to industrial and medical items. However, the environmental impact of conventional packaging materials, particularly single-use plastics, has raised serious concerns about sustainability and the long-term health of our planet. In response to these challenges, biodegradable sustainable packaging materials have emerged as a promising solution that aligns with our growing commitment to reducing waste and minimizing our carbon footprint. Biodegradable sustainable packaging materials represent a significant innovation in the field of packaging [1]. They offer a holistic approach to the packaging lifecycle, addressing both the production and disposal stages with a keen focus on environmental responsibility. These materials are designed to break down naturally, returning to the earth as harmless organic matter, and they often originate from renewable resources like plant-based polymers, making them a far eco-friendlier alternative to traditional plastics. This

innovative approach not only reduces the accumulation of plastic waste in landfills and oceans but also lessens the reliance on fossil fuels for production [2,3].

Biodegradable sustainable packaging material is a type of packaging that is designed to break down naturally over time without harming the environment. This is a great alternative to traditional plastic packaging, which can take hundreds or even thousands of years to decompose. There are many different types of biodegradable sustainable packaging materials such as plant-based starch, seaweed, mushrooms, recycled paper and carboard, biodegradable, compostable, refillable, reusable packaging. Plant-based starch are material that is made from renewable resources like corn, wheat, and potatoes. It can be used to make a variety of packaging products, including bags, films, and trays [4]. Seaweed is a fast-growing marine plant that is a valuable source of renewable resources. It can be used to make packaging that is strong, flexible, and water-resistant. Mushrooms are a type of fungus that can be used to make a variety of packaging products. They are a good source of chitin, a biopolymer that is similar to plastic. Recycled paper and cardboard are made from post-consumer waste, which reduces the need to harvest new trees. Biodegradable packaging is made from materials that will break down naturally over time. This includes materials like plant-based starch, seaweed, and mushrooms. Compostable packaging is a type of biodegradable packaging that can be broken down into nutrient-rich compost. This is a great option for food packaging, as it can be composted along with food scraps. Reusable packaging can be used multiple times before being thrown away. This includes items like reusable shopping bags, water bottles, and food containers. Refillable packaging is designed to be refilled with new products instead of being thrown away. This is a great option for items that are used regularly, such as cleaning supplies and personal care products [5].

Types of packaging materials:

Chitin and chitosan

Chitin and chitosan are versatile and promising biodegradable sustainable packaging materials derived from natural sources, primarily from the exoskeletons of crustaceans like shrimp, crabs, and insects. These biopolymers have gained attention in recent years for their potential to address environmental concerns associated with conventional plastic packaging. Chitin, the second most abundant biopolymer after cellulose, is derived from the exoskeletons of crustaceans, insects, and fungi. It is a semi-crystalline, linear polysaccharide composed of N-acetyl-D-glucosamine (GlcNAc) units. Chitosan, a deacetylated derivative of chitin, is obtained by treating chitin with an alkali solution. It is a water-soluble cationic polysaccharide with a degree of deacetylation (DD) ranging from 50% to 95% [6]. Both chitin and chitosan possess several desirable properties that make them attractive candidates for sustainable packaging applications [7]:

Biodegradability: Chitin and chitosan are readily biodegradable by microorganisms found in the environment, breaking down into harmless byproducts like carbon dioxide and water. This eliminates the long-term environmental impact associated with synthetic plastics.

Antimicrobial activity: Chitosan exhibits inherent antimicrobial activity due to its positive charge, which interacts with the negatively charged cell walls of microorganisms, disrupting their membranes and causing cell death. This property can help extend the shelf life of packaged food products and reduce the risk of spoilage.

Film-forming ability: Chitin and chitosan can be processed into flexible and semi-permeable films, making them suitable for packaging a wide range of products.

Biocompatibility: Chitin and chitosan are non-toxic and biocompatible. It is considered safe for use in contact with food, pharmaceuticals, and cosmetics. It does not leach harmful chemicals into its contents, making it an attractive option for various applications.

Starch and cellulose

Starch and cellulose are two of the most abundant natural polymers on Earth, making them attractive candidates for sustainable packaging materials. They are both biodegradable, renewable, and can be processed into various forms suitable for packaging applications. Starch, a semi-crystalline polysaccharide composed of glucose units, is the primary carbohydrate storage molecule in plants. It can be extracted from various sources, including grains, tubers, and roots. Starch-based packaging materials are typically produced by gelatinizing starch granules and processing them into films, sheets, or molded containers [8].

Cellulose, a linear polysaccharide composed of glucose units, is the main structural component of plant cell walls. It is the most abundant organic compound in nature and can be extracted from wood, cotton, and other plant sources. Cellulose-based packaging materials are typically produced by dissolving cellulose in a suitable solvent and processing it into films, fibers, or molded containers. They also offer several advantages such as biodegradability, renewability, biocompatibility, film-forming ability etc [9].

Collagen and gelatine

Collagen and gelatin are natural biopolymers derived from animal sources, primarily connective tissues and bones, and have gained attention as potential biodegradable sustainable packaging materials. Collagen is the most abundant protein in the human body, providing structural support to connective tissues such as skin, bones, and cartilage. It is composed of amino acid chains, primarily glycine, proline, and hydroxyproline, that form a triple helix structure. Gelatin is a derivative of collagen obtained by partial hydrolysis, a process that breaks down the protein into smaller peptides. It is a water-soluble, transparent, and thermosetting biopolymer, meaning it can be shaped into various forms when heated and cooled [10].

Some examples of how collagen and gelatin are being used in packaging applications are as follows [11]:

Food packaging: Collagen and gelatin films are used to package a variety of food products, such as fruits, vegetables, meats, and cheeses. They provide protection against moisture loss, oxygen ingress, and microbial contamination.

Pharmaceutical packaging: Collagen and gelatin capsules are commonly used to deliver medications in a controlled and targeted manner. They are also used to coat tablets and other pharmaceutical formulations.

Cosmetics packaging: Collagen and gelatin are used in various cosmetics applications, such as mascara wands, lipstick tubes, and facial masks. They provide structure, adhesion, and biocompatibility.

Medical device packaging: Collagen and gelatin are used to coat medical devices, such as stents and catheters, to improve biocompatibility and reduce the risk of infection.

Wheat gluten and soy protein

Wheat gluten is an economically viable byproduct readily available from starch production. Its degradation rate surpasses that of many other polymers, leaving no harmful residues. It excels as a film-forming agent, although it can become brittle without the addition of a plasticizer [12]. Soy protein concentrate, with a protein concentration of 70%, lacks water-soluble carbohydrates. Textured soy protein (TSP) is a textured variation of soy protein concentrate, but its films suffer from suboptimal barrier and mechanical properties due to the protein's inherent hydrophilic nature. Isolated soy protein films are moisture-sensitive; however, the incorporation of 25% stearic acid can enhance their thermal and tensile characteristics while reducing moisture susceptibility. Moreover, soy protein films can be improved for use in biodegradable soybean-based packaging containers through the addition of glycerol, gellan gum, or K-carrageenan [13].

Applications:

Modified atmosphere packaging (MAP)

It is a technique that involves altering the composition of the gases surrounding a food product to extend its shelf life and improve its quality. This is typically done by replacing the air inside the packaging with a mixture of gases, such as nitrogen, carbon dioxide, and oxygen, in specific concentrations. The use of MAP is based on the principles of gas diffusion and the effects of different gases on the preservation of food. Nitrogen is an inert gas that does not react with food and helps to displace oxygen, which can cause oxidation and spoilage. Carbon dioxide can inhibit the growth of microorganisms that cause food spoilage. Oxygen is necessary for respiration, so reducing the level of oxygen in the package can slow down the respiration rate of fresh produce, which can extend its shelf life [14,15].

Edible packaging

Edible packaging, also known as "biodegradable packaging" or "ecoplastic," is a type of packaging material that is designed to be eaten or biodegrade as efficiently as the food it protects. It is made from natural, plant-based materials that are safe for consumption, such as seaweed, starch, or casein. Edible packaging is a promising alternative to traditional plastic packaging, which is a major source of environmental pollution. Examples of edible packaging [16]:

Seaweed wraps: Seaweed is a natural polymer that can be made into thin, flexible sheets that can be used to wrap food. Seaweed wraps are a popular alternative to plastic wraps for sandwiches, snacks, and other foods.

Starch-based films: Starch is a carbohydrate that can be made into films that can be used to package food. Starch-based films are often used to package snacks and other dry foods.

Casein-based coatings: Casein is a protein that can be made into coatings that can be applied to food. Casein-based coatings are often used to protect food from moisture and oxygen.

Edible straws: Edible straws are made from a variety of materials, such as rice, wheat, and pasta. They are a biodegradable alternative to plastic straws.

Edible cups and bowls: Edible cups and bowls are made from a variety of materials, such as seaweed, starch, and rice. They are a biodegradable alternative to plastic cups and bowls.

Active packaging

Active packaging is a type of packaging that goes beyond simply containing and protecting a product. It actively interacts with the product and its environment to extend shelf life, improve quality, and maintain safety. Active packaging systems employ various mechanisms to achieve these goals, such as:

Absorbing or releasing gases: Active packaging can absorb or release gases, such as oxygen or ethylene, to create an optimal atmosphere for the product. For instance, oxygen scavengers are used to slow down the oxidation of food products, while ethylene absorbers can prevent fruits and vegetables from ripening too quickly.

Releasing antimicrobial agents: Active packaging can incorporate antimicrobial agents, such as ethanol or carbon dioxide, to inhibit the growth of microorganisms that can cause spoilage. This is particularly useful for products that are prone to microbial contamination, such as meat, poultry, and seafood.

Regulating humidity: Active packaging can regulate humidity levels to prevent moisture loss or gain, which can affect the texture and quality of certain foods. For example, moisture absorbers are used to keep dry products like crackers and cereal crisp, while humidity-releasing films can help prevent moisture loss in fresh produce.

Providing temperature control: Active packaging can incorporate materials that help control the temperature of the product, either by providing insulation or by using phase change materials that absorb or release heat. This can be useful for temperature-sensitive products, such as pharmaceuticals or frozen foods.

Monitoring product quality: Active packaging can incorporate sensors or indicators that monitor the product's quality and provide information about its freshness or safety. For instance, freshness indicators can change color or appearance based on the product's spoilage level, while gas sensors can detect changes in the gas composition within the package [17].

Different forms of biodegradable packaging are shown in Fig.1.

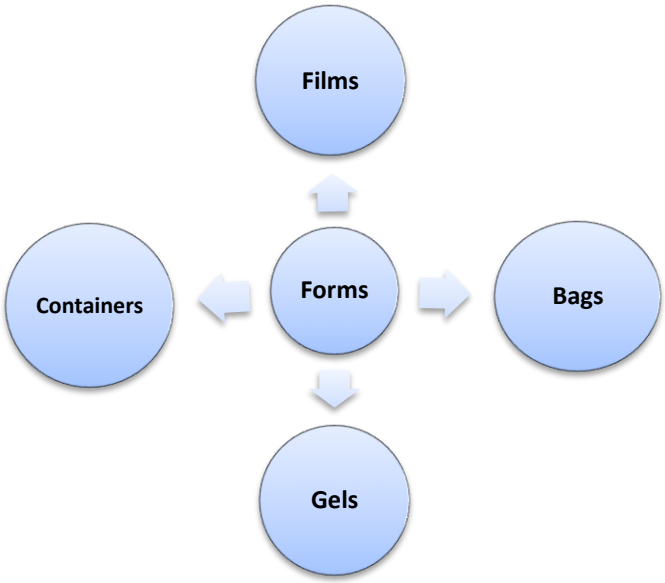

Figure 1: Different forms of biodegradable packaging

Consumer perception on biodegradable packaging

Consumers play a pivotal role in determining the success of eco-friendly food packaging through their purchasing decisions. Several factors influence these decisions, including design, color, and shape, with color even affecting the perceived taste of certain products. However, there are various barriers that may deter consumers from choosing sustainable products, such as higher costs, perceived lower quality, and limited availability. A significant challenge hindering the growth of this market is the lack of recognition. Many consumers identify sustainable packaging through logos and labels but remain unaware of biobased packaging, often dismissing it as a marketing gimmick. Notably, studies have shown that attributes like price and product quality tend to outweigh the importance of environmentally friendly packaging. Consumers are typically only willing to pay a modest premium price. To enhance the market for environmentally friendly packaging, several strategies can be considered. Packaging should carry third-party label certifications to instill trust in consumers. Food companies embracing eco-friendly packaging should prominently display effective labels on their products and provide clear information about the associated benefits. Effective communication is key to ensuring that

environmentally friendly packaging is a mutually beneficial endeavor for both food industry companies and the environment [18,19].

Conclusion:

Biodegradable sustainable packaging materials represent a significant advancement in packaging technology. They provide a sustainable and eco-friendly alternative to traditional plastics, mitigating concerns about environmental impact. Biodegradable materials, such as chitin, starch, collagen, and wheat gluten, offer a range of advantages, including biodegradability, renewable sourcing, and biocompatibility. Furthermore, active packaging, edible packaging, and modified atmosphere packaging techniques are revolutionizing how we preserve and present products. Consumer perception of these sustainable packaging options is evolving, with environmental consciousness and sustainability playing key roles in driving their acceptance. To continue promoting environmentally friendly packaging, third-party certifications, effective labeling, and clear communication about the benefits are essential. The future of packaging lies in these sustainable materials and innovative approaches, contributing to a more environmentally responsible and sustainable future.

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BLOCKCHAIN TECHNOLOGY IN PHARMACEUTICAL SCIENCES

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Abstract:

Blockchain technology has emerged as a transformative force in the field of pharmaceutical sciences, addressing critical challenges related to drug authentication, supply chain management, data security, and transparency. This abstract provides a brief overview of the application of blockchain technology in pharmaceutical sciences, highlighting its impact on various aspects of the industry. Blockchain's unique features, including immutability, transparency, and decentralization, are revolutionizing drug authentication and anti-counterfeiting efforts. Pharmaceutical products are assigned unique identifiers, and their entire journey from manufacturing to distribution is recorded on the blockchain, ensuring the authenticity and integrity of each product. Regulatory compliance, such as the Drug Supply Chain Security Act (DSCSA) in the United States, is facilitated by blockchain's ability to maintain an auditable record of drug movements and regulatory compliance. Clinical trials and data management benefit from blockchain technology by securing the data, ensuring traceability, and automating data-sharing agreements. Patients' privacy is safeguarded through blockchain-based consent management, giving patients more control over their data while enabling secure data sharing among healthcare providers and researchers. Smart contracts on blockchain platforms automate drug supply agreements, ensuring efficient and transparent transactions. This not only reduces the risk of fraud but also enhances the overall supply chain efficiency. The application of blockchain technology in pharmaceutical sciences is a dynamic field, with significant potential to improve the safety, quality, and efficiency of pharmaceutical products and processes. Ongoing research and implementation are expected to shape the future of pharmaceuticals.

Keywords: Blockchain Technology, Drug Authentication, Regulatory Compliance.

Introduction:

Blockchain technology is increasingly gaining traction in the field of pharmaceutical sciences due to its potential to enhance data security, traceability, and transparency. Below are various recent trends in the application of blockchain technology in pharmaceutical sciences. Blockchain is used to track the movement of pharmaceutical products from manufacturers to

consumers, ensuring the authenticity and integrity of the supply chain. This can help in preventing counterfeit drugs and ensuring the quality of medications [1]. Blockchain can be used to secure and streamline the management of clinical trial data, ensuring the immutability and transparency of data collection and analysis [2]. Blockchain technology can be employed to verify the authenticity of pharmaceutical products by recording their journey from production to distribution [3]. Blockchain can enable secure data sharing among healthcare providers, patients, and researchers while maintaining patient privacy and consent [4]. Blockchain-based serialization allows each pharmaceutical product to have a unique identifier, enhancing traceability and reducing the risk of counterfeit drugs [5]. Blockchain can facilitate compliance with regulatory requirements by maintaining a secure and immutable record of drug-related data, including manufacturing and distribution details [6]. Smart contracts on blockchain platforms can automate and enforce drug supply agreements, reducing the risk of fraud and enhancing transparency [7]. These trends in blockchain technology's application in pharmaceutical sciences demonstrate its potential to address critical issues like drug counterfeiting, data security, and regulatory compliance. Researchers, healthcare professionals, and pharmaceutical companies continue to explore the full potential of blockchain in improving the pharmaceutical industry.

Applications of blockchain technology in the various fields of pharmaceutical sciences

1. Drug traceability and supply chain management

Drug traceability and supply chain management are critical aspects of the pharmaceutical industry. Ensuring the integrity and transparency of the pharmaceutical supply chain is essential for patient safety and regulatory compliance. Blockchain technology has emerged as a powerful tool to address these challenges. The adoption of blockchain technology in pharmaceutical supply chain management is an ongoing trend with the potential to greatly enhance drug traceability, transparency, and patient safety. It is crucial for the pharmaceutical industry to continue exploring and implementing blockchain solutions to address the challenges associated with the supply chain.

1.1 Enhanced traceability: Blockchain allows for the creation of an immutable and transparent ledger of drug-related data, including the production, distribution, and sale of pharmaceutical products. Each transaction is recorded in a "block," and once added, it cannot be altered. This ensures that the entire history of a drug product is traceable.

1.2 Prevention of counterfeit drugs: The pharmaceutical industry is plagued by counterfeit drugs entering the supply chain. Blockchain technology provides a tamper-proof record of a drug's journey, making it difficult for counterfeit drugs to infiltrate the legitimate supply chain. This helps in ensuring that patients receive genuine medications.

1.3 Regulatory compliance: The pharmaceutical industry is subject to strict regulatory requirements. Blockchain can facilitate compliance with regulations such as the Drug Supply

Chain Security Act (DSCSA) in the United States by maintaining a secure and auditable record of drug movements [8].

1.4 Real-time visibility: Blockchain platforms offer real-time visibility into the location and status of pharmaceutical products at each stage of the supply chain. This real-time data can help in optimizing logistics and ensuring the timely delivery of medications.

1.5 Reduced errors and fraud: By automating and securing data entry, blockchain technology reduces the risk of errors and fraud in the supply chain. This contributes to increased trust and efficiency in the pharmaceutical industry.

1.6. Supply chain optimization: Blockchain can enable the creation of "smart contracts" that automate various supply chain processes, such as payment verification and quality control. These contracts can help streamline operations and reduce costs.

1.7. Transparency and collaboration: Blockchain encourages transparency and collaboration among various stakeholders in the pharmaceutical supply chain, including manufacturers, distributors, pharmacies, and regulatory authorities. Each participant can access the same shared ledger, promoting trust and cooperation [9].

2. Clinical trials and data management

Clinical trials and data management are pivotal aspects of pharmaceutical research and development. The accuracy, security, and transparency of clinical trial data are critical for ensuring the safety and efficacy of new drugs. Blockchain technology is increasingly being explored to enhance clinical trials and data management in the pharmaceutical sciences. The utilization of blockchain technology in clinical trials and data management offers a promising avenue for enhancing the reliability, transparency, and efficiency of pharmaceutical research. Researchers, pharmaceutical companies, and regulatory bodies are increasingly exploring blockchain solutions to address the complex challenges of data management in clinical trials.

2.1 Secure data management: Blockchain ensures the secure and immutable storage of clinical trial data. Each data entry is recorded in a tamper-proof block, guaranteeing the integrity of the data.

2.2 Data traceability: Every action related to clinical trial data, from data collection to analysis and storage, is recorded in the blockchain. This traceability ensures transparency and accountability in the research process [10].

2.3 Data integrity: Blockchain technology prevents unauthorized modifications to clinical trial data. This is especially critical in maintaining the credibility of research outcomes and regulatory compliance.

2.4 Patient consent and privacy: Blockchain can be used to manage patient consent and ensure the privacy of sensitive health data. Patients have more control over who accesses their data and for what purpose [11].

2.5 Efficient data sharing: Blockchain enables efficient, secure, and selective data sharing among stakeholders involved in clinical trials, including researchers, patients, and regulatory authorities.

2.6 Real-time data updates: Real-time updates of clinical trial data are possible with blockchain technology. This feature is valuable for monitoring the progress of trials and making timely decisions [12].

2.7 Smart contracts for protocols: Smart contracts, self-executing agreements, can be used to automate various aspects of clinical trial protocols. For example, they can automatically trigger payments to research sites based on predefined criteria.

2.8 Regulatory compliance: Blockchain can help pharmaceutical companies and research organizations adhere to regulatory requirements for data management, such as those stipulated by the U.S. Food and Drug Administration (FDA) [13].

3. Drug authentication and anti-counterfeiting

Drug authentication and anti-counterfeiting are significant concerns in the pharmaceutical industry. Counterfeit drugs can pose serious health risks to patients and undermine trust in the pharmaceutical supply chain. Blockchain technology is increasingly being employed to address these issues by ensuring the authenticity of pharmaceutical products. The use of blockchain technology for drug authentication and anti-counterfeiting is a critical application in the pharmaceutical industry, where patient safety and the integrity of the supply chain are paramount. Blockchain solutions in this context offer a robust mechanism to combat counterfeit drugs and enhance transparency in pharmaceutical product tracking. Pharmaceutical companies, regulators, and technology providers are actively exploring and implementing blockchain-based anti-counterfeiting system

3.1 Unique product identifiers: Blockchain enables the assignment of unique identifiers to pharmaceutical products, making each drug package distinguishable. These identifiers are recorded on the blockchain, allowing for easy verification of product authenticity.

3.2 Immutable product records: Information about the production, distribution, and sale of drugs is stored in an immutable blockchain ledger. Any changes or tampering with this information would be immediately detectable.

3.3 Verification at each stage: Blockchain technology allows for the verification of a drug's authenticity at each stage of the supply chain, from manufacturing to distribution to the end consumer [14].

3.4 Real-time verification: Pharmacists, healthcare providers, and consumers can verify the authenticity of a drug product in real-time by scanning the product's unique identifier and checking it against the blockchain.

3.5 Prevention of counterfeiting: Counterfeit drugs can be identified and prevented from entering the legitimate supply chain. This protects patients from potentially harmful or ineffective medications.

3.6 Consumer empowerment: Blockchain technology can empower consumers to verify the authenticity of the drugs they purchase. This transparency enhances consumer confidence in the pharmaceutical industry.

3.7 Regulatory compliance: Blockchain-based anti-counterfeiting solutions help pharmaceutical companies adhere to regulatory requirements, such as the Drug Supply Chain Security Act (DSCSA) in the United States [15].

4. Data sharing and privacy protection

Data sharing and privacy protection are essential considerations in pharmaceutical research and healthcare, especially when handling sensitive patient information. Blockchain technology offers a promising solution to balance the need for data sharing with the imperative of maintaining patient privacy and data security. Blockchain technology offers a secure and transparent means of data sharing and privacy protection in pharmaceutical sciences, addressing concerns related to patient consent, data security, and compliance with data protection regulations. Researchers, healthcare providers, and pharmaceutical companies are actively exploring blockchain-based solutions to ensure the privacy of sensitive health data while enabling secure data sharing for research and healthcare purposes

4.1 Secure data sharing: Blockchain provides a secure and transparent platform for data sharing among various stakeholders, including healthcare providers, pharmaceutical companies, researchers, and patients.

4.2 Patient consent management: Blockchain can be used to manage and record patient consent for data sharing. Patients have control over who can access their data and for what purposes, ensuring privacy [16].

4.3 Data encryption: Blockchain networks can incorporate encryption techniques to protect data while in transit and at rest, adding an extra layer of security.

4.4 Granular access control: Blockchain enables granular access control, allowing stakeholders to define who can view and modify specific pieces of data, further safeguarding patient privacy.

4.5 Auditability: All data transactions on a blockchain are recorded and time-stamped, creating an immutable audit trail. This transparency ensures accountability and helps in identifying any unauthorized access [17].

4.6 Consent management and smart contracts: Smart contracts on the blockchain can automate consent management and data sharing agreements, ensuring that data is only shared as per predefined conditions and consent agreements.

4.7 Compliance with regulations: The use of blockchain can assist pharmaceutical companies and healthcare providers in complying with data protection regulations such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States [18].

5. Drug authentication and serialization

Drug authentication and serialization using blockchain technology is an innovative approach in the pharmaceutical industry to ensure the integrity, traceability, and authenticity of pharmaceutical products. Counterfeit drugs pose a significant threat to patient safety and can lead to loss of trust in the healthcare system. The use of blockchain technology for drug authentication and serialization is a vital step in safeguarding patient safety and ensuring the authenticity of pharmaceutical products. Pharmaceutical companies, regulatory authorities, and technology providers are actively exploring and implementing blockchain-based anti-counterfeiting and serialization systems to address the critical issue of counterfeit drugs. This technology holds the promise of significantly improving the integrity of the pharmaceutical supply chain.

5.1 Unique product identifiers: Each pharmaceutical product is assigned a unique identifier, often in the form of a barcode or QR code, which is recorded on the blockchain. This unique identifier distinguishes genuine products from counterfeit ones [19].

5.2 Immutable record keeping: Information related to the production, distribution, and sale of pharmaceutical products is securely and immutably stored on the blockchain. This makes it extremely difficult for counterfeiters to manipulate data.

5.3 Traceability throughout the supply chain: Blockchain technology enables real-time tracking of the pharmaceutical product's journey from manufacturing to distribution to the end consumer. All stakeholders in the supply chain can verify the product's authenticity at any point.[19]

5.4 Anti-counterfeiting measures: Counterfeit drugs are a significant global problem. Blockchain technology provides a robust solution by creating transparency in the supply chain, making it easier to detect and prevent counterfeit products from entering the market.

5.5 Consumer empowerment: Blockchain allows consumers, healthcare providers, and pharmacists to verify the authenticity of the drugs they purchase in real-time by scanning the product's unique identifier and cross-referencing it with the blockchain. This empowers patients to make informed decisions about their medication.

5.6 Regulatory compliance: Blockchain-based drug authentication and serialization solutions help pharmaceutical companies meet regulatory requirements, such as those laid out in the Drug Supply Chain Security Act (DSCSA) in the United States.

6. Regulatory compliance and transparency

Regulatory compliance and transparency are essential in the pharmaceutical industry to ensure the safety, efficacy, and quality of drugs. Blockchain technology has gained attention for its potential to enhance regulatory compliance and transparency within the field of pharmaceutical sciences. Blockchain technology provides a robust platform for ensuring regulatory compliance and transparency in the pharmaceutical industry. It offers the means to address the complexities of regulatory requirements, data management, and supply chain traceability while providing a secure and auditable record of pharmaceutical activities. Researchers, pharmaceutical companies, and regulatory bodies are actively exploring and implementing blockchain-based solutions to enhance regulatory compliance and transparency in the field of pharmaceutical sciences

6.1 Regulatory compliance: Blockchain can help pharmaceutical companies comply with various regulations, including the Drug Supply Chain Security Act (DSCSA) in the United States. By maintaining an immutable ledger of drug movements, blockchain facilitates compliance with tracking and traceability requirements.

6.2 Data integrity and transparency: The transparency and immutability of blockchain data ensure that regulatory authorities can easily audit and verify pharmaceutical records. This simplifies the process of demonstrating compliance during inspections.

6.3 Supply chain traceability: Blockchain technology allows for the traceability of pharmaceutical products at each stage of the supply chain, from manufacturing to distribution to the end consumer. This transparency helps ensure that products are handled and stored according to regulatory standards.

6.4 Real-time reporting: Blockchain networks can provide real-time reporting of pharmaceutical data, which is crucial for regulatory reporting and decision-making. This can lead to more efficient and responsive regulatory processes.

6.5 Smart contracts for compliance: Smart contracts can be programmed to automate compliance processes, ensuring that pharmaceutical companies adhere to regulatory standards. These contracts can automatically trigger actions based on predefined rules.

6.6 Anti-counterfeiting and serialization: Blockchain's role in anti-counterfeiting and serialization is critical for compliance with regulations aimed at preventing counterfeit drugs from entering the supply chain.

7. Smart contracts for drug supply agreements

Smart contracts are self-executing agreements with predefined rules and conditions. They can be used in the pharmaceutical industry to automate various aspects of drug supply agreements, including payments, quality control, and compliance monitoring. The use of smart contracts for drug supply agreements in pharmaceutical sciences offers a compelling way to

automate and enhance the efficiency of supply chain operations. This approach can lead to cost savings, improved transparency, and increased compliance with regulatory requirements. Stakeholders in the pharmaceutical industry are actively exploring the integration of smart contracts within their operations to streamline and improve drug supply agreements.

7.1 Automated payments: Smart contracts can automate payments within drug supply agreements. For instance, when a pharmaceutical product is delivered to a distributor, the smart contract can automatically release payment to the manufacturer.

7.2 Quality control: Quality control standards can be encoded into smart contracts. If a batch of pharmaceutical products does not meet specified quality criteria, the contract may automatically trigger alerts or block further distribution until the issue is resolved.

7.3 Compliance monitoring: Smart contracts can help ensure compliance with various regulations and agreements. They can automatically validate that all participants in the supply chain meet their regulatory obligations and contractual commitments.

7.4 Real-time data sharing: Smart contracts can access real-time data from the blockchain, allowing for up-to-date information on product availability, orders, and delivery statuses. This ensures that stakeholders have access to the latest information.

7.5 Cost reduction and efficiency: Automation through smart contracts reduces the need for intermediaries and manual processes, ultimately reducing costs and improving the efficiency of drug supply agreements.

7.6 Transparency: Smart contracts on a blockchain provide transparency to all parties involved. All contract terms and conditions are visible and immutable, enhancing trust and reducing the risk of disputes [20].

Conclusion:

Blockchain technology is transforming various aspects of pharmaceutical sciences, addressing critical challenges and introducing innovative solutions. In drug traceability and supply chain management, blockchain offers enhanced traceability, prevention of counterfeit drugs, regulatory compliance, real-time visibility, and reduced errors and fraud, ultimately optimizing the supply chain. In clinical trials and data management, it ensures secure data management, data traceability, data integrity, patient consent, and efficient data sharing. Blockchain technology provides a powerful tool for drug authentication and serialization, ensuring unique product identifiers, immutable records, traceability, and prevention of counterfeit drugs. It also enhances regulatory compliance and transparency by ensuring data integrity, supply chain traceability, real-time reporting, and smart contracts for compliance. Smart contracts for drug supply agreements automate various processes, including payments, quality control, and compliance monitoring, leading to cost reduction, efficiency, and transparency. The integration of blockchain technology is reshaping the pharmaceutical industry

by improving patient safety, regulatory compliance, data security, and supply chain efficiency. As the pharmaceutical sciences continue to adopt blockchain solutions, the industry is poised for enhanced trust, safety, and transparency, ultimately benefiting patients and all stakeholders involved.

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Abbreviations

DSCSA: Drug Supply Chain Security Act

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PEPTIC ULCER DISEASE: DIGESTIVE DISORDER

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Abstract:

Peptic Ulcer Disease (PUD) is a prevalent gastrointestinal disorder characterized by the development of open sores or ulcers in the lining of the stomach, duodenum, or esophagus. This condition is primarily associated with the erosion of the mucosal barrier, caused by an imbalance between aggressive factors such as gastric acid and pepsin, and the protective mechanisms of the mucosa. PUD has multiple etiological factors, with the most common being infection with *Helicobacter pylori* and the chronic use of nonsteroidal anti-inflammatory drugs (NSAIDs). The clinical presentation of PUD varies, with symptoms ranging from abdominal pain, bloating, and heartburn to more severe complications like gastrointestinal bleeding, perforation, and obstruction. Accurate diagnosis typically involves endoscopic evaluation, radiographic imaging, and laboratory tests. Treatment strategies for PUD encompass a combination of eradicating *H. pylori* infection, discontinuing NSAID use when possible, and utilizing acid-suppressive medications such as proton pump inhibitors (PPIs) and histamine H2-receptor antagonists. Lifestyle modifications, including dietary changes and stress management, can also contribute to symptom relief and ulcer healing. Understanding the pathophysiology, risk factors, and available therapeutic options is crucial in managing peptic ulcer disease effectively, ultimately reducing the morbidity and complications associated with this common gastrointestinal disorder.

Keywords: Peptic Ulcer Disease (PUD), Esophagogastroduodenoscopy (EGD), Proton Pump Inhibitors (PPIs), Gastroesophageal Reflux Disease (GERD), Nonsteroidal Anti-Inflammatory Medicines (NSAIDs)

Introduction:

Due to pepsin or gastric acid secretion, peptic ulcer disease (PUD) is characterized by discontinuity in the GI tract's inner lining. It penetrates the stomach epithelium's muscularis propria layer. Usually, the stomach and proximal duodenum are affected. It might affect the distal duodenum, jejunum, or lower esophagus. Patients with gastric ulcers typically have epigastric pain 15 to 30 minutes after eating; in contrast, patients with duodenal ulcers typically experience pain 2 to 3 hours after eating. All patients with peptic ulcer disease are now advised to get tested for *Helicobacter pylori*. Some individuals may need an endoscopy to confirm the

diagnosis, particularly those who have troubling symptoms. Today, a triple-drug therapy based on proton pump inhibitors (PPI) can handle the majority of patients.

Etiology

There are many causes of peptic ulcer disease (PUD), however *Helicobacter pylori*- and NSAID-related PUD make up the majority of the illness's pathogenesis.

Common causes of stomach ulcer disease include- *H. pylori* infection, NSAIDs, Medical supplies.

Rare causes of stomach ulcer disease include- Zollinger-Ellison condition, Cancer (lung, stomach, and lymphomas), Anxiety (acute sickness, burns, a concussion), Virus contamination, Vascular dysfunction, Radiation treatment, Crohn's illness, Cancer treatment [1]

PUD with *Helicobacter pylori*

The gastric epithelial cells contain the gram-negative bacillus *H. pylorus*. 90% of duodenal ulcers and 70% to 90% of stomach ulcers are brought on by this bacterium. Lower socioeconomic status individuals are more likely to have *H. pylori* infection, which is frequently acquired during childhood. The bacteria can attach to and inflame the stomach mucosa thanks to a broad spectrum of virulence factors. This causes hypo- or achlorhydria, which causes stomach ulcers.

***Helicobacter pylori* Virulence Factors**

1) Urease: By neutralizing the acidic gastric environment, the production of urease converts urea into ammonia and protects the body.
2) Toxins: CagA/VacA is linked to host tissue damage and stomach mucosal inflammation.
3) Flagella: Offers motility and permits migration in the direction of the stomach epithelium

An NSAID-related PUD

After *H. pylori* infection, the use of nonsteroidal anti-inflammatory medicines is the second most frequent cause of PUD. Prostaglandin is often secreted to protect the stomach mucosa. By inhibiting the COX-1 enzyme, NSAIDs prevent the creation of prostaglandins, which lowers the production of gastrointestinal mucus, bicarbonate, and mucosal blood flow. [2,3]

Medications

Other drugs than NSAIDs that have been linked to PUD's pathogenesis include corticosteroids, bisphosphonates, potassium chloride, and fluorouracil.

Smoking also seems to be associated with duodenal ulcers, however the relationship is not a straight line. Alcohol can cause acidity by irritating the stomach mucosa.

The following situations lead to a hypersecretory environment.

- The Zollinger Ellison condition
- Mastocytosis omnipresent

- Cystic fibrosis
- Overactive thyroid
- Hyperplasia of the antral G cells

Epidemiology

The probability of developing peptic ulcer disease (PUD) during the course of one's lifetime is between 5% and 10%. Globally, PUD incidence has decreased as a result of improved hygienic and sanitary settings, competent medical care, and prudent NSAID usage. There are four times as many duodenal ulcers as stomach ulcers. Additionally, men are more likely than women to develop duodenal ulcers [4,5].

Pathophysiology

An imbalance between the protecting and damaging elements that affect the stomach mucosa is what causes peptic ulcer disease. Risk elements favoring the emergence of PUD

- *H. pylori* contamination
- NSAID use
- First-degree kin who have PUD
- A person who left a developed country
- Ethnicity of African Americans and Hispanics

There is typically a mucosal defect associated with peptic ulcers that spreads to the muscularis mucosa. When the outer, protective layer of the mucosa is harmed, the interior layers are vulnerable to acidity. Additionally, the mucosal cells' capacity to release bicarbonate is impaired.

It is well known that *H. pylori* colonizes the stomach mucosa and inflames it. Additionally, the *H. pylori* affects bicarbonate secretion, which encourages the growth of stomach metaplasia and acidity.

Histopathology

The lower curvature is where gastric ulcers are most frequently seen, whereas the duodenal bulb is where duodenal ulcers are most frequently found. The ulcer has a smooth foundation and a circular to oval shape. While chronic ulcers have raised borders with inflammation, acute ulcers have regular borders. The muscularis mucosa is not the limit of an ulcer.

Physical and historical

Depending on the location of the disease and age, the signs and symptoms of peptic ulcer disease can change. Differentiating between gastric and duodenal ulcers depends on when they first manifest themselves in relation to meals. Duodenal ulcers commonly cause nighttime pain. People who have a gastric outlet obstruction frequently describe having a bloated or full abdomen in the past.

The following are typical warning signs and symptoms: epigastric stomach discomfort; bloating, Fullness in the abdomen, vomiting and nauseous, weight increase or loss, hematomesis, melanie.

The following are warning or alarm symptoms that require immediate referral: Inadvertent weight loss, Progression of dysphagia, Prominent abdominal bleeding, Anemia due to a lack of iron, Repeated vomiting, A history of upper gastrointestinal cancer in the family. [6]

Evaluation

A medical history, physical examination, and invasive and non-invasive diagnostics are necessary for the diagnosis of PUD. A thorough history should be taken, and any difficulties should be noted. Epigastric stomach pain, early satiety, and fullness after eating are all symptoms that point to PUD. While the discomfort of duodenal ulcers diminishes with a meal and may lead to weight gain, the pain of stomach ulcers increases with a meal and worsens 2 to 3 hours later. Any patient who exhibits anemia, melena, hematemesis, or weight loss should have their PUD complications most commonly bleeding, perforation, or cancer further evaluated. Physical examination results may show epigastric belly soreness and anemia-related symptoms.

Investigations

1) Esophagogastroduodenoscopy (EGD): The gold standard and most reliable diagnostic procedure, with sensitivity and specificity up to 90% in the detection of stomach and duodenal ulcers. Guidelines on the use of endoscopy in patients presenting with upper abdominal pain or dyspeptic symptoms suggestive with PUD have been issued by the American Society of Gastrointestinal Endoscopy. Patients over 50 who have recently developed dyspeptic symptoms should have an EGD assessed. Regardless of age, everyone who exhibits alarm symptoms should have an EGD. [6]
2) Barium swallow: This procedure is advised when EGD is not appropriate.
3) Complete blood tests, liver function, and amylase and lipase concentrations.
4) If Zollinger Ellison syndrome is suspected, serum gastric is ordered.
5) Testing for *Helicobacter pylori*:
    - Serologic evaluation
    - High sensitivity and specificity for the urea breath test. After ceasing treatment for 4 to 6 weeks, it can be utilized to confirm eradication. The radiolabeled carbon dioxide produced by the stomach is expelled by the lungs when urease, an enzyme made by H. pylori, is present.
    - *H. pylori* antibodies can also be tested.
    - Test for stools antigens
    - Rapid urine test and urine-based ELISA

- Endoscopic biopsy: Because it is costly, time-consuming, and intrusive, cultures are generally not advised. If eradication therapy fails or there is concern about antibiotic resistance, it is advised. To enhance sensitivity, biopsies must be taken from at least 4 different places. The smaller curvature between the antrum and the fundus is where gastric ulcers are frequently found. The first section of the duodenum contains the bulk of duodenal ulcers.

6) Although computerized tomography of the abdomen with contrast is not very useful in the diagnosis of PUD itself, it can be quite useful in identifying its consequences, such as perforation and obstruction of the gastric outlet.

Management / Treatment

A medical diagnosis

H2-receptor antagonists and proton pump inhibitors (PPIs) are antisecretory medications used to treat peptic ulcer disease (PUD). Due to PPIs' greater healing and efficacy, H2 receptor blockers have mostly been supplanted. PPIs suppress the stomach's ability to produce acid, relieving symptoms and accelerating recovery. Given that long-term PPI use raises the risk of bone fractures, treatment may include calcium supplements. Stopping the usage of NSAIDs or switching to a lower dose helps alleviate NSAIDs-induced PUD. It would be best to stop using corticosteroids, bisphosphonates, and anticoagulants as well. Misoprostol, a prostaglandin analog, is occasionally used as a preventative measure for peptic ulcers brought on by NSAIDs. A triple antibiotic, proton pump inhibitor, and pylori-inducing PUD therapy combination is the first line of defense. For 7 to 14 days, patients take pantoprazole, clarithromycin, metronidazole, or amoxicillin. Combining PPIs and antibiotics effectively kills H. pylori. The antibiotic chosen should take into account the existence of environmental antibiotic resistance. Quadruple therapy, which uses bismuth and several antibiotics, is used if first-line therapy is unsuccessful. [7,8]

Chronic illness and surgical management

When a patient is unresponsive to medicinal therapy, disobedient, or at a high risk of consequences, surgical intervention is needed. Over 5 mm in diameter peptic ulcers that do not cure after 8–12 weeks of PPI medication are referred to as refractory peptic ulcers. Consistent *H. pylori* infection, continued NSAID usage, serious comorbidities that hinder ulcer healing, or other disorders such gastrinoma or stomach cancer are the usual causes. Patients may be candidates for surgical therapy if the ulcer still exists despite taking the aforementioned risk factors into consideration. Both vagotomy and partial gastrectomy are surgical alternatives. [9]

Multiple diagnoses

The symptoms of the following illnesses can resemble those of peptic ulcer disease, so it's critical to understand how they appear clinically in order to make the right diagnosis.

- Gastritis is an inflammatory condition of the stomach mucosa caused by immune-mediated or infectious etiologies, and its clinical appearance is remarkably similar to that of peptic ulcer disease.
- Gastroesophageal reflux disease (GERD): Patients typically report experiencing burning in the lower retrosternal and epigastrium, excessive salivation, or sporadic regurgitation of food.
- Patients with gastric cancer typically report alarming symptoms such weight loss, melena, recurrent vomiting, or signs of disease elsewhere in the case of metastases, in addition to stomach pain.
- Epigastric or right upper quadrant pain that is more intense and persistent, worsens when the patient is supine, and people with pancreatitis typically have a history of alcoholism or gallstones. Amylase and lipase levels in the serum can help in diagnosis.
- Biliary colic, which is brought on by fatty foods and manifests as sporadic, intense, deep discomfort in the right upper quadrant or epigastrium. [10]
- Cholecystitis: This condition causes right upper quadrant or epigastric pain that typically lasts for hours, is made worse by fatty foods, and is accompanied by nausea and vomiting. Leukocytosis, tachycardia, a positive Murphy sign, fever, and abnormal liver functions are additional indicators that this is not biliary colic. [11]

These illnesses all have the potential to be fatal and can present similarly.

- Myocardial infarction, especially when the inferior wall and right ventricle are affected; occasionally, patients will also have nausea and vomiting in addition to epigastric pain. When a high-risk patient exhibits additional symptoms including dizziness, breathlessness, and abnormal vital signs, the doctor should be on the lookout for this. [12]
- Mesenteric ischemia: whereas acute mesenteric ischemia manifests as severe, acute-onset abdominal pain, the chronic form typically manifests as persistent post-prandial epigastric pain and might be misinterpreted for peptic ulcer disease. Age, the existence of atherosclerosis risk factors, and weight reduction should all trigger an examination for the disease. [13]
- Mesenteric vasculitis - suspicion of mesenteric vasculitis should be raised if a patient exhibits unexplained abdominal symptoms, including lower gastrointestinal haemorrhage whether present or absent. [14]

Prognosis

Peptic Ulcer Disease (PUD) has a very good prognosis when the underlying cause is adequately treated. The ulcer's recurrence may be avoided by practicing proper hygiene and staying away from NSAIDs, alcohol, and smoking. Regrettably, recurrence is frequent, with rates in the majority of series exceeding 60%. Gastric perforation brought on by NSAIDs

happens to one patient every year at a rate of 0.3%. However, compared to earlier times, peptic ulcer disease mortality rates have dramatically declined.

Complications

If discovered and treated late, peptic ulcer disease (PUD) can have dangerous side effects. The following issues could develop in PUD:

- Upper digestive bleeding
- Blockage of the gastric outlet
- Punctuation
- Infiltration
- Stomach cancer

Patient education and dissuasion

Nonsteroidal anti-inflammatory medicines (NSAIDs), aspirin, alcohol, tobacco, and caffeine are examples of substances that should be discussed with patients who have Peptic Ulcer Disease (PUD). If using NSAIDs is necessary, utilize the lowest dose possible and think about prophylaxis for individuals who use NSAIDs. Because of the strong link between obesity and peptic ulcer disease, patients should be encouraged to lose weight. Counseling for stress management may be beneficial in some

Among other things: Pearls

Based on size, ulcers are distinguished from erosions. Erosions and ulcers are both terms used to describe lesions that are smaller than or equal to 5 mm in diameter. Because COX-2 is not expressed on the stomach mucosa, COX-2 selective NSAIDs are less likely to result in PUD. Therefore, COX-2 selective NSAIDs are preferable in patients with a history of PUD. Zollinger-Ellison syndrome is brought on by a gastrin-producing endocrine tumor, which typically develops in the pancreas or duodenum. The jejunum and duodenum develop many ulcers as a result. It can be identified by checking the levels of serum gastrin.

Improving healthcare team results

It is advised to treat peptic ulcer disease using evidence-based methods. Millions of individuals worldwide suffer from PUD, which is a relatively prevalent illness. It has severe morbidity if untreated. The majority of PUD patients visit their primary care provider, but some also visit the emergency room, an urgent care facility, or an outpatient clinic. Healthcare professionals, particularly nurses, need to be aware of this diagnosis because PUD's presentation is frequently ambiguous. Treatment may be postponed since the stomach pain can mimic a number of other diseases.

Once the diagnosis has been made, it is important to inform the patient about lifestyle adjustments, such as quitting smoking, abstaining from alcohol and caffeine, and avoiding taking too many NSAIDs. Gastroenterology nurses keep tabs on patients, educate the team, and keep

them informed about their conditions. To get symptom alleviation and a cure, the pharmacist needs to counsel the patient about taking their medications as prescribed. There is evidence to suggest that obesity may be a risk factor for developing peptic ulcer disease, so it is advisable to seek dietary advice. The morbidity of peptic ulcer disease can only be reduced by a cooperative effort. The outcomes are excellent for the majority of PUD patients receiving the triple regimen or PPI treatment; however, symptom recurrence is not unusual [15,16].

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CHROMOSOMAL ABERRATIONS AND ITS RELATED SYNDROMES

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Introduction:

Chromosomal mutations are variations from the wildtype condition in chromosome number or chromosome structure. Chromosomal mutations can occur spontaneously, or they can be induced by treatment with chemicals or radiation. We often have the impression that reproduction in humans usually occurs without significant problems affecting chromosome structure or number. After all, most babies appear normal, as does the majority of the adult population. However, chromosomal mutations are more common than we once thought, & they contribute significantly to spontaneously aborted pregnancies & stillbirths, as well as to some forms of cancer. For example, major chromosomal mutations are present in approximately half of spontaneous abortions, & a visible chromosomal mutation is present in about 6 out of 1,000 live births. Other studies have shown that some 11% of men with serious fertility problems & about 6% of people institutionalized with mental deficiencies have chromosomal mutations. Chromosomal mutations are significant causes of developmental disorders.

Numerical abnormalities of human chromosomes & related syndrome

When an organism or a cell has one complete set of chromosomes or an exact multiple of complete sets, that organism or cell is said to be euploid. Thus, eukaryotic organisms that are normally diploid (such as humans & fruit flies) & eukaryotic organisms that are normally haploid (such as yeast) are euploids. Chromosome mutations that result in variations in the number of chromosome sets occur in nature, & the resulting organism or cells are also euploid.

Aneuploidy

It is addition or loss of one or more chromosomes to the complete diploid chromosome complement of an organism. Changes in chromosome number can occur in both diploid & haploid organisms. The nondisjunction of one or more chromosome during meiosis I or meiosis II is responsible for generating gamates with abnormal number of chromosomes

Types of Aneuploidy

In Aneuploidy, one or more chromosomes are lost from or added to normal set of chromosomes. It can occur from loss of individual chromosome in meiosis or in mitosis by nondisjunction in animals autosomal Aneuploidy is almost always lethal, so in mammals it is detected mainly in aborted foetuses.

There are four types of aneuploidy -

- Nullisomy -

It is diploid cell which lacks a homologous pair of chromosome & is represented as (2n – 2).

- Monosomy -

It is a diploid cell lacking one chromosome from a pair & is represented as (2n-1)

- Double monosomy -

Two chromosomes are lost from two different pairs & is represented as (2n -1 -1).

- Trisomy -

It has one extra chromosome in a pair that is the cell has three copies of particular chromosome & two copies of all other chromosomes it is represented as (2n + 1)

- Double trisomy -

Addition of two chromosomes to two different pairs & represented as (2n + 1 +1).

- Tetrasomy -

It has an extra chromosome pair that is there are four copies of one particular chromosome & two copies of all other chromosomes. it is represented as (2n + 2)

- Double Tetrasomy -

Two chromosomes are added to two different pairs & represented as (2n + 2 + 2).

Table 1: Aneuploid abnormalities in the human populations

Chromosomes	Syndrome	Frequency at Birth
Autosomes		
Trisomic 21	Down	14.3/10,000
Trisomic 13	Patau	2/10,000
Trisomic 18	Edwards	2.5/10,000
Sex chromosomes, females		
XO, monosomic	Turner	4/10,000 females
XXX, trisomic	Viable; most	
XXXX, tetrasomic	are fertile	14.3/10,000 females
XXXXX, pentasomic		
Sex chromosomes, males		
XYY, trisomic	Normal	25/10,000 males
XXY, trisomic		
XXYY tetrasomic	Klinefelter	40/10,000
XXXY, tetrasomic		

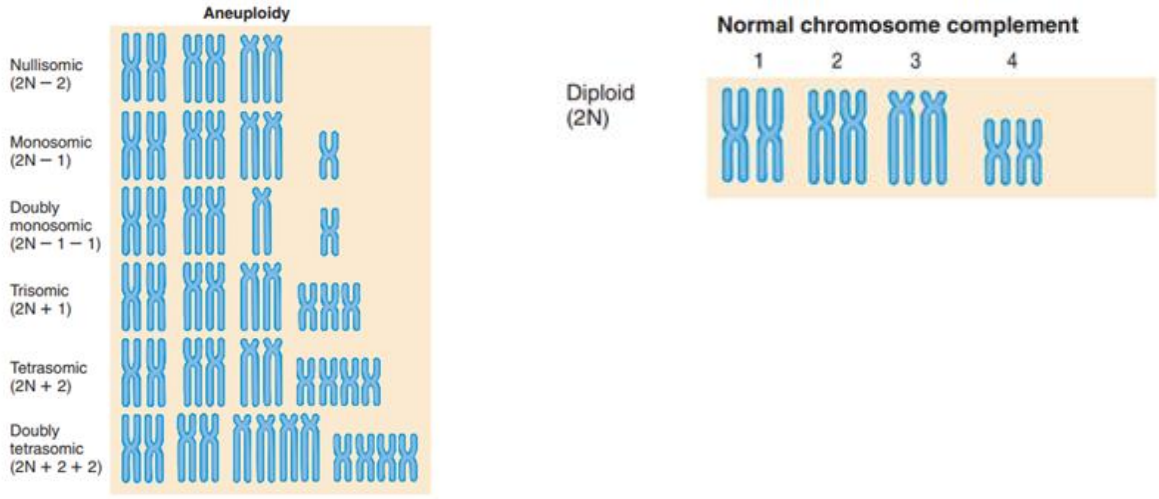

Figure 1: Normal (theoretical) set of metaphase chromosomes in a diploid (2N) organism & examples of aneuploidy

Edwards syndrome

Trisomy 18 produces Edward syndrome which occurs in about 2.5 in 10000 live births. For unknown reason 80% of infants with Edward syndrome are female. 90% of infants with trisomy 18 die within 6 months often from cardiac problem.

Causes - Increased age of mother & nondisjunction.

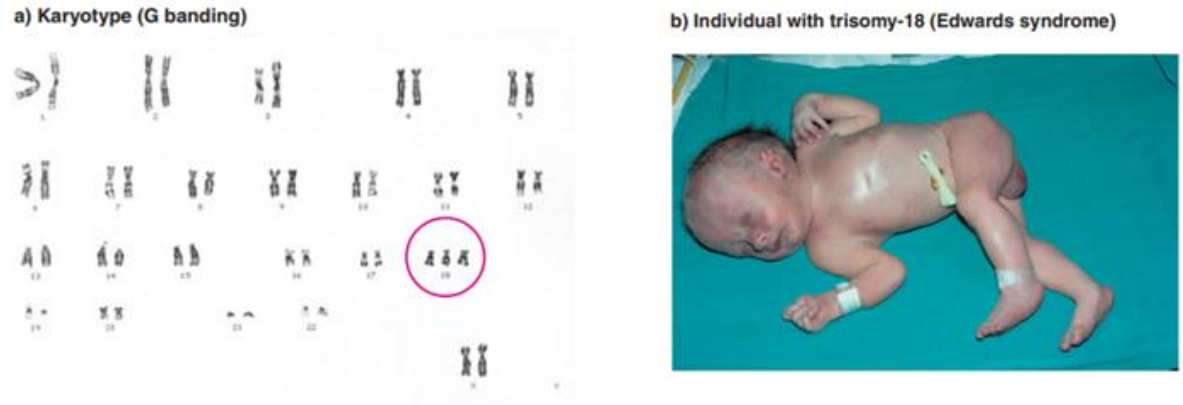

Figure 2: Trisomy-18 (Edwards syndrome)

Features of Edward syndrome

- Individuals with Edward syndrome are small at birth due to growth failure, micrognathia, feeding & breathing difficulties, cleft palette
- Narrow eyelid, widely spaced eyes, dropping of upper eyelid, highly arch eyebrows
- Intellectual disability & mental retardation growth deficiency
- Undescended testicles, developmental delays
- Wide fantanelles (gap between two skull bones) & hence their skull is protruding. protruding occiput, retroflexion of head
- Short sternum, horse-shoe kidney
- Flat foot, prominent heel, dorsal friction of big toes, Rocker bottom feet, Clenched fist, simian crease
- Low set & deformed ears, flexion deformities of fingers
- Abduction - the act of moving a limb away from the body, deformity of hips
- Congenital malformation
- Ventricular septal defects
- Small placenta & polyhydramnios
- Prominent external genitalia
- Persistent ductus arteriosus -

Ductus arteriosus is present in reptiles which is a connection between pulmonary artery & aorta. It mixes oxygenated & deoxygenated blood. This ductus arteriosus is present in human beings at infant stage & degenerates with growing age. This ductus arteriosus is well developed

in patients of Edward syndrome due to which pure & impure blood is mixed & this is the reason that why these patients die within 6 months of their life.

- Omphalocele, Oesophageal atresia - oesophagus end in blind pouch rather than connecting normally to the stomach
- Every organ is defective.

Patau syndrome

Trisomy 13 produces Patau syndrome. about 1 in 15000 live birth produce individual with tricsomy 13. Maternal age is the main cause of Patau syndrome. Most infants die before the age of 3 months. It was discovered by Thomas Bartholin in 1657 & was cytogenetically discovered by Klaus Patau in 1960.

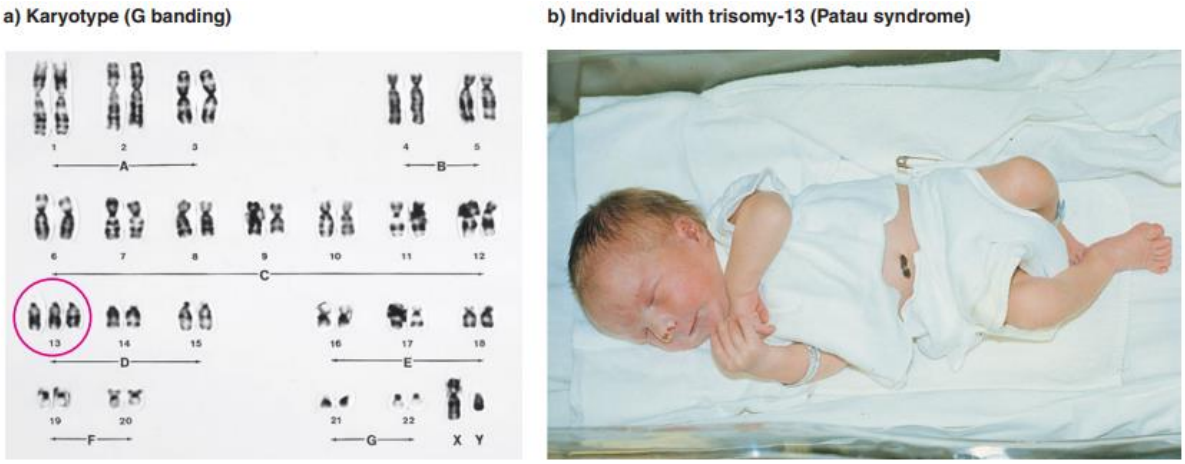

Figure 3: Trisomy-13 (Patau syndrome)

Features of Patau syndrome

- Cyclopia - most striking feature of Patau syndrome; fusion of developing eyes so that baby has one large eye in centre of head. Retinal dysplasia, cataract ,some are blind
- Polydactyly, mental & development retardation
- Flexion deformity & fingernails deformity
- Dextrocardia -congenital disposition of heart from left to the right
- Ventricular septal defect, atrial septal defect
- Increased segmentation of polymorphonuclear granulocytes
- High frequency of drumsticks in blood, Sensory nystagmus, intellectual disability
- Kidney cust, hydroureter, double nephrosis, hydronephrosis.
- Cleft lip & pallete. Nose is malformed large & triangular.
- Low set & deformed ears, deafness, wine coloured birth marks over the skin
- Posterior heel prominence extreme jitterness, motor disorders
- Females have uterus divided into parts, Umbilical hernia
- Holoprosencephaly – Failure of forebrain to divide properly.

- Cryptorchidism – In males of this syndrome, there is failure of one or both testes to descend into the abdomen. As the abdomen temperature is high, there is no production of sperm & males are infertile.

Klinefilter syndrome

In 1940s, Harry Klinefilter described a syndrome occurring in males & usually not detected until after puberty. Later cytogenecists Jacobs & Strong (1959) showed that males with Klinefilter syndrome usually but not always have the 47,XXY karyotype.

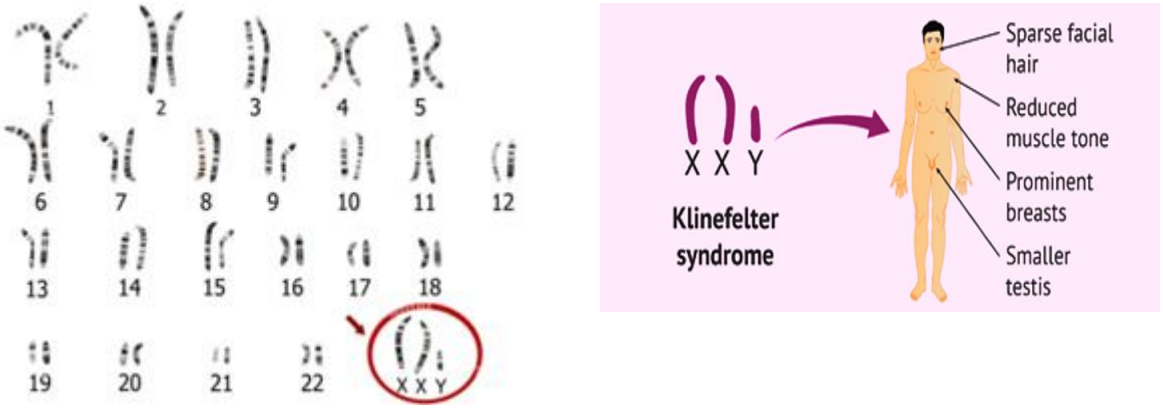

Figure 4: Klinefilter syndrome

Features of Klinefilter syndrome

- Individual having this syndrome has very small testes & as the testes are small & immature there is absence of sperm & androgen deficiency.
- They have poorly developed male secondary sexual character like scanty facial hairs. Breast development in some.
- They possess unusually long limbs & average about 2-4.5 inches taller than unaffected males; their hands &feet may be large too.
- They exhibit mild retardation or learning disabilities which together with an increase tendency lead to emotional problems.
- There is increase risk of breast cancer in adult.
- There is normal sexual behavior in young males having Klinefilter syndrome who experienced spontaneous erection and ejaculation.
- One important feature of this syndrome is that the person with this syndrome is very aggressive.

Klinefilter variants

About 80-85% of males with syndrome exhibit usual 47, XXY karyotype but 10% have abnormal karyotype 48,XXXY, 48,XXYY. Within families Klinefilter syndrome occurs randomly. The extra chromosome is thought to arise from nondisjunction, with slightly more than half of cases occurring during oogenesis in affected man's mother. It is not rare in general

population. Its overall frequency is 1 in 600-1000 liveborn males & about 1 in 300 among spontaneous abortions.

Turner syndrome

An American Endocrinologists Henry Turner (1938) first discovered several grown females who lacked breast development & other secondary sexual characters. They also fail to menstruate & were sterile. In 1959, it was reported that females with Turner syndrome have 45,X karyotype. Females with Turner syndrome is often identified at birth by characteristic skin fold on back of neck, by swelling of hands & feet, by abnormally large fingerprint pattern & low birth weight. As the Turner females lack the second X chromosome they are virtually always sterile. In 80% of cases, it is maternal X chromosome that is retained. About 1 in 2500 live born females have Turner syndrome. But it is highly lethal in embryos being the most common karyotype among miscarriages.

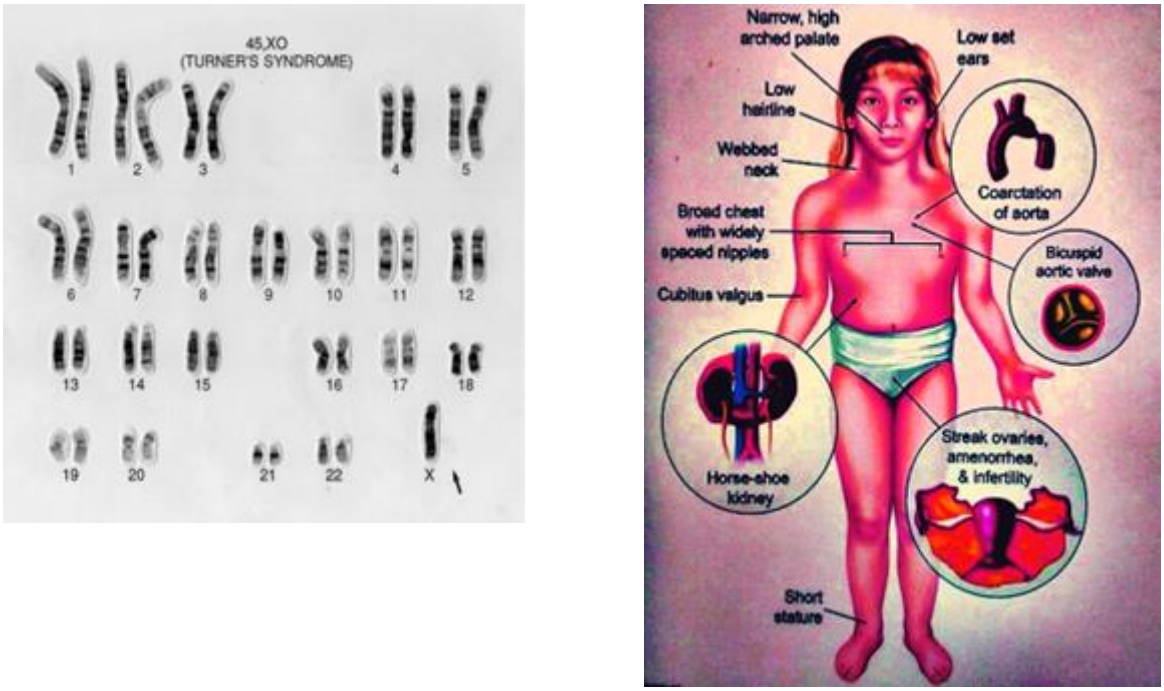

Figure 5: Turner syndrome

Features of Turner syndrome

- Person affected with this syndrome possess short stature (150cm/4feet).
- They have short & webbed neck.
- Most females with Turner syndrome have gonads that lack both germ cells & hormone Oviduct, uterus, vagina remain small & immature.
- External genitals are also immature, only 10% female can menstruate & ovulate.
- Females with this syndrome has widely spaced nipples on broad chest, a narrowed aorta, kidney abnormalities & minor skeletal deformities.
- There is premature aging sometimes occurs, decreased IQ, defects of heart & other organs.

Down syndrome

This syndrome was first described in 1866 by a British physician, Langdon Down, but its chromosomal basis was not clearly understood until 1959. The extra chromosome 21 in Down syndrome is an example of a trisomy.

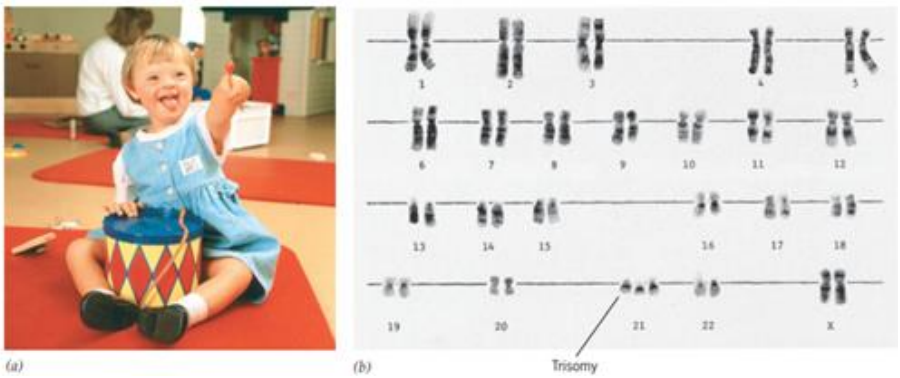

Figure 6: Down syndrome. (a) A young girl with Down syndrome. (b) Karyotype of a child with Down syndrome, showing trisomy for chromosome 21 (47, XX, +21)

Trisomy 21 can be caused by chromosome nondisjunction in one of the meiotic cell divisions. The nondisjunction event can occur in either parent, but it seems to be more likely in females. In addition, the frequency of nondisjunction increases with maternal age. Thus, among mothers younger than 25 years old, the risk of having a child with Down syndrome is about 1 in 1500, whereas among mothers 40 years old, it is 1 in 100. This increased risk is due to factors that adversely affect meiotic chromosome behavior as a woman ages. In human females, meiosis begins in the fetus, but it is not completed until after the egg is fertilized. During the long time prior to fertilization, the meiotic cells are arrested in the prophase of the first division. In this suspended state, the chromosomes may become unpaired. Longer the time in prophase, greater the chance for unpairing and subsequent chromosome nondisjunction. Older females are therefore more likely than younger females to produce aneuploid eggs. Down syndrome can also result from a different sort of chromosomal mutation called centric fusion or Robertsonian translocation, which produces three copies of the long arm of chromosome 21. A Robertsonian translocation is a type of reciprocal translocation in which two nonhomologous acrocentric chromosomes (chromosomes with centromeres near their ends) break at their centromeres and then the long arms become attached to a single centromere The short arms also join to form the reciprocal product, which typically contains nonessential genes and usually is lost within a few cell divisions. In humans, when a Robertsonian translocation joins the long arm of chromosome 21 with the long arm of chromosome 14 (or 15), the heterozygous carrier is phenotypically normal, because there are two copies of all major chromosome arms and hence two copies of all essential genes. This form of Down syndrome, called familial Down syndrome, is responsible for 2–3% of Down syndrome cases.

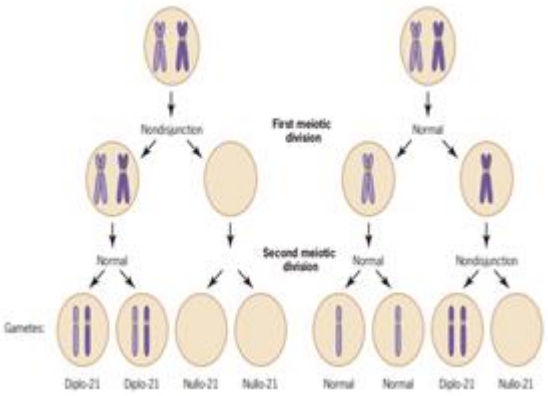

Figure 7: Meiotic nondisjunction of chromosome 21 and the origin of Down syndrome

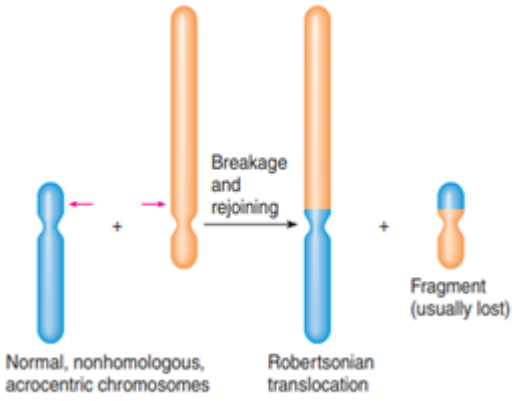

Figure 8: Robertsonian translocation

Features of Down syndrome

- People with Down syndrome are typically short in stature and loose-jointed, particularly in the ankles
- They have broad skulls, wide nostrils, large tongues with a distinctive furrowing,
- Stubby hands with a crease on the palm.
- Impaired mental abilities require that they be given special education and care.
- The life span of people with Down syndrome is much shorter than that of other people.
- Down syndrome individuals also almost invariably develop Alzheimer's disease, a form of dementia that is fairly common among the elderly.
- However, people with Down syndrome develop this disease in their fourth or fifth decade of life, much sooner than other people

Structural abnormalities of human chromosome & related syndrome

The structural abnormalities in chromosomes involves changes in total number of genes or gene loci in chromosome. Structural changes in chromosome are the rearrangement in chromosome. Structural changes in chromosome may be due to deletion, duplication, inversion & translocation.

Deletion – A deletion is a structural change in chromosome resulting from the loss of segment of chromosome that is there is a decrease in length of chromosome. The lost segment does not survive because it lacks the centromere (acrocentric fragment). The portion of chromosome carrying the centromere functions as genetically deficient chromosome. The break may occur at any time during cell cycle either in somatic or germs cell. Chromosome lacks either in interstitial or terminal chromosomal segment which may include only single gene or block of genes. The break in chromosome may be caused by several agents such as chemicals, drugs & radiations.

Deletions may be homozygous & heterozygous –

Homozygous deletion

It involves loss of both copies of chromosome & it is less frequent because at the same time both of the copies of the chromosome may not be mutated. Normally one copy of chromosome is mutated & one copy is normal. Hence the person is protected from number of diseases caused due to mutation & that's why the homozygous deletion does not frequently occur.

Heterozygous deletion

It involves loss of only one copy of chromosome & is more frequent. Maternal imprinting is involved in causing heterozygous deletion. Maternal imprinting suppresses the normal paternal gene & undergoes hypermethylation. So the normal paternal chromosome is of no use.

Types of deletion

1. Interstitial or intercalary deletion -

If two brakes occur at any two points, it results in the loss of intercalary segment of chromosome.

2. Terminal deletion –

If the break in chromosome occurs near the end of chromosome then a small piece of terminal end is lost. The terminal eccentric part of chromosome does not survive. Terminal deletion results from single breaking chromosome.

Cri-du-chat syndrome

It is also known as 5p-syndrome & cat cry syndrome because it occurs by deletion of short arm (p) of chromosome 5 & baby born with the syndrome cry like the mewing of cat. This syndrome was first noted by Lejeune & having karyotype 46(5p-). Frequency is one in 50000 live births. Fertility is not associated with the syndrome.

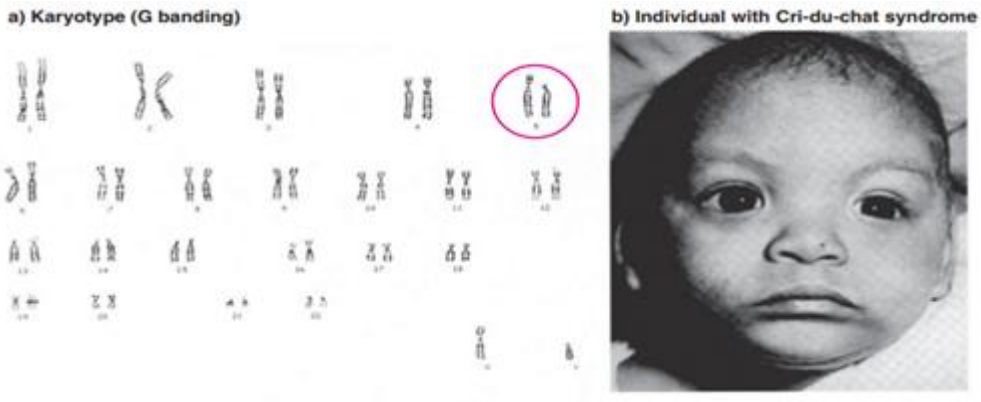

Figure 9: Cri-du-chat syndrome, the result of the deletion of part of one of the copies of human chromosome 5

Features of Cri-du-chat syndrome

- Children's with the syndrome have high pitched cat like cry

- Poor growth
- Microcephaly, broad & moon like face.
- Widely spaced eyes with epicanthal folds, saddle nose, deep-set-eyes, prominent Supra orbital ridges
- Venticular septal defects, atrial septal defects, Persistent ductus arteriosus.
- Short fingers & single palmar crease
- Behavioural problems like hyper activity & aggression
- Excessive drooling, micrognathia, hypotonia, low birth weight
- Distinct facial features, low hair set
- Mental retardation, delayed development
- Impaired language, low IQ, scoliosis
- This type of deletion never get transmitted because most of the individual dies in infancy & rest are having severe mental retardation
- Bicornuate uterus

Prader-Willi syndrome

It is a rare genetic disorder in which 7 genes on chromosome 15 are deleted or unexpressed on paternal chromosome. it was first described in 1956 by Andrea Pradar , Heinrich Willi & Alexis Labhart. In 70 to 80% of cases, the deletion occurs in father & genomic imprinting plays a role. In child with Prader-Willi syndrome, some genes on maternal chromosome 15 are supressed by hypermethylation. Paternally inherited alleles are required for normal development but because of gene deletions or disruption in father, these alleles are lost. The frequency is 1 in 25000 live births & are predominantly males.

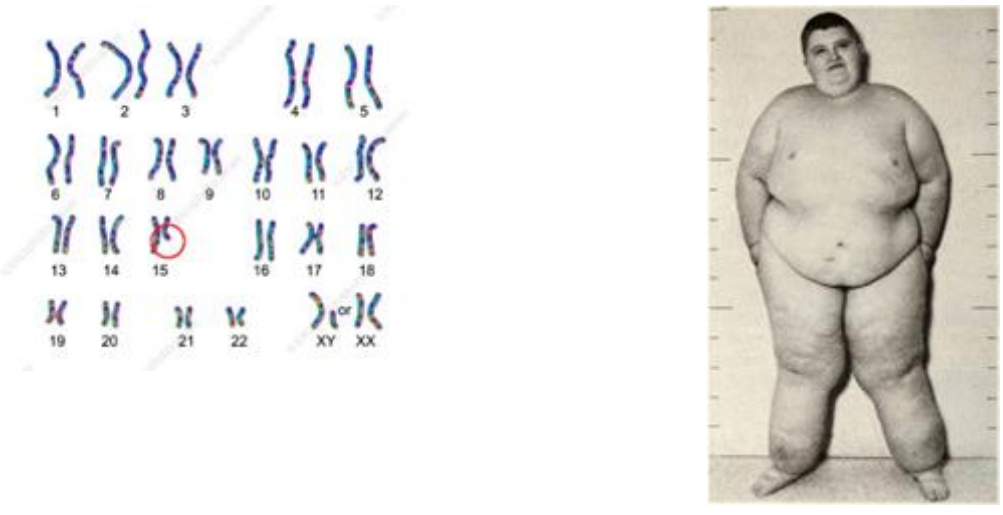

Figure 10: Prader-Willi syndrome

Features of Prader-Willi syndrome

- They are weak because of their diminished swallowing & sucking reflex
- Small hands & feet with tapering of fingers

- High narrow forehead, scoliosis
- Prone to diabetes mellitus
- Sleep disorders, poor growth, poor muscle tone, short stature
- Lethargy, depression
- By the age of 5 to 6, for unknown reasons childrens with Prader-Willi syndrome becomes compulsive eaters, producing obesity & health problems like diabetes. if they are left untreated they eat so horaviously that it will lead to death
- Light coloured skin, childrens with Prader-Willi syndrome rarely live beyond 30 years unless they maintain strict weight control program to control diabetes
- Mental retardation, thin upper lips, weak eyesight & lack of eye coordination
- Incomplete sexual development, tiny external genitalia & under developed gonads
- Behavioural problems, low IQ

Williams syndrome

It is an odd & rare condition because children with this syndrome have some abnormalities but are blessed with number of good qualities. It results due to heterozygous deletion of tiny piece of short arm of chromosome 7 which codes for elastin gene & other which control behavioral characters. Larger is the deletion more will be abnormality. Children with William's syndrome are both gifted & inept. The frequency of the syndrome is 1 in 10000 to 20000 newborns. It was discovered by Dr. John Cyprian Phipps Williams in 1961.

Figure 11: William's syndrome

Features of William's syndrome

- Widely spaced teeth, long philtrum, hypotonia, loss of weight during infancy
- Hypothyroidism, hyperacusia, phonophobia, nystagmus, hypertension
- GI problems, urinogenital problems
- They cannot visualise & manipulate objects or tell left from right
- They are extremely friendly to the family members & strangers, seeking out human contact
- They are very sensitive, sociable & have very strong need for order in their lives

- Young patients have high heart defects, physical problems, behavioural & aorta problems that is aortic stenosis
- They have short strature, wide mouth, turn up nose, large ears, puffy eyes & hoarse voice
- Premature aging of skin, poor IQ
- Mentally retarded but surprisingly good in conversation, having large vocabularies most of them possess verbal & musical abilities, talent for remembering names & faces.

Wolf-Hirschhorn syndrome

It occurs due to deletion in short arm of chromosome 4. It shows distinct crianofacial features. It was first described by Cooper & Hirschhorn in 1961. Prevalence of this syndrome is 1 in 20,000-50,000 births with a female to male ratio of 2:1.

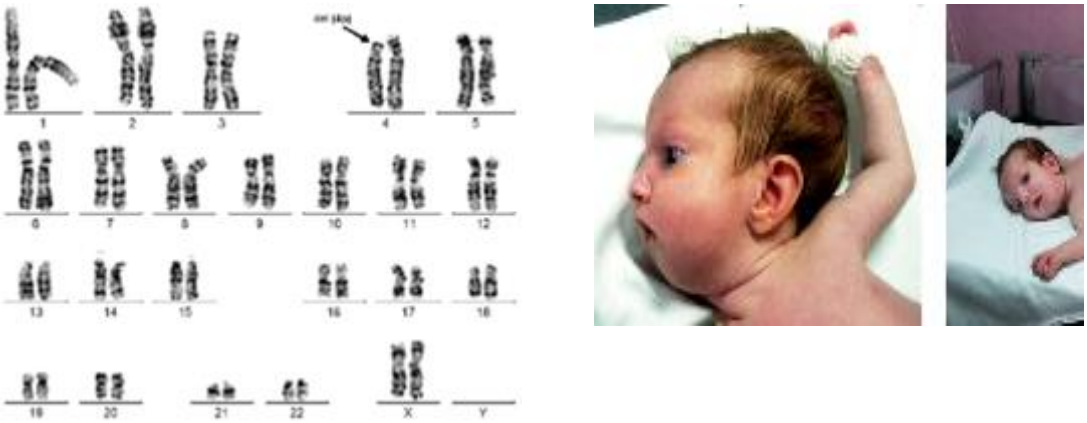

Figure 12: Wolf -Hirschhorn syndrome

Features of Wolf- Hirschhorn syndrome -

- There is improper fusion of midline of body
- Preauricular tags
- Widely set & bulging eyes
- Prominent head, broad nose, low set ears, dysplastic ears
- Intellectual disability, hypotonia, congenital heart defects
- Cleft palate, microcephaly, microganthia
- Heart, lung & skeletal deformities, prominent glabella, hypospandias,
- Colobomata of iris, renal anomalies, deafness, growth restriction
- IgA deficiency, common variable immunodeficiency
- T cell immunity is normal
- Penis in males is improperly fused
- Low birth weight & most of them die young

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ETHICAL DILEMMAS IN MEDICINE: BALANCING PATIENT AUTONOMY AND BENEFICENCE

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Abstract:

Balancing patient autonomy and beneficence is a fundamental challenge in healthcare ethics. Patient autonomy involves respecting a patient's right to make decisions about their medical care, while beneficence obligates healthcare providers to act in the best interests of patients. The intersection of these principles gives rise to complex ethical dilemmas in medical practice. Understanding patient autonomy, informed consent, and the legal and ethical foundations of autonomy is crucial. Informed consent is a cornerstone of autonomy, ensuring patients are well-informed about their care. Ethical codes and guidelines, such as the Declaration of Helsinki, emphasize autonomy and beneficence in research involving human subjects. The principle of beneficence entails providing the best care possible, considering the risks and benefits of interventions. Ethical dilemmas often arise in end-of-life care, psychiatric treatment, and obstetrics, where patient autonomy may conflict with recommended treatments. Factors influencing ethical dilemmas include cultural, religious, and personal values, legal frameworks, and medical advances. Effective strategies for balancing autonomy and beneficence include shared decision-making, ethical consultations, and communication skills. Real-world case studies highlight the challenges of ethical decision-making, demonstrating the importance of a patient-centered approach and interdisciplinary collaboration. Legal consequences and professional codes of ethics underscore the significance of proper documentation in healthcare. Balancing autonomy and beneficence in healthcare requires a nuanced and comprehensive approach that respects patient autonomy while providing the best possible care within the bounds of legal and ethical standards.

Keywords: Ethical dilemmas, patient autonomy, beneficence, informed consent, cultural values, legal consequences, professional ethics

Introduction:

In the field of medicine, ethical dilemmas frequently arise, necessitating a delicate balance between two fundamental principles: patient autonomy and beneficence. These principles serve as cornerstones of medical ethics, guiding healthcare professionals in their

decision-making processes. This chapter aims to explore the nuances of these principles, their definitions, and the ethical complexities that emerge when they intersect.

Definition of patient autonomy

Patient autonomy is a fundamental ethical concept that grants individuals the right to make decisions about their own medical care. It encompasses the idea that patients have the capacity to make informed choices regarding their health and medical treatment. The principle of patient autonomy is rooted in respect for an individual's self-determination, values, and preferences. Informed consent is a critical manifestation of patient autonomy, as it requires healthcare providers to obtain a patient's voluntary and informed agreement before any medical intervention.

Definition of beneficence

Beneficence, on the other hand, is the ethical obligation of healthcare professionals to act in the best interests of their patients, promoting their well-being and doing good. This principle underscores the responsibility to provide competent, compassionate, and effective care. Beneficence can involve actions such as administering appropriate treatments, sharing vital information with patients, and prioritizing their health and safety.

Importance of balancing these principles

The tension between patient autonomy and beneficence often arises when patients' autonomous decisions conflict with what healthcare providers perceive as the best course of action to maximize patient well-being. For instance, a patient may refuse a life-saving treatment due to personal beliefs or cultural considerations, creating a moral dilemma for healthcare professionals who want to act in the patient's best interest. In such situations, the importance of balancing these principles becomes evident. Striking the right balance between respecting a patient's autonomy and fulfilling the ethical duty of beneficence is vital for ensuring both individual rights and the patient's welfare.

Overview of the chapter's structure

This chapter is structured to delve deeper into the ethical dilemmas that arise in medicine when balancing patient autonomy and beneficence. The following sections will provide a comprehensive exploration of these dilemmas, offering practical examples, ethical frameworks, and guidance for healthcare professionals.

Dilemmas in informed consent: This section will address issues related to informed consent, exploring scenarios where patients may not fully understand the implications of their choices and the ethical responsibilities of healthcare providers in obtaining valid consent.

Cultural and religious considerations: Here, we will examine how cultural and religious beliefs can impact a patient's decisions and how healthcare professionals should navigate these complex intersections while maintaining ethical standards.

End-of-life decisions: The ethical challenges surrounding end-of-life decisions will be discussed, emphasizing the delicate balance between respecting a patient's wishes and ensuring that no harm befalls them.

Resource allocation and distributive justice: The final section will explore the broader ethical dilemmas that healthcare systems face when determining the allocation of limited resources, such as organ transplants, and the ethical principles of beneficence and justice in these contexts.

In conclusion, this chapter underscores the multifaceted nature of ethical dilemmas in medicine, where patient autonomy and beneficence often intersect and sometimes collide. Navigating these dilemmas requires a nuanced understanding of the principles at play, as well as an appreciation of the ethical frameworks that can guide healthcare professionals in their decision-making processes, ultimately ensuring the best possible care for patients while respecting their autonomy.

The principle of autonomy:

Explanation of patient autonomy in healthcare

Patient autonomy in healthcare refers to the fundamental ethical principle that recognizes an individual's right to make decisions about their own medical care and treatment. It is rooted in the principle of respect for persons, emphasizing that individuals have the capacity and right to make informed choices regarding their health, medical interventions, and the course of their treatment. This principle acknowledges that patients are not merely passive recipients of medical care but active participants in the decision-making process. Patient autonomy respects an individual's values, beliefs, and preferences, allowing them to exercise control over their medical decisions. Healthcare providers should engage in open and honest communication with patients, ensuring that they have access to relevant information necessary to make informed choices about their health. This empowerment of patients promotes their dignity and agency in the healthcare context.

Informed consent: A cornerstone of autonomy

One of the central components of patient autonomy is informed consent. Informed consent is a process by which healthcare providers obtain the voluntary and informed agreement of a patient before any medical intervention. It ensures that patients are aware of the risks, benefits, alternatives, and consequences of a proposed medical procedure or treatment. Informed consent is crucial in upholding patient autonomy because it allows individuals to exercise their right to make choices based on a clear understanding of the situation.

Informed consent involves several key elements, including:

Disclosure: Healthcare providers must provide patients with comprehensive and relevant information about their medical condition, proposed treatments, potential risks, and expected outcomes.

Capacity: Patients must possess the mental and emotional capacity to comprehend the information provided and make a decision. If they lack the capacity to make decisions, a legally authorized representative may act on their behalf.

Voluntariness: Patients must make their decisions freely and without coercion or undue influence. They should feel comfortable declining treatment or seeking a second opinion.

Understanding: Patients should demonstrate a sufficient understanding of the information provided, enabling them to make an informed decision.

Informed consent not only respects patient autonomy but also establishes a legal and ethical framework for healthcare providers to ensure that patients are active participants in their care. It protects patients from unwanted medical interventions and safeguards their right to determine their own medical destiny.

Legal and ethical foundations of autonomy

The legal and ethical foundations of patient autonomy are crucial to ensuring its protection and promotion in healthcare settings. Various documents and guidelines reinforce the principle of autonomy:

The Nuremberg Code (1947): This code was developed in response to the unethical medical experiments conducted during World War II. It emphasizes the importance of voluntary, informed, and uncoerced consent in medical research involving human subjects.

The Declaration of Geneva (1948): A revision of the Hippocratic Oath, it underscores the ethical duty of physicians to respect patient autonomy and maintain the confidentiality of patient information.

The Declaration of Helsinki: As previously mentioned, this document by the World Medical Association outlines ethical principles for medical research involving human subjects and underscores the importance of respecting autonomy.

Legal regulations: Many countries have enacted laws and regulations that recognize and protect patient autonomy, such as the U.S. Health Insurance Portability and Accountability Act (HIPAA), which safeguards the privacy and control of patient information.

In summary, patient autonomy is a foundational principle in healthcare that respects an individual's right to make decisions about their medical care. Informed consent, as a cornerstone of autonomy, ensures that patients have the information and agency needed to make informed choices. The legal and ethical foundations of autonomy, rooted in historical documents and modern regulations, provide the framework for protecting and promoting this critical ethical principle in healthcare.

The principle of beneficence:

Definition and ethical considerations of beneficence

Beneficence, as an essential principle of medical ethics, entails the moral obligation of healthcare professionals to act in the best interests of their patients, promoting their well-being and doing good. The principle of beneficence underscores the responsibility to provide competent, compassionate, and effective care to patients, ensuring that their health and welfare are paramount in every medical decision and action.

Ethical considerations associated with beneficence include the following:

Non-maleficence: Beneficence is closely tied to the principle of non-maleficence, which emphasizes the duty to do no harm. Healthcare providers must not only aim to benefit their patients but also to avoid causing unnecessary harm. The ethical balance between these two principles is crucial, as it helps guide medical decisions that may involve risks or potential harm.

Weighing risks and benefits: In practice, healthcare professionals must carefully weigh the potential risks and benefits of medical interventions to determine the course of action that maximizes the overall well-being of the patient. This process involves evaluating the likely outcomes, potential side effects, and the patient's individual circumstances.

Confidentiality: Maintaining patient confidentiality is an important aspect of beneficence, as it helps build trust and ensures that patients receive the best possible care without fear of privacy breaches. By safeguarding personal information, healthcare providers create a supportive environment for patients.

The Duty to Provide the Best Possible Care The duty to provide the best possible care is a fundamental aspect of beneficence. Healthcare professionals are ethically bound to strive for excellence in their medical practice, offering the highest quality of care to their patients. This duty includes several key components:

Competence: Healthcare providers are expected to maintain high levels of professional competence, staying up to date with the latest medical knowledge and skills. They must continuously improve their expertise to provide the best care possible.

Patient-centered care: Beneficence demands a patient-centered approach, where healthcare decisions are made based on the individual needs and values of the patient. This approach ensures that the care provided is tailored to the unique circumstances and preferences of the patient.

Effective communication: Effective communication between healthcare providers and patients is vital for ensuring that patients are well-informed about their condition, treatment options, and potential outcomes. Transparent and compassionate communication fosters trust and helps patients make informed decisions.

Beneficence and medical ethics codes

Medical ethics codes and guidelines serve as a framework for the application of beneficence in healthcare. They outline the ethical responsibilities of healthcare professionals and institutions to prioritize patient welfare. Several important documents and codes emphasize the principle of beneficence:

The Hippocratic Oath: This ancient oath, historically taken by physicians, includes the commitment to beneficence by pledging to "do no harm" and "use my power to help the sick."

The American Medical Association code of medical ethics: This code provides guidance to physicians and the medical profession, emphasizing the importance of patient welfare, informed consent, and respect for patient autonomy.

International ethical guidelines: International organizations such as the World Medical Association have developed ethical guidelines that underscore the importance of beneficence, particularly in research involving human subjects.

In conclusion, beneficence is a foundational principle in medical ethics that obligates healthcare professionals to act in the best interests of their patients. This principle encompasses considerations of non-maleficence, the duty to provide the best possible care, and adherence to medical ethics codes and guidelines that prioritize patient welfare and well-being. By upholding the principle of beneficence, healthcare providers demonstrate their commitment to doing good for their patients and maintaining the highest ethical standards in their practice.

Ethical dilemmas at the intersection of autonomy and beneficence:

Cases and scenarios illustrating conflicts

The intersection of patient autonomy and beneficence often gives rise to complex ethical dilemmas in the field of healthcare. These dilemmas occur when patient preferences or decisions conflict with what healthcare professionals believe to be the best course of action for maximizing patient well-being. Several cases and scenarios illustrate these conflicts:

Case of Jehovah's witnesses: A patient who is a Jehovah's Witness refuses a blood transfusion, even in a life-threatening situation, due to religious beliefs that prohibit blood transfusions. Healthcare providers must respect the patient's autonomy but are faced with the ethical dilemma of providing life-saving treatment that conflicts with the patient's wishes.

Psychiatric treatment: A patient with severe mental illness may refuse necessary psychiatric treatment. Healthcare providers grapple with the tension between respecting the patient's autonomy and ensuring their safety and well-being.

Pediatric decision-making: In pediatric cases, parents may make decisions on behalf of their children that healthcare professionals consider detrimental to the child's health. Balancing parental autonomy with the child's best interests creates ethical complexities.

Examples of dilemmas in treatment decisions:

Dilemmas at the intersection of autonomy and beneficence often manifest in treatment decisions:

End-of-life care: A terminally ill patient may refuse aggressive medical interventions, opting for palliative care to maximize comfort and quality of life. Healthcare providers may believe that further treatment is warranted, leading to a conflict between the patient's autonomy and the duty to provide the best care.

Mental health treatment: A patient with severe depression may decline medication or therapy. Healthcare providers must weigh the patient's autonomy against the duty to alleviate suffering and promote mental well-being.

Childbirth and obstetrics: Pregnant individuals may refuse medically recommended interventions during childbirth. Healthcare providers must balance respecting the patient's autonomy with ensuring the safety of both the mother and the baby.

The tension between respecting patient wishes and providing optimal care:

The tension between respecting patient wishes and providing optimal care underscores the ethical complexity of these dilemmas. It necessitates a careful, nuanced approach to decision-making. Several key considerations come into play:

Informed decision-making: Healthcare providers should ensure that patients make decisions based on accurate and complete information. This empowers patients to make informed choices that align with their values and preferences.

Shared decision-making: Collaboration between healthcare providers and patients, often referred to as shared decision-making, allows for a more balanced approach. It involves discussing treatment options, risks, benefits, and patient values to reach a consensus on the most appropriate course of action.

Ethical frameworks: Ethical frameworks, such as the four principles of biomedical ethics (autonomy, beneficence, non-maleficence, and justice), can guide healthcare professionals in resolving dilemmas. These frameworks help weigh the ethical principles involved and prioritize patient welfare while respecting autonomy.

Advance directives: Patients can express their treatment preferences in advance directives, which are legally binding documents that guide care in situations where patients may lose decision-making capacity. This allows for the pre-establishment of autonomy while addressing potential conflicts.

Ethical consultations: In complex cases, healthcare institutions may offer ethics consultations involving a team of experts to provide guidance on resolving dilemmas while balancing autonomy and beneficence.

In conclusion, ethical dilemmas at the intersection of autonomy and beneficence are inherent to the practice of healthcare. These dilemmas often arise in treatment decisions where patient autonomy conflicts with the duty to provide optimal care. By applying ethical principles, engaging in open communication, and respecting informed decision-making, healthcare providers can navigate these complexities while upholding the best interests of their patients.

Factors influencing ethical dilemmas:

Cultural, religious, and personal values

Cultural, religious, and personal values play a significant role in shaping ethical dilemmas in healthcare. These factors influence the moral beliefs and preferences of both patients and healthcare providers, leading to situations where autonomy and beneficence may come into conflict:

Cultural values: Different cultures have distinct beliefs and practices related to health and medical decision-making. For example, some cultures prioritize family decision-making, while others emphasize individual autonomy. These cultural variations can lead to ethical dilemmas, especially when the patient's values clash with those of the healthcare team.

Religious values: Religious beliefs often guide healthcare decisions, such as end-of-life care, reproductive choices, and blood transfusions. For instance, Jehovah's Witnesses may refuse blood transfusions, presenting ethical challenges for healthcare providers who prioritize beneficence.

Personal values: Individuals have their own personal values and preferences that may influence their healthcare choices. Personal values can include ethical principles, moral convictions, and life priorities. When these values conflict with recommended medical treatments, ethical dilemmas may arise.

Legal frameworks and guidelines:

Legal frameworks and guidelines play a crucial role in defining and addressing ethical dilemmas in healthcare. These frameworks often establish the boundaries within which decisions must be made and provide guidance on the legal aspects of respecting autonomy and beneficence:

Informed consent laws: Legal requirements for informed consent vary by jurisdiction. Laws define what information must be disclosed to patients, the capacity required for consent, and the process for obtaining informed consent. Healthcare providers must adhere to these laws when navigating ethical dilemmas related to patient autonomy.

Advance directives: Many countries have laws that recognize advance directives, allowing individuals to specify their medical treatment preferences in advance. These directives serve as legal guides when patients lose decision-making capacity, reducing conflicts in some cases.

Legal standards for beneficence: Legal standards often establish the duty of healthcare providers to provide a certain standard of care. Failure to meet these standards can lead to legal consequences, which creates an ethical obligation for healthcare professionals to provide the best possible care.

Medical advances and technological possibilities:

Advances in medical technology and the possibilities they present can introduce new ethical dilemmas:

Treatment options: Technological advancements may create a wider range of treatment options, making it challenging for patients and healthcare providers to decide the most appropriate course of action. Balancing autonomy and beneficence becomes more complex as the number of choices increases.

Resource allocation: Medical advances may also raise questions of resource allocation. The availability of expensive treatments or procedures may lead to dilemmas regarding the equitable distribution of limited resources, necessitating ethical consideration of beneficence on a broader scale.

Privacy and data ethics: The use of electronic health records and telemedicine may pose ethical dilemmas related to patient privacy and data security. Balancing patient autonomy in healthcare decisions with the need to protect patient information presents ongoing challenges.

These factors underscore the dynamic and evolving nature of ethical dilemmas in healthcare, influenced by cultural, religious, and personal values, legal frameworks, and the continuous development of medical technology. Navigating these dilemmas requires healthcare professionals to be aware of these factors and to adopt a patient-centered, ethical decision-making approach that prioritizes both autonomy and beneficence.

Strategies for balancing autonomy and beneficence

Balancing autonomy and beneficence in healthcare is a complex and critical endeavor. Several strategies and approaches help healthcare providers navigate ethical dilemmas while ensuring the best interests of the patient.

Shared decision-making: An approach to involve patients

Shared decision-making (SDM) is a patient-centered approach that involves patients in the decision-making process by collaborating with healthcare providers. It allows patients to actively participate in determining their medical care while considering their values, preferences, and the best available evidence. Key elements of shared decision-making include:

Information sharing: Healthcare providers share relevant information about the patient's medical condition, treatment options, potential risks, and benefits in a clear and understandable manner. This empowers patients to make informed choices.

Deliberation: Patients and healthcare providers engage in discussions about the available options and consider the patient's values and goals in relation to the proposed treatments.

Respect for autonomy: Shared decision-making respects the patient's autonomy by recognizing their right to make decisions about their care. It acknowledges that the patient's perspective is crucial in determining the best course of action.

Collaborative decision: The final decision is made jointly, considering the patient's preferences and the healthcare provider's expertise.

Ethical consultations and case conferences:

Ethical consultations and case conferences are valuable tools for addressing complex ethical dilemmas in healthcare:

Ethical consultations: These involve seeking input from experts in medical ethics when faced with challenging cases. Ethics consultants provide an objective, ethical analysis of the situation and can offer guidance on how to balance autonomy and beneficence. The process may include reviewing the ethical principles at stake, analyzing relevant guidelines, and exploring potential solutions.

Case conferences: Interdisciplinary case conferences bring together healthcare professionals from various fields, including physicians, nurses, social workers, and ethicists, to discuss complex cases. These conferences encourage collective decision-making and a thorough examination of the ethical dimensions of the case.

Communication and negotiation skills for healthcare providers:

Effective communication and negotiation skills are essential in resolving ethical dilemmas and balancing autonomy and beneficence. Healthcare providers should possess the following skills:

Active listening: Actively listening to patients and their concerns allows healthcare providers to understand the patient's values and preferences, which are critical in respecting autonomy.

Empathy: Demonstrating empathy and understanding fosters trust and open communication, making it easier for patients to express their needs and concerns.

Cultural competency: Healthcare providers should be culturally sensitive and aware of the diverse beliefs and values of patients to ensure that care aligns with their cultural and religious backgrounds.

Negotiation skills: In cases where patient preferences conflict with recommended treatments, healthcare providers should employ negotiation skills to reach a consensus. This may involve discussing alternative options that respect the patient's autonomy while ensuring their well-being. These strategies, rooted in shared decision-making, ethical consultations, and effective communication, provide a framework for healthcare providers to address ethical dilemmas while

respecting patient autonomy and promoting beneficence, ultimately ensuring the best possible care for their patients.

Case studies and practical examples:

Real-world cases highlighting ethical challenges

Real-world case studies in healthcare illustrate the ethical dilemmas that healthcare professionals often encounter, highlighting the intersection of autonomy and beneficence. These cases serve as powerful examples of the complexities involved in medical decision-making:

The case of Mrs. Smith: Mrs. Smith is an elderly patient with advanced cancer who is in severe pain. She refuses all pain medication because she fears becoming addicted. Healthcare providers must balance respecting her autonomy, including her right to refuse medication, with the obligation to relieve her suffering through beneficence.

Pediatric decision-making: In the case of a critically ill child, parents insist on pursuing an unconventional and unproven alternative treatment despite the medical team's recommendation for standard care. The healthcare team faces the challenge of respecting parental autonomy while ensuring the child's best interests.

Mental health treatment: A patient with schizophrenia refuses antipsychotic medication, citing concerns about side effects. The medical team must navigate the ethical dilemma of respecting the patient's autonomy while providing treatment to manage severe symptoms and prevent harm.

How healthcare professionals navigated the dilemmas:

Healthcare professionals navigate these ethical dilemmas by employing a combination of strategies, communication, and ethical principles:

Informed consent discussions: In the case of Mrs. Smith, healthcare providers engage in open, compassionate discussions about pain management, explaining the benefits and risks of medications without dismissing her concerns. Shared decision-making is used to ensure her autonomy while addressing her suffering.

Ethical consultations: In the pediatric case, healthcare professionals seek an ethical consultation to discuss the ethical principles and potential courses of action. The consultation involves experts in pediatric care, medical ethics, and child welfare to collaboratively determine the best approach.

Communication and education: In the mental health case, healthcare providers emphasize the importance of understanding the patient's concerns. They educate the patient about the potential consequences of refusing medication, engage in ongoing discussions, and involve family members or support networks in the decision-making process.

Lessons learned and best practices:

From these case studies, several lessons and best practices emerge:

Patient-centered approach: Adopting a patient-centered approach that values open communication, respect for autonomy, and shared decision-making is essential. This ensures that patients actively participate in decisions about their care.

Interdisciplinary collaboration: In complex cases, interdisciplinary collaboration and ethical consultations can provide valuable insights and guidance. Involving experts in ethics, psychology, and other relevant fields allows for a more holistic and informed approach.

Balancing autonomy and beneficence: Healthcare providers must continually seek a balance between respecting patient autonomy and fulfilling their duty to provide the best possible care. This may require creative solutions, alternative treatments, or ongoing support to address patients' concerns.

Ethical reflection and ongoing education: Regular ethical reflection, training, and education are essential for healthcare professionals to navigate ethical dilemmas effectively. Staying updated on the latest ethical guidelines and healthcare practices is crucial.

Respect for diversity: Recognizing and respecting cultural, religious, and personal values is critical. Healthcare providers should be culturally sensitive and adaptable to the diverse backgrounds and beliefs of their patients.

By learning from real-world case studies and implementing these best practices, healthcare professionals can better address ethical dilemmas, respect autonomy, and uphold the principles of beneficence to provide optimal care for their patients.

Legal and ethical implications:

Legal consequences of ethical decision-making

Legal consequences often accompany ethical decision-making in healthcare, and understanding these implications is essential for healthcare professionals. Key aspects include:

Informed consent: Ethical requirements for obtaining informed consent are often reinforced by legal standards. Failure to adequately inform patients about risks, benefits, and alternatives may result in legal liability.

Negligence and malpractice: When healthcare providers fail to meet the standard of care, they may be liable for negligence or malpractice. Negligence in ethical decision-making, such as not adequately assessing a patient's capacity to make decisions, can have legal consequences.

Advance directives: Ignoring or not following valid advance directives, which are legally binding, can result in legal challenges. Healthcare professionals must respect these documents.

Professional consequences and codes of ethics:

Ethical decision-making in healthcare is closely tied to professional consequences and adherence to codes of ethics:

Professional licensure and accreditation: Ethical misconduct can lead to professional repercussions, including disciplinary actions against a healthcare provider's license or accreditation status.

Malpractice insurance: Ethical violations can affect a healthcare provider's malpractice insurance, potentially leading to increased premiums or coverage limitations.

Professional codes of ethics: Ethical decision-making is guided by professional codes of ethics that outline the standards and principles that healthcare providers must follow. Violating these codes can result in professional consequences.

The importance of documenting decisions:

In healthcare, thorough documentation of ethical decisions is crucial. Proper documentation helps protect healthcare providers and institutions by providing a record of the decision-making process. Key points include:

Informed consent records: Detailed records of informed consent discussions, including what was disclosed, patient questions, and their agreement, serve as legal protection in the event of disputes.

Advance directives: Documenting the presence of advance directives, discussions with patients about these directives, and actions taken in accordance with them helps ensure legal compliance.

Ethical consultations: Records of ethical consultations and case conferences should be maintained to demonstrate due diligence in addressing complex ethical dilemmas.

Proper documentation is not only a legal safeguard but also an ethical obligation to maintain transparency, ensure accountability, and provide a clear record of how ethical decisions were reached.

Conclusion:

This chapter explores the ethical dilemmas at the heart of healthcare, where the principles of patient autonomy and beneficence intersect. It defines these principles, highlighting their importance and how they relate to informed consent. The duty of healthcare providers to provide the best care while respecting patient autonomy is central to the discussion. Factors influencing these dilemmas, such as cultural values, legal frameworks, and medical advancements, are examined. Strategies for navigating these ethical challenges, including shared decision-making and ethical consultations, are presented. Real-world case studies illustrate the complexities of these dilemmas, emphasizing the need for a patient-centered approach and interdisciplinary collaboration. The chapter also underscores the legal and professional consequences of ethical decisions, emphasizing the importance of proper documentation. In essence, this chapter underscores the delicate balance healthcare providers must strike between respecting patient autonomy and providing optimal care while navigating complex ethical terrain. It highlights the

ethical responsibilities inherent in medical practice, ensuring the well-being of patients and upholding the highest ethical standards in healthcare.

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A REVIEW ON HERBAL PLANTS AND IT'S THERAPEUTIC PROPERTIES

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Abstract:

Currently, more than half of the world's population suffers with dandruff. A scalp condition known as dandruff is caused by the yeast. The major causes of dandruff are bacteria (*Staphylococcus aur*eus) and fungus (*Candida albicans*). This fungus, which disrupts normal dead cell discharge, causes dandruff. One may experience poor confidence and problems with their social or self-esteem as a result. It frequently occurs around the folds of the nose and eyebrows in addition to the scalp (Sahraie-Rad *et al.*, 2015). In order to successfully manage and control dandruff; total eradication is not possible. The Shampoo and serum are used to clean off surface grit, filth, and skin debris without endangering the scalp or hair by removing it from hair shafts and appropriate surface-active substances (surfactants) in liquid, solid, or form of powder. Several anti-fungal medications can be used to treat dandruff agents. The adverse consequences of synthetic chemical shampoos in human body include headaches, nausea, increased itching, and hair loss and damage (Sahraie-Rad *et al.*, 2022). Due to This safer herbal anti-dandruff shampoo was created from many plants extracts Rural locations may readily find the plants employed in ancient medical systems, which provide an affordable alternative to modern treatment. multiple herbal polyherbal hair products and shampoos are produced to reduce dandruff in healthy manner. Hair care products are made from herbal plant extracts

Keywords: Dandruff, Herbal plants, Scalp, plant extracts

Introduction:

Nearly half of the world's populations regardless of gender affected by dandruff. Dandruff is characterized as a hyperproliferation of the scalp epidermis accompanied with scalp itching and redness. Your hair, mustache, beard, and scalp may all have skin flakes. scratchy scalp Infants with cradle cap have a scaly, crusty scalp. mostly occurs after puberty, between 20-30 years. Cells are pushed outwards of the epidermal layer as it continuously replaces itself, where they finally perish and flake off. These skin flakes are often too minute to be seen by most people. Cell turnover can, however, be extraordinarily quick under certain circumstances, particularly in the scalp. According to a theory, skin cells may grow and shed for those with dandruff in 2–7 days as contrasted to those without it in about a month. Humans have struggled to combat numerous diseases, discomforts, and threats for a long time using a variety of methods. The utilization of medicinal plants for the treatment of various diseases is one of the

many strategies used to battle sickness (Chandrani *et al.,* 2012). Shampoos are used in the treatment of dandruff. Anti dandruff shampoo is synthesized, because chemical shampoo has some side effects in human body and they unable to prevent occurrence. To achieve patient compliance, a good anti-dandruff shampoo must not just deliver outstanding anti-dandruff relief. provide superior hair and cosmetic services simultaneously beneficial for conditioning. The multi-herbal anti-dandruff hair oil, shampoo, serum that has been created is quite effective.

Types of dandruff:

Skin flakes can form on the scalp due to the disorder known as dandruff. There are two main types of dandruff: dry dandruff and oily dandruff. Dry dandruff is characterized by tiny, white skin flakes. This kind of dandruff is frequently caused by dry skin or sensitivity to hair care products. The telltale sign of oily dandruff are larger, yellowish skin flakes. The cause of this type of dandruff is typically oily skin or a fungal infection (Malpani *et al.,* 2020).

Symptoms:

The main symptoms of dandruff are an itchy scalp and flakiness. Red and greasy patches of skin and a tingly feeling on the skin are also symptoms, flakes on your scalp.

Plant material:

Plants classified as herbal are those that have historically been employed for their therapeutic, gastronomic, or fragrant qualities. They are frequently appreciated for having natural components that provide a variety of health advantages Plant leaves, flowering tissues, and woody parts like stems and bark are abundant with phenolic antioxidants, such as flavonoids and phenolic acids, which are crucial for proper plant development and infection resistance (Yadav *et al.*,2009). Plants were meticulously and thoughtfully harvested from the locations.

Aloe vera: Aloe vera's calming and anti-inflammatory qualities might help lessen itching and flakiness on the scalp (Arora *et al.*,2019)

Neem: Compounds including nimbin and azadirachtin, which have antifungal and antimicrobial properties, are found in neem leaves and oil (kumari *et al.*,2022)

Hibiscus; Hibiscus may relieve itchy scalp and contains anti-dandruff qualities. To treat dandruff, it is frequently used in shampoos and hair masks and hair Oil (Naphade *et al.,* 2021).

Plant extract:

Extracts from plants, such as those made from their leaves, stems, flowers, or roots, are concentrated compounds. Due to their potential therapeutic and health advantages, plant extracts are employed in a variety of sectors, such as medicines, cosmetics, food additives, and traditional medicine. A variety of bioactive substances, including phytochemicals, essential oils, and antioxidants, are present in them. Plant bioactive chemicals may be extracted using a variety of techniques.

Effect of herbs on dandruff

Plants and natural ingredients often used in antidandruff treatments can have various effects on the scalp (Keragala, R. K *et al.,* 2020).

Antifungal properties: Many plants, like tea tree oil, neem, and rosemary, contain compounds that have antifungal properties. These can help control the growth of the yeast that contributes to dandruff.

Anti-inflammatory effects: Ingredients like aloe vera and oatmeal have anti-inflammatory properties that can soothe an irritated scalp, reduce redness, and alleviate itchiness caused by dandruff.

Moisturization: Coconut oil, honey, and yogurt are known for their moisturizing properties. They can help nourish a dry scalp, reducing flakiness and promoting overall scalp health.

Exfoliation: Baking soda and oatmeal act as natural exfoliants. They can help remove dead skin cells and excess oil, which are factors that contribute to dandruff.

pH Balance: Apple cider vinegar is believed to help balance the pH of the scalp, creating an environment less conducive to the growth of dandruff-causing microbes.

Restoring microbiome: Some ingredients, like yogurt, contain probiotics that can help restore the balance of beneficial bacteria on the scalp, which may play a role in controlling dandruff.

Cleansing: Lemon juice has natural astringent properties that can help cleanse the scalp and regulate oil production.

Materials and Methods:

***Aloe barbadensis* miller extract**

Pick Aloe vera leaves that are ripe and healthy. The gel on leaves that are nearer the plant's base is frequently thicker. Trim the plant's outer leaves with a sharp knife. Choose leaves that are a couple inches or longer. If you cut the leaves, a yellowish liquid may ooze out. This substance is known as latex, which has a laxative effect and isn't frequently utilized in skin or hair care products. Place the chopped leaves upright in a basin for 10 to 15 minutes to enable the latex to drain, then remove the latex. After draining, gently cut off the spiky leaf edges with a sharp knife before slicing the leaf open lengthwise to extract the gel. Gently scoop out the clear gel from the leaf's inside using a spoon or knife. Put the gel in a pristine container. Aloe vera gel that has been extracted should be kept in the fridge in an airtight container preparing agar plates or another suitable growing medium for the fungus that causes dandruff. To create a fungal culture, inoculate the plates with the fungus and let it develop for a certain amount of time. Group the plates into a control group and an experimental group with various Aloe vera gel or extract concentrations. While ensuring even distribution, apply different doses of Aloe vera gel or extract to the experimental plates. All plates, including the control, should be incubated in circumstances that will promote fungal development. Check the fungal development in each

plate periodically using a microscope or by gauging colony diameter. Compare the fungus's ability to grow in the experimental and control plates. a decrease in fungus development in the Aloe vera-treated (Arora *et al.,* 2019).

Delonix regia extract

Obtain the leaves of Delonix regia or other plant components. Utilize a suitable solvent (ethanol) to extract the active components. Purify and concentrate the extract. Malassezia spp., a fungus that causes dandruff, should be grown in an appropriate growth medium as part of an antifungal assay. Delonix regia extract in various quantities should be added to the fungal cultures. Incubate the fungus and track its development over time.by using techniques like turbidity readings or colony we can counts to measure the suppression of fungal growth. hence its extract has anti dandruff effect (Meena *et al.,* 2023).

***Hibiscus rosa-sinensis* extract**

Gather fresh hibiscus blooms or leaves. Utilize a suitable solvent (ethanol) to extract the active components. Purify and concentrate the extract. Malassezia species should be grown in an appropriate growth medium, such as Sabouraud agar, to eradicate dandruff. Place the culture in an incubator set at the right temperature for the particular fungus (often between 30-37°C). Prepare Petri plates for sterilization and add a layer of the fungus growth media. Make wells in the agar using a well-cutter or a sterile cork borer. Fill the wells with various amounts or concentrations of the hibiscus extract. Include control wells that contain simply the growth medium (negative control) and wells that also include well-known antifungal substances (positive control). For a predetermined amount of time (48 hours), incubate the Petri plates at the right temperature for the fungus. Measure the diameter of the clear zones (zones of inhibition) surrounding each well where fungal growth has been stopped after incubation. Make use of a ruler or calipers. Note the data for each Hibiscus extract concentration and the controls. The outcomes of the measurements will show how Hibiscus extract inhibits the growth of fungi that cause dandruff (Meena *et al.,* 2021)

***Azadirachta indica* A. Juss extract**

Neem extract should be prepared as a stock solution in a suitable solvent (ethanol) at a predetermined concentration, such as 10 mg/mL.and sterilize the neem extract. Place Petri plates with sterilized agar media within. Give the agar time to harden and form agar plates.

By smearing or streaking, inoculate the agar plates with a standardized concentration of the fungus. Until observable growth is seen, incubate the plates at the proper temperature for the particular fungus (37°C for *Candida albicans*, 25°C for Aspergillus niger).

The use of neem extract: Using a sterile tool (such as a cork borer), make wells or holes in the agar. Each neem extract concentration should be added in a specified volume (for instance, 100

L) into a different well of the agar plates. Include control plates with recognized antifungal agents on them as positive controls and control plates with the solvent (without neem extract).
Incubation: The plates should be incubated for the proper amount of time, such as 24-72 hours. Measurement: Using calipers, determine the diameter of the clear zones (zones of inhibition) surrounding each well. Keep track of the readings for each neem extract concentration by measurements obtained we came to know the inhibitory effect of neem extract on fungal growth (Pal *et al.,* 2020).

Results and Discussion:

In order to fight infections, natural or plant-derived substances are crucial. This study examined the four plant extracts' capacity to prevent the development of fungal culture. Muli herbal hair care products are used to prevent dandruff.

Effect of *Aloe barbadensis miller* on dandruff

This study revealed that antifungal activity of Aloe vera gel extract against fungus. The results showed that Aloe vera exhibited inhibitory effects against a range of fungi, including *Candida albicans* and Aspergillus niger Aloe vera extract, which is made from the plant's leaves, is well known for its potential health and beauty advantages (Arora *et al*.,2019).

Effect of *Hibiscus rosa-sinensis* extract on dandruff

This study demonstrated that hibiscus leaf extracts have antifungal properties that are effe ctive against fungus like *Candida albicans* and Aspergillus niger. According to the findings, hibiscus extracts had a growth-inhibiting impact on these fungus (Naphade *et al.,* 2020).

Effect of *Azadirachta indica A. Juss* extract on dandruff

According This study, neem extracts had antifungal properties against a variety of fungus species. Neem leaf extract shown considerable antifungal effectiveness against fungus species. Natural antifungal and antibacterial properties of Neem may aid in the treatment of dandruff and itchy scalp issues. Neem extract can support the maintenance of a healthy scalp environment in hair care products (Anand Niharika *et al.,* 2020).

Effect of *Delonix regia* extract on dandruff

This study demonstrated that delonixregia leaf extracts have antifungal properties that are effective against fungus like *Candida albicans* and Aspergillus niger. According to the findings, Delonix Regia extracts had a growth-inhibiting impact on these fungus (Meena *et al.,* 2023).

Conclusion:

By this study we came to know the impacts of numerous plant extracts on dandruff. Many plant extracts, including Alovera extract, Neem extract, hibiscus extract, Delonix Regia extract have shown promise in treating various aspects of dandruff, such as lessening flakiness, easing itching, and preventing the growth of fungi that cause dandruff. These organic plant extracts are probably going to have a big impact on helping people with this common scalp issue

feel better and improving their general health and wellbeing. Hibiscus possesses anti-inflammatory and antibacterial qualities that might ease itchy and dandruff-prone scalp disorders. It may encourage a scalp environment that is better for hair growth. Hibiscus possesses anti-inflammatory and antibacterial qualities that might ease itchy and dandruff-prone scalp disorders. It could encourage a better environment on the scalp for hair development. Hibiscus has a pH level that is somewhat acidic, which can assist in balancing the pH of the scalp and hair. Natural antifungal and antibacterial properties of Neem, Alovera, Hibiscus, Delonixregia, may aid in the treatment of dandruff and itchy scalp issues.

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OVERVIEW ON NATURAL HERBAL HAIR DYES

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Abstract:

Due of the numerous benefits it offers over chemical-based hair colors, herbal hair dyes are being adopted on a global scale. We made an effort to prepare and standardize this preparation in order to guarantee both its stability and quality. Henna, clove, Reetha, tea, walnuts, coffee, butterfly pea, bhringraj, and other natural herbs are just a few examples. Herbal hair dye is used to treat several illnesses such head lice, premature graying, and dandruff. Natural hair stains, which are safe to use, address the issue of poll and hair cuticle damage. The synthesis of herbal hair dye and evaluation of its many parameters, including organoleptic, physicochemical, phytoconstituent, rheological, patch test, and stability testing for its efficacy and shelf life, were the foci of the current study. In addition to being a hair dye, it also serves as a conditioner, anti-dandruff agent, hair growth promoter, and hair nourisher thanks to the optimum herbal combination in this formulation.

Keywords: Herbal hair color, stability, Physico chemical tests and anti-dandruff agent.

Introduction:

The urge to seem beautiful is a universal human weakness that dates back to ancient times. The beginning of the human being. Currently, all of the People are extremely conscientious of their beauty. In addition, humans take care of their appearance. both many items and all body parts are available to make bodies in the market attractive.60% to 70% of individuals suffer with the hair graying and balding issue. The People begin to age owing to a lack of vitamin B12 deficiencies, thyroid conditions, or other influences heredity (Palade *et al.*, 2022). The most well-liked dye was and continues to be henna. However, red to copper red color was obtained rather than black. Loss of natural hair color can be caused by a variety of reasons, including genetics and the environment (Zanke *et al.*, 2020). The majority of people today take great care to maintain their beauty, and hair plays a significant role in this. For healthy hair, herbal medications without any side effects are employed. Nearly 70% of people over 50 struggles with the issue of hair thinning and balding (Pal *et al.*, 2018). Any part of the plant, such as the bark, leaves, flowers, seeds, etc., can be used to produce useful goods. Since ancient times, plant compounds have been a component of phytomedicines. Around 80% of the world's population relies on traditional medicines made of plant extracts for primary treatment. Amla, Hibiscus, Henna, Coffee, and Custard Apple Pulp Powder are all used as hair colors. There are

two types of colorants: temporary and permanent. Temporary hair coloring allows for simple removal of the color (Sudheer Kumar *et al.,* 2016). The areas of color saturation, color development, accurate initial color consistency, wash fastness, and better hair conditioning without producing hair damage or skin irritation, however, require significant improvement. There is a critical need for a replacement to the existing greenish brown color dye due to the risks associated with manufacturing, environmental pollution, its side effects, and hazardous consequences (Ravichandran *et al.,* 2023).). It is common knowledge that many of these synthetic dyes can induce dermatitis and other related problems. This has prompted us to search for herbal dyeing materials of plant origin as alternatives. An attempt here has been made to review the use and suitability of these herbal products to replace the synthetic hair dyes. Continuous usage of such compounds on natural hair causes multiple side effects such as skin irritation, erythrema, loss or damage of hair and also skin cancer (Naishadham *et al.,* 2013).

Role of ingredients used in the formulation.

1. Henna

The primary coloring component of henna is lawsone, a reddish-orange chemical found in dried plant leaves at a concentration of 1.5% weight to weight. At a maximum dosage of 1.5% in the hair dyeing product, lawsone functions as a non-oxidizing hair coloring ingredient. Other henna components, like flavonoids and gallic acid, serve as organic mordants in the coloring process. The henna paste's appropriate consistency for adhesion to the hair is provided by carbohydrates. Even while black henna, a blended kind, can cause allergy problems, natural henna is mostly hypoallergenic (Santhosham *et al.,* 2022).

2. Black tea

Tea's tannin content will make the color more intense (Naishadham *et al.,* 2013).

3. Curry leaves

The name Murraya Koenigii is botanical. This has been shown to contain a significant amount of phenols, flavanols, amino acids, and alkaloids, all of which have high antioxidant capacities (Naishadham *et al.,* 2013).

4. Hibiscus

It greatly improves the activity of hair growth. Natural amounts of calcium, phosphorus, iron, vitamin B1, vitamin C, riboflavin, and niacin found in hibiscus aid in stronger hair development and slow down the onset of premature graying. This flower is employed to manage dandruff. Hibiscus produces flavonoids like anthocyanins and other phenolic substances, which have antioxidant qualities. By conditioning the hair, it can be utilized to revitalize it (Saxena Pal *et al.,* 2018).

5. Beetroot

Fresh roots of Beta vulgaris make up beetroot. Chenopodiodeae family. With a name like sugar beet, this root vegetable comes from fresh beet vulgaris roots and has uses. It is frequently used as a coloring agent for liver diseases (Zanke *et al.*, 2020).

6. Amla fruit

The well-known astringent amla, sometimes known as the "Indian gooseberry," is utilized in tanning. Amla has reportedly been used as a natural mordant for silk fabric when combined with natural colors (tesu dye). Pre-mordanting with amla produced a pale yellow color on silk fiber, while simultaneous mordanting with amla produced a light yellow color on silk fiber. Post-mordanting with amla produced a yellowish green color on silk fiber (Zanke *et al.*, 2020).

Benefits of Natural Hair Dye (Santhosham *et al.*, 2022)

Color your hair with more natural, non-chemical chemicals.

- Natural hair color conceals gray hair without having any negative consequences.
- Deeply hydrates and feeds hair strands from the inside out.
- Treat the current hair issues.
- Because real human hair fibers are used, the appearance is natural.
- Can be fashioned to resemble real hair.
- Less prone to harm from heat.
- capable of coloring and perming.
- Moves naturally like hair.

The drawbacks of natural hair dye (Santhosham *et al.*, 2022)

- More costly.
- More upkeep and attention are required.
- Needs to be styled.
- More vulnerable to damage from the environment and sunlight fading.
- They might weigh more than synthetic wigs, which could cause itching.

Materials and Methods:

We have chosen nine essential ingredients for the manufacture of herbal hair dye, including henna, reetha, coffee, tea, shikakai, amla, hibiscus, bhringraj, and jatamansi. The PSIT herbal garden provided the henna leaves and hibiscus flowers that were used in this study. In the Institute's Pharmacognosy lab, they underwent quality authentication (Saxena Pal *et al.*, 2018).

1. Natural hair colorant preparation

Henna, indigo, tea, and bhringraj leaves are all dried in the shade.They were ground up and used as a base for hair colorants. Lupeol, Spinasterol, Lactone, Hexacosanol, Spinasterone, Calyctomine, Racimase-A, and Oleanolic Acid are all present in it. Betulin, lupenone, betulinic acid, and betulonic acid. The passage obtained from its housings is utilized as a dandruff-control

and hair-detergent. It is effective at strengthening and conditioning hair as well as lowering the pH level and retaining the natural oils that keep hair glossy and healthy (Palade *et al.,* 2022).

2. Plant extract preparation (methanolic extract)

In a rotatory shaker, 50 g of dry powdered materials were soaked in 125 ml of methanol for 16 hours. Whatman The plant extract was separated using No. 1 filter paper. The filtrates were put to use for additional phytochemical investigation (Naishadham *et al.,* 2013).

3. Preparation in advance of hair colorants

To the 200 mg of urea in the sample, one gram of each of the following was added: indigo, henna, tea, and bhringraj. Water was used to make a smooth paste, which was then set aside for 1 hour to inhibit. The hair was left in the paste for one hour, washed with water, and its coloring was checked (Soham R Palade *et al.,* 2022).

4. Test for carbohydrates (Fehling's Test) reducing sugars (Naishadham *et al.,* 2013)

A boiling water bath was used to treat the extracts with 5.0 ml of Fehling's solution. Reducing sugars are present when yellow or red colored precipitate forms.

Detect saponins

The sample that had been pulverized was heated in a 20 ml bath of distilled water and then filtered. To create a suitably persistent froth, 10 ml of the filtrate were combined with 5 ml of distilled water and forcefully shaken. Three drops of extra virgin olive oil were added to the mixture, which was then quickly shaken to create an emulsion. This suggests that saponins are present.

Analyze terpenoids

To create a layer, concentrated H2SO4 was added to a mixture of 5 ml of the plant extract and 2 ml of chloroform. The interface's reddish brown color indicates the presence of terpenoids.

Analyze for alkaloids

A few drops of acetic acid were added to the plant extract, and then Dragendroff's reagent was thoroughly combined. Alkaloid is present when an orange-red precipitate forms.

Analyze flavonoids

The aqueous filtrate of the plant extract received 5 ml of diluted ammonia solution, then concentrated H2SO4 was added. The presence of flavonoids is indicated by the extract's yellow tint.

Tannins and phenolic compounds should be tested

The dried powdered sample weighed around 0.5 g, which was cooked in 20 ml of water in a test tube before being filtered. A few drops of 0.1% ferric chloride are added, and the color of the solution is checked for blue-black or brownish green. The plant extract was combined with a solution of ferric chloride and a few drops of ethanol. The presence of phenol is indicated by a blue-green hue.

Check your proteins and amino acids

2 drops of freshly made 0.2% ninhydrin reagent were heated and applied to 1 ml of extract. The presence of proteins and amino acids is shown by the color blue.

Examine for quinones

The plant extract was combined with a few drops of sodium hydroxide and violently shaken. Quinones are visible as blue, green, or red colors.

5. Patch test

Testing the formulation's potential for sensitization is necessary. In order to monitor for any local reactions like irritation and erythema within three hours of treatment, a little amount has been administered on the forearm (Naishadham *et al.*, 2013).

Sr. No.	Parameters	Results
1.	Swelling	Negative
2.	Redness	Negative
3.	Irritation	Negative

6. Stability test

By keeping the developed formulation at various temperatures for a month, stability testing of the formulation was carried out. The packed glass vial formulation was tested for physical characteristics such as color, odor, pH, texture, and smoothness as shown in Table while being held at room temperature and 35°C (Santhosham *et al.*, 2022).

Results and Discussions:

The produced herbal hair dye is made up entirely of beneficial natural components. Due to the ideal herbal combination in this composition, it also functions as a conditioner, anti-dandruff agent, hair growth promoter, and hair nourisher in addition to being a hair dye. Additionally, it helps condition the hair properly and remove extra oil from the scalp. Reetha revives the health of hair that has been dull, dry, or damaged. The growth of hair can be aided by jatamansi extract. It is advantageous for healthy, silky, and supple hair as well. Vitamins A, C, D, and K, which together make up a potent antioxidant, are abundant in shikakai. By providing new nutrients to assist hair growth, bhringraj helps to improve the circulation of blood flow at the base of the hair. This is a tried-and-true solution for anyone who has struggled to find healthy hair devoid of gray or silver. The herbals were shown to be compatible with the proteins in hair in their natural form without the use of artificial additives, according to an irritancy test that produced negative findings for irritancy, redness, and swelling. The inert nature of the pack was revealed by stability tests conducted at various temperatures over a consistent period of one month in terms of color, odor, appearance, texture, and PH. The formulation was kept for one month at room temperature to observe the changes in its color, odour, texture and appearance. The pH was also noticed before and after one month. The formulation was found to be stable. It

can be easily stored and used at any temperature, at any place. Since it is a natural herbal based formulation, it is free from the ill-effects of ammonia based chemical dyes.

Conclusion:

A natural hair dye colors the hair in a very delicate way. Herbal-based cosmetics have the benefit of being nontoxic. It nourishes the block's hair and skin. The quality of hair is negatively impacted by pollution, aging, stress, and severe weather. In this study, we discovered the herbal hair pack's therapeutic features; nevertheless, more research is required to determine its full range of beneficial effects. The benefit of using this natural hair dye is that it won't irritate your skin or lead to erythema or edema. It is made entirely from plant-based chemicals that are soluble in water, making it smell less. Both the initial ingredients and the finished product are fully biodegradable. In order to meet the demands of the expanding global market, herbal formulations are in high demand. A notable effort has been made to create a herbal hair pack that has the goodness of powders from various plants that are great for hair maintenance.

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ANDROGENETIC ALOPECIA (PATTERN BALDNESS) AND ITS TREATMENTS

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Abstract:

Androgenetic alopecia (AGA) is one of the common reasons for dermatological consultation. Over the last decades our understanding of the pathophysiology of AGA has improved and this has paved way for better diagnostic and therapeutic options. Many treatment options have emerged for the treatment of Androgenetic alopecia. While the major treatment options continue to be topical minoxidil, systemic Finasteride and hair transplantations, newer modalities are under investigation. This chapter reviews the recent concepts in relation to Androgenetic Alopecia. With regards to the mechanism of occurrence of Androgenetic Alopecia, I have tried to stress on recent knowledge of few currently available treatments available for Androgenetic Alopecia.

Keywords: Androgenetic Alopecia, DHT, LLLT, PRP

Introduction:

Androgenetic alopecia, which is a pattern hair loss, is a genetically determined, patterned, progressive loss of hair from the scalp.

Men present with hair thinning in the temporal areas (producing a characteristic M shape) that advances to the crown (vertex) area as the alopecia progresses. Women usually have more diffuse thinning on the crown area, and less commonly present with a male-type pattern.

Figure 1: Androgenetic Alopecia in men

The name AGA reflects the importance of both androgens and genes in this disorder etiology. The role of androgens is demonstrated by a lack of AGA in pseudo hermaphrodites who lack a functional 5α- reductase type II enzyme – which, along 5α-reductase type I, is

responsible for the conversion of T to DHT. Both T and DHT bind to the androgen receptor and effect transcription of androgen-dependent genes. Also, AGA is recognized as a genetically multifactorial trait. Proving the relation AGA disorder-androgens, is known that both the 5α-reductase enzymes and the androgen receptor were more highly expressed in balding follicles compared to non-balding follicles on the same scalp. In addition, it is known that a sequence variation in androgen receptor differed significantly between young balding men (high genetic predisposition) and older men with full heads of hair (low genetic predisposition). This finding reveals androgen receptor as a gene responsible for increased risk of AGA, and it has been estimated that it may confer up to40% of total genetic risk for this disorder.

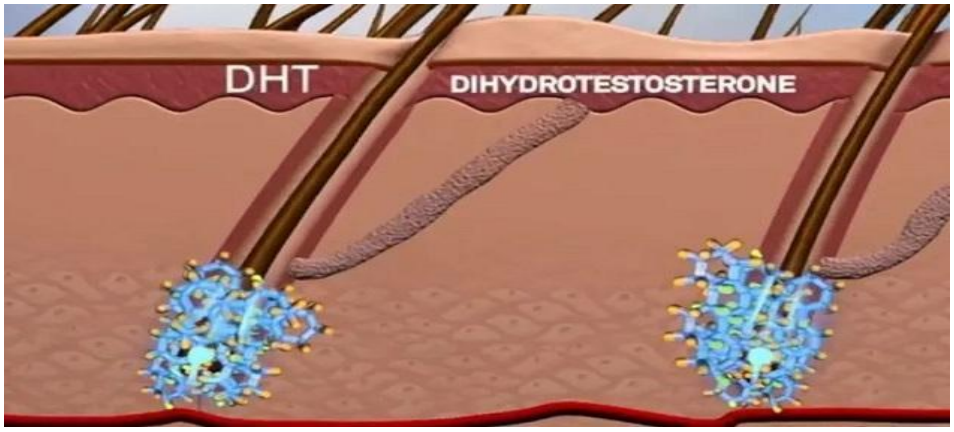

Figure 2: Role of DHT in Androgenetic Alopecia

Current treatments for Androgenetic Alopecia in market

Topical minoxidil

Topical minoxidil is one of the FDA-approved treatments for male and female pattern hair loss. It was approved as a first-line treatment for men with mild-to-moderate AGA. It is readily available in both 2% and 5% foam and liquid solutions with different efficacies.

Side effects

Patients may exhibit side effects with topical minoxidil which are more often seen with use of 5% solutions rather than 2%", which includes contact dermatitis, pruritus, and scalp irritation.

Topical finasteride

Finasteride as a topical formulation is available from market which have been shown to reduce plasma and scalp DHT levels significantly well. Compared to the oral form, topical finasteride gel has demonstrated similar efficacy as oral formulations.

Side effects

Side effects included skin erythema, contact dermatitis, as well as increased liver enzymes, nocturnal enuresis, testicular pain, and oropharyngeal pain etc.

Oral finasteride

Finasteride has been approved for the treatment of male pattern baldness since 1997. The drug functions by inhibiting Type II 5-alpha-reductase enzyme thereby blocking the conversion of testosterone to DHT. It is available as 1 mg and 5 mg tablets in market. It is not approved for use in women and is assigned to pregnancy category X due to risk of causing ambiguous genitalia in a male fetus. The literature has shown finasteride to be effective in treating patients with AGA and long-term use of up to 5 years has shown significant hair growth and permanent stabilization of hair loss

Side effects

Side effects of oral finasteride includes orthostatic hypotension, dizziness, erectile dysfunction, ejaculatory dysfunction and decreased. Researchers urge decrease in sperm count while studies conducted in both rats and humans while others have shown no alteration in sperm with daily finasteride at 1 mg daily. Studies that demonstrated decreased concentrations of sperm with finasteride use typically showed reversal or improvement 3–4 months after treatment termination

Oral dutasteride

Dutasteride is the successor to finasteride acting as a second-generation 5-alpha-reductase inhibitor and functioning as a selective competitive inhibitor of type 1 and type 2 isoenzymes of 5-alpha-reductase. Dutasteride is reported to be three times more potent at inhibiting the Type I enzyme and 100 times more potent at inhibiting the type II enzyme than finasteride. The drug comes in 2.5 and 5 mg doses, both of which have shown superior efficacy to finasteride 5 mg. Due to dutasteride's large molecular size, it is difficult to formulate and deliver as a topical agent. However, its large size and lipophilic nature contribute to it remaining on the scalp and preventing systemic absorption. Dutasteride has shown superior efficacy both in blocking DHT and promoting hair growth compared to finasteride. Despite the greater efficacy demonstrated by dutasteride, finasteride is still likely to be prescribed by physicians more often as a first-line agent in treating AGA due to FDA approval.

Side effects

Like finasteride, the side effects of oral dutasteride include decreased libido, erectile dysfunction, and ejaculatory dysfunction

Oral minoxidil

Most popular drug used as equivalent to finasteride in market is oral minoxidil. The drug is available as a 2.5 mg tablet for the treatment of AGA. Researchers reported the combination of oral minoxidil 0.25 mg and spironolactone 25 mg to be a safe and effective option in managing female pattern hair loss. Case series also reported oral minoxidil to be an effective treatment for female AGA. Studies suggested that optimal safe doses range between 0.6 mg and 1.2 mg daily.

Oral minoxidil has also shown equivalent efficacy in women compared to the 5% topical formulation.

Side effects

Although it may be more convenient for patients to take the oral form of minoxidil, its systemic side effects such as increased 'heart rate, weight gain, hirsutism, hypertrichosis, and lower extremity edema' makes it unfavorable compared to topical minoxidil as a first-line treatment.

Spironolactone

Spironolactone which is labeled for the treatment of cardiovascular diseases, has been widely used as a treatment for female pattern hair loss due to its antiandrogenic properties. It works by decreasing testosterone production in the adrenal gland by affecting the 17a-hydroxylase and desmolase, as well as the competitive inhibitor of the androgen receptor. Spironolactone is the most used antiandrogen for female pattern hair loss (FPHL), and the standard dose is 100–200 mg daily.

Side effects

Although well-tolerated and has been on the market for decades, the side effects of spironolactone include electrolyte imbalance, worsening of renal function, and hypotension.

Flutamide

Flutamide is an oral antiandrogen medication rarely used in practice. Oral flutamide first reported to be an appropriate option for managing hyperandrogenic alopecia. Oral flutamide 250 mg daily was noted to be effective in managing FPHL refractory to topical minoxidil and oral spironolactone

Side effects

Flutamide carries a risk of hepatic injury and has a Black box warning of hepatic failure.

Low-Level Laser Therapy (LLLT)

LLLT has emerged as a more commercially available therapeutic method for treating AGA. LLLT is typically administered through home-use devices that are available in the forms of combs, helmets, and caps. The Capillus® laser cap and Hairmax® Lasercomb/Laserband are two such devices that are FDA-cleared for the management of AGA.

Side effects

Minimal side effects were reported. Small number of participants reported adverse events of acne, mild paresthesia such as burning sensation, dry skin, headache, and pruritus

Platelet-Rich Plasma (PRP)

Platelet-rich plasma (PRP) is another alternative treatment for AGA with the benefit that it is performed without any patient responsibilities. PRP is generally indicated for patients with early-stage AGA, as intact hair follicles are present and a more significant hair restorative effect can be achieved. During the procedure, approximately 10–30 mL of blood is drawn from the

patient's vein and centrifuged for 10 min to separate the plasma from red blood cells. The platelet-rich plasma, containing numerous growth factors, is then injected into the deep dermis or subcutaneous tissue at a volume of 4–8 mL per session. Mild side effects include scalp pain, headache, and burning sensation, but these effects usually subside in 10–15 min post-injection and do not warrant use of topical anesthesia or pain medications. PRP is not curative for hair loss and must be continued long term for hair sustenance. However, patient satisfaction is typically very high and 60–70% of patients continue to undergo maintenance treatments. Due to the relatively recent introduction of PRP injections for AGA, there are no long-term studies evaluating its effectiveness.

Side effects

While PRP injections are considered safe when performed by a trained medical provider, these treatments are not suitable for everyone. PRP may not be appropriate for those with a history of bleeding disorders, autoimmune disease, or active infection, or those currently taking an anticoagulant medication. Although most patients seem to tolerate the pain associated with scalp injections, some patients may prefer to avoid it.

Micro needling

Micro needling appears to work by releasing growth factors and dermal papilla-associated stem cells, activating wound regeneration mechanisms with collagen formation secondary to physical minor wounding from the needles, and creating channels to enhance topical penetration. Studies revealed that micro needling appears to be a safe and effective adjuvant therapy and can enhance penetration of topical therapies. There is evidence that micro needling preceding PRP enhances the efficacy of PRP as the pinpoint bleeding provoked by micro needling allows more uniform absorption of PRP. However, there is lack of standardization in this method of treatment.

Side effects

Common side effects of micro needling include pain, bruising, and folliculitis. Patient compliance is an important factor to consider as the procedure is typically costly and often painful.

Hair Transplantation

Patients that opt for hair transplantation have either failed medical therapy or have lost a significantly large and non-recoverable surface area of scalp hair that can only be treated by implanting new hairs into the area. The procedure, if done successfully, induces a natural-appearing look in both men and women and essentially lasts permanently with graft survival among AGA patients being greater than 90%. Transplantation can be done under expert supervision with topical anesthesia in a matter of hours. This procedure involves removing up to four hair follicle groupings from a donor region using small caliber punches manually or robotically and circumvents the development of a linear visible scar as in ellipse procedures

although there is the possibility of scattered 1mm pin point white scars left over from punches. The challenges of performing the procedure manually are that transection of follicles is more likely due to human error and determination of the angle of hair growth is difficult as this varies throughout a patient's scalp. Robotic FUE helps to minimize these challenges as it continuously adjusts punch angles per unit of hair, can harvest a large number of follicular groupings while avoiding follicle transection, and eliminates operator fatigue. Robotic FUE is an automated process that can create 80–120 grafts per 3 × 3 cm grid and can extract 500–800 grafts per hour as per literature. Although the process is monitored by the operator, it rarely requires override or correction.

Side effects

Since hair transplant is an in-office procedure. Side effects include adverse reaction to anesthesia, bleeding, pain, edema, intraoperative or postoperative pain, and patient dissatisfaction. For FUE, problems with wound healing may occur, such as keloid or hypertrophic scar formation.

Conclusion:

There are a variety of options in a practitioner's hand for treating AGA which include oral and topical medications, hormonal therapies, nutraceuticals, PRP, exosomes, microneedling, and more invasive techniques such as hair transplantation. The treatment of AGA can be particularly challenging due to non-uniformity in patient response to conventional therapies and even the incomplete understanding of the exact pathogenesis of the condition itself. Patients must adhere to lifelong therapy as AGA continues to progress if treatment is stopped. Oral finasteride, topical minoxidil, and LLLT are currently the only FDA-approved treatments for this condition, all of which may be effective in treating particular patients with AGA. However, selecting an appropriate therapy for a patient should take into consideration the individual's age and aesthetic concerns, lifestyle and preferences, access to treatment, compliance, extent of hair loss, and financial budget.

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COMMUNICATION IN HONEY BEES

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Abstract:

To persuade other hive worker bees to explore in the same location, forager bees share their flower discoveries with them. Evaluating the calibre of the nectar and/or pollen that is brought in is one of the elements that impact recruitment success. Two theories are put out to explain how "foragers recruit other worker bees in hive," waggle dance and olfactory plume. In comparison to the odour hypothesis, the dance idea is far more commonly accepted and supported by more evidence. Dance theory advocates frequently accord odour a large role in recruitment, whereas odour theory supporters say that the dance is mainly unrelated to recruitment The scholarly discussion over these hypotheses has been heated and even aggressive. In this chapter, we'll look more closely at the evolution of honey bee foraging communication. I want to specifically focus attention to queen communication, mate-finding signals, danger signals, dance language signals, and experiments that can help us answer issues concerning honey bee dance accents

Introduction:

In the darkness inside the nest, honeybees spend almost all of their time interacting with one another. So, interactions between bees inside the nest are not influenced by vision, despite the fact that vision is crucial for orientation and guidance outside the nest. The honeybee's world first appeared to be almost entirely a chemical one where pheromones were the primary means of communication. Karl von Frisch, who found a symbolic information system by which small insects exchanged the locations of supplies up to 10 km distant, changed our knowledge of the sensory world of insects in the middle of the 20th century. His work earned him a share of the only Nobel Prize ever given to academics studying animal behaviour. The employment of functionally referential communication by honey bees to encode the location and direction of a food source makes them a crucial animal communication model (von Frisch, 1967).

Communication among queen

One of the sounds that bees make has been well-known for a long time. This is the sound that emerging queens make as they swarm. Charles Butler (1609), the author of "feminine monarchy," the first known scientific treatise on bee biology, provided one of the earliest accounts of this so-called queen piping. He documented two distinct kinds of bee noises using musical notation. A few years later, Janscha (1774) investigated bee swarming and discovered that the new queens are raised in unique queen cells while the old queen departs with a portion of her colony. Huber (1792) then observed that the first of these young queens to emerge from the cell in which she formed makes a sound signal known as tooting, and that other young queens who are still in their cells respond by quacking.

Honeybee queen piping (tooting and quacking) is disseminated in the bee's nest as vibrations of the combs (Michelsen *et al*, 1986a). They are generated by fast thoracic muscular contractions and delivered straight to the substratum. The wings do not vibrate. Both signals have a distinct temporal structure: tooting begins with a first syllable that lasts more than 1 s and climbs in amplitude and frequency at the start. This is then followed by a configurable number of syllables lasting 1/4 s each, each with an initial rise in amplitude. Quacking is made up of a series of syllables that are slightly shorter in duration, approximately 200 ms, and lack the initial spike in frequency and amplitude. The frequency of quacking signals is often lower than that of tooting signals, however there is some overlapping as well as an age dependency of these frequencies. The signals are conveyed in the combs at amplitudes of ≈ 0.1-1 µm depending on the comb displacement. The signal attenuation with distance is relatively minimal, i.e. 6 dB every 10 cm. These vibrations can be detected by bees. Young queens are able to distinguish between tooting and quacking and more commonly respond to tooting than to quacking. They mainly employ distinctions in temporal structure to discriminate between the two signals. Queen piping also has an impact on worker bees. They immediately stop moving and remain still throughout the song by the queen (Michelsen *et al,* 1986a). What biological importance does queen piping have? At first glance, it would not appear prudent for a young, unemerged queen to respond to the tooting signals of a young, emerging queen, as this queen is quite aggressive, locates the sound emitter, and attempts to open the cell in order to kill the inhabitant. The tooter learns whether and where quacking rivals are present. What advantage does the quacker gain by quaking as opposed to simply waiting? While it has never been empirically demonstrated, it appears that worker bees who gather around the queen cells and appear to scare the tooter away provide security for quackers. Also, they feed the quacker through a little opening in the cell. After a few days, the first young queen finally departs with a second swarm. The previous quackers then emerge from their cells and become tooters, and so forth. Finally, it appears that the workers let one of the queens to murder all of the other queens. There is a definite reward at

the colony level. Considering that queens can only be generated by mated queens and that they require some time to grow, time that is expensive during the swarming season, it appears to make sense to save some spare queens for after swarms and in the event that the first queen is lost, for example during a mating trip (Simpson and Cherry, 1969; Bruinsma *et al*, 1981; Michelsen *et al*, 1986a). If the tooting queen utilises the quacking reaction to assess the quantity and strength of the rivals, she may then evaluate this danger against the value of using the nest resources, such as the nesting place, food storage, brood, and worker bees, at the risk of departing the hive with a second swarm. If the response is mild, she may stay, but if it is powerful, she may swarm. Although there is no direct evidence to support it, the concept that the queen determines whether to allow swarms is an intriguing one.

Signaling for mating

As drones are mating, the virgin queen produces a pheromone that serves as a signal. This pheromone's chemical makeup alters after mating, preventing it from promoting the creation of new queens, workers' behavioural maturation, or the growth of their ovaries (so they remain sterile). Moreover, the queen's scent draws nearby workers to her and triggers the "retinue reaction," in which they lick and antennate her. The workers in the retinue thus pick up the pheromone and spread it throughout the colony. The brood pheromone that the growing larvae create encourages eating, caps the cells before pupation, delays the behavioural maturation of workers, and prevents the growth of worker ovarian tissue.

Signaling honey bees about danger

According to recent research by Nieh (Nieh, 2010), a bee can send out a warning signal to discourage other bees from visiting a food site after having a distressing or unpleasant experience there, such as being injured or being attacked by another bug or bee. She accomplishes this by banging her head against a dancing bee that is used to promote the website, which causes it to buzz briefly (Michelsen *et al.*, 1986). The dancer stops dancing as a result of this "danger" signal, which also prevents future recruiting at that location (Nieh, 2010). In order to ambush passing bees, predators like spiders, mantids, and predacious bugs frequently station themselves around flowers with nectar. Nieh (Nieh, 2010) discovered that lightly pinching a bee's leg when it visits a feeder might cause the bee to send 'danger' signals towards dancing bees when it returns to the hive (Nieh, 2010). Interestingly, Nieh discovers that in battles between bees from competing colonies, a bee would communicate danger only after she has lost and sustained injuries, not after she has triumphed and returned unharmed (Nieh, 2010). Exposure to the so-called "alarm pheromone"—a pheromone that bees produce when they feel threat or are in a behaviorally aggressive state—is another stimulus that invokes the perception of risk in a visiting bee. There is evidence for signalling that negates the positive feedback that recruitment dances generate. *A. mellifera* foragers who were assaulted while competing for a feeder returned

to the nest and gave forth "stop signals." The stop signal is often transmitted by a sender butting her head into a receiver, most frequently waggle dancers, and lasts for just around 150 milliseconds (Kirchner, 1993) at 380 Hz (Nieh, 1993). The stop signal, also known as the "short piping signal" (Seeley and Tautz, 2001; Thom *et al.*, 2003), was first characterised as a request for food (Esch 1964; von Frisch 1967). It does not, however, prompt a food exchange (Nieh, 1993; Pastor and Seeley, 2005). As a result, waggle dancers cease moving and depart the nest (Kirchner, 1993; Nieh, 1993; Pastor and Seeley, 2005). In normal circumstances, bees will produce stop signals, and people who receive them will stop waggle-dancing for natural resources (Pastor and Seeley, 2005). Waggle dancer departure was dramatically accelerated by natural and synthetic cues (Nieh, 1993). Waggle dance durations were cut by 59% and recruitment was cut by 60% when stop signals were played again (Kirchner, 1993). Moreover, worsening foraging circumstances (such as congestion or longer feeder wait times) result in a rise in the output of stop signals (Thom *et al.*, 2003; Lau and Nieh, 2010). Competitors among the *A. mellifera* species killed local bees while vying for a plentiful food source. Attacked bees (victims) exhibited a dramatic drop (12.6-fold) in the number of waggle dance circuits executed and a sharp rise (43-fold) in the number of halt signals. Both bees that were left alone (experienced no assaults) and bees that attacked rivals persisted in recruiting and produced practically no stop signals (Nieh, 2010). Moreover, signalers hunted after bees that reeked of the scent at their feeding site. Receiving physical aggression (biting) and recognising an alarm scent can be further split down as the proximal reasons of stop signal generation (Nieh, 2010). A signal of this kind has an advantage. The choice to recruit and the amount are made by each individual forager. The choice of one person to quit recruiting, nevertheless, does not prevent other waggle dancers from doing the same. She can warn other foragers that are in the same area of unfavourable foraging circumstances by providing halt signals, and she may also provide unfavourable feedback to negate other foragers' waggle dance. In general, the superorganism's collective foraging results from both positive and negative feedback between various agents, with negative feedback cycles clearly enhancing the precision and speed of labour reallocation. It is uncertain if this happens to other honey bee species, particularly Asian ones. The stop signal, however, may also be present in Asian species of honey bees given the evidence of interspecific antagonism at floral resources and during nest robbing. We might be able to comprehend this signal's operation and potential evolutionary history through a comparative investigation. The halt signal is a movement and vibratory signal that refers to the sense of risk at a food source and is a subset of a wider group of such signals. As a result, it would be instructive to investigate additional signs of risk and determine whether they have any similarities. It could be possible to comprehend some protective actions better (some of which may be signals). One example is defensive hissing signals. Butler (1954) noted that *A. cerana* hissed while also shaking its body.

When attacked by the hornet *Vespa orientalis, Apis mellifera cypria* makes high-pitched hissing noises (Papachristoforou *et al.*, 2008). While they are also attacked by wasps, other *A. mellifera* subspecies have not been noted to hiss in this manner.

During nest defence, *Apis florea* workers hiss while making a little amount of wing motions. These actions spread to neighbouring bees and could prevent some predators (Sarma *et al.*, 2002). It would be interesting to know if other Asian honey bee species hiss when being attacked by predators. When compared to species that nest in nest cavities, open nesting species' nests are more vulnerable to predators. Because of this, open nesting species have developed several intriguing deterrents and signals. In reaction to hornet predators, *Apis nuluensis* engages in protective shaking movements. This trembling attracted guards to the predator's presence and caused neighbouring bees to tremble (Koeniger *et al.*, 1996).

The shimmering patterns created by *Apis dorsata* are made up of nearby bees turning their abdomens upward. When a predator, like as a wasp, is present, it causes this motion to spread over the surface of the comb in a wave-like pattern (Schmelzer and Kastberger, 2009). Since that shimmering is largely induced in the region where foragers enter, dance, and then go, there may be specialisation in the workers who execute it (Schmelzer and Kastberger, 2009). Last but not least, drones are often not regarded to play a significant part in colony defence. Nonetheless, shimmering was purportedly done by *A. cerana* drones. While less pronounced than the movements of the employees, the shimmering wing motions of the drone were nonetheless recognisable (Sakagami, 1960). Given the lack of knowledge on drone contributions to the colony outside of their role in mating with virgin queens, research into drone defensive behaviour might be beneficial.

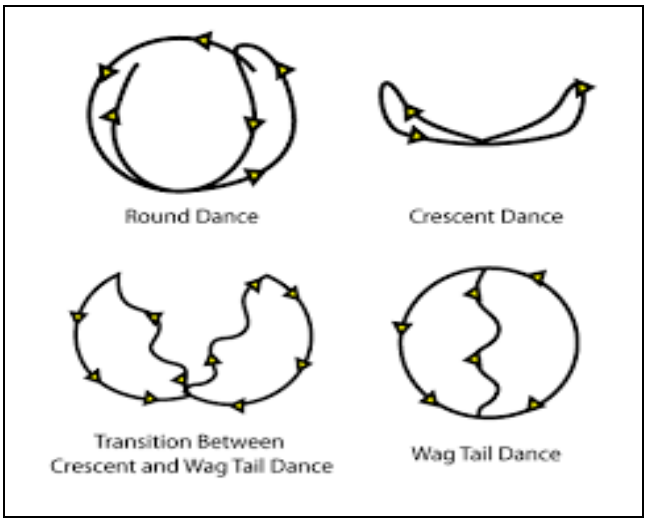
Signals in dance language

Successful forager bees communicate with their nestmates by using a type of dancing, as Karl von Frisch observed in the 1940s (Von Frisch, 1967). The dancing figure's position on the vertical comb with regard to gravity encodes the direction of the food supply in relation to the direction of the sun. The pace of dancing is a good indicator of the distance to the food supply; the closer to the food source, the more dance circuits are performed in a given amount of time.

Distance

When a food supply is within 50 metres of the hive, a forager will conduct a round dance. She accomplishes this by sprinting in tight circles before abruptly reversing direction and returning to her previous path. She can repeat the dance multiple times at the same spot or go to a different spot on the comb to do so. She frequently gives food to the bees circling behind her after the circle dance has concluded. Hence, a circular dance conveys distance (in this case, "near to the hive") but not direction.

The sickle dance indicates the location of food supplies that are 50 to 150 metres away from the hive. This crescent-shaped dance serves as a bridge between the round dance and the waggle dance.



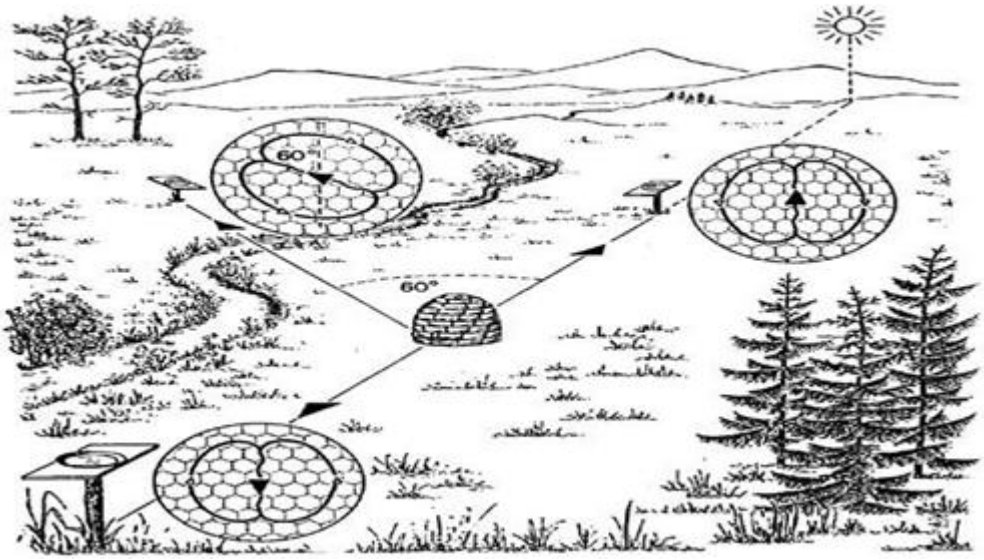
Bees that are foraging at sources of food more than 150 metres away from the hive execute the waggle dance, also known as the wag-tail dance. Unlike the circular dance, this dance conveys both direction and distance. A bee that engages in the waggle dance first travels straight forward for a short distance, then circles back to the starting place in a semicircle. The bee then travels through the straight path once again before doing a full figure-eight circuit in the opposite direction. The bee's body, particularly the abdomen, fiercely wags from side to side as it moves through the dance's straight line. The tail begins to wag as a result of the body vibration. The bees' capacity to gather this knowledge in the darkness of the beehive has long been a mystery. Dancing bees make sound during waggle dances, as discovered separately by Esch and Wenner in 1961 and 1962, respectively. Dance noises were discovered to be produced in round dances by Kirchner *et al.* in 1988. Airborne sound is produced by the wings' dorsoventral vibrations, which transmit the dancing sound signals (Michelsen *et al.*, 1987). The sound has a frequency of 200–300 Hz and a 15–Hz repetition rate. It is made up of brief pulses. A few millimetres behind the dancer, the amplitude is 94 dB sound pressure level. These interactions are more complicated in the near field of a sound emitter than they are in typical, so-called far field sound, where there is a set link between sound pressure and the associated air particle velocity. It has been demonstrated that air particle oscillations in bees are around 200 times more powerful than predicted for the pressure amplitudes observed in round dances (Kirchner *et al.*, 1988) and waggle dances (Michelsen *et al.*, 1987). It was discovered that the air particle movement around a dancing bee reached a peak velocity of 1 m/s. Due to the 180° phase difference between the sound pressures below and above the wings and the resulting large pressure gradients around the edge of the wings, the dancer's vibrating wings act as dipole sound emitters. These dipole sound emitters create oscillating air currents that circle the dancer's abdomen and diminish quickly with increasing distance. At the area where these air currents have their highest velocity, the majority of follower bees may be found. The dancer's tail-wagging movements cause a significant modification in the amplitude of the sound signals at the location of the dance followers (Michelsen *et al*, 1987). In both round dances (Kirchner *et al.*,

1988) and waggle dances (Esch, 1964), the length of the dance sounds is strongly connected with distance and serves as a useful source of information for the dance followers. Moreover, there is a weak inverse relationship between distance and sound frequency (Spangler, 1991). The noises are produced when the tail is wagging. Although tail wagging and sound generation are strongly correlated, Griffin and Taft (1992) found that the two behaviours are not always tightly correlated. The dancer's body's position while making the sound pointed in the direction of the food source (Kirchner et al, 1988). Waddington and Kirchner (1992) have demonstrated that there are some correlations between the profitability of food sources and the sound signals of round dancers. Profitability and sound frequency showed the strongest association. Consequently, the dancing noises give the follower bees information about proximity, profitability, and direction. Not only does the western honeybee, *Apis mellifera*, generate dancing noises. According to Towne (1985), *Apis cerana* dancers make a similar dancing sound. Recently, both *Apis cerana indica* and *Apis cerana japonica* validated this discovery (Kirchner, unpublished observations). There were no dancing noises in *Apis dorsata*, according to Towne (1985). *Apis dorsata* has recently been discovered to produce dancing noises that are comparable to those of *Apis mellifera* but significantly lower in frequency, or around 100 Hz (Kirchner and Dreller, 1993). Throughout the duration of the wagging runs in *Apis florea*, no dancing sounds are produced (Towne, 1985; Kirchner, unpublished observations).

Direction

The waggle dance has a fairly simple way of representing distance, but it has a more sophisticated way of expressing direction. The dancing bee's direction during the straight part of her waggle dance reveals where the food source is in relation to the sun. The bee's angle in relation to vertical shows the angle of the sun's angle with respect to the flowers outside the hive. In other respects, the dancing bee converts the angle of the sun into the angle of gravity. The forager will conduct a dance, with the waggle-run component moving straight up on the honey comb, to a source of food in the same general direction as the sun. In contrast, the straight run will be carried out vertically downhill if the food supply is situated exactly opposite the sun. The waggle run is 60 degrees to the left of vertical if the food source is 60 degrees to the left of the sun.

Since directional information is supplied according to the position of the sun rather than a compass direction, a forager's dance for a certain resource will shift during the day. This is due to the fact that the sun's position changes during the day. For example, a food supply positioned due east will drive foragers to dance roughly straight up in the morning (since the sun rises in the east), while foragers will dance approximately straight down in the late afternoon (because the sun sets in the west). As a result, the position of the sun is an important variable in deciphering the directional information in the dance.



****Waggle Run Dance**

Geographic location and time of year also influence the sun's position. Throughout the day, the sun will always move from east to west. Nevertheless, the sun will travel from southeast to southwest above the Tropic of Cancer, and northeast to northwest below the Tropic of Capricorn. Depending on the season, the sun may be placed to the south or to the north within the tropics.

To decipher the directional information included in the honey bee dance, one must first understand the angle of the waggle run (with regard to gravity) and the sun's compass direction, which varies depending on location, date, and time of day.

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SOIL CONTAMINATION IN DELHI-NCR: ORIGIN AND SOLUTIONS

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Abstract:

In the past several decades, soil contamination has gained more attention and evolved into a more widespread environmental concern. Previously, it was mostly a local problem linked to unsustainable practices like careless garbage disposal. The national capital region's dumpsites, municipal solid waste, overuse of herbicides and insecticides, and the various chemical emissions from their burning are the main causes of soil contamination. The various indicators of soil pollution include oil that is discolored and stained, smells, little plant growth, erosion, and paint chipping. The industrial zones of Jhilmil, Wazirpur, New Friends Colony, Dilshad Garden, and Lawrence Road, together with the waste sites at Bhalswa and Ghazipur, are the most polluted areas of Delhi's soil. The heavy metal pollution in Delhi-NCR's peri-urban areas, wholesome sites, irrigation water, and soil is examined in this study, coupled with the region's rapidly increasing industrial growth's impact on the health rate index.

Keywords: Soil Contamination; Dumpsites; Municipal Solid Waste; Heavy Metal Toxicity; Human Health.

Introduction:

Soil contamination occurs when dangerous substances, commonly referred to as pollutants or contaminants, are found in the soil at concentrations high enough to put at risk ecosystem health as well as human health. The origin of soil pollution is associated with human activities, resulting in the accumulation of containments in soil that may reach levels of concern, and deforestation is also one of the causes. High concentrations of hazardous chemicals in the soil can have a detrimental effect on fertile soil production, which might cause problems for agriculture and the environment. Polluted soil can cause harmful substances to build up in crops that are eaten by people or animals. This affects the region's food security in addition to endangering our health.

Soil quality is viewed as the key link between conservation management measures and the accomplishment of key objectives of sustainable agriculture. Environmental quality, plant, animal, and human health, as well as agricultural sustainability, are all influenced by soil quality and health. Soil management and land care are of utmost importance to guarantee agricultural sustainability, which is necessary to feed the growing population. In Asia, poor soil quality is

caused by nutrient imbalances, over-fertilization, soil pollution, and soil erosion. As a result, it cannot produce as much food as it consumes, and per capita, food production is falling. Among the many crop-related factors. Both natural and human processes and activities can contaminate the soil such as landslides, oil spills, the misuse of pesticides & insecticides, which causes the soil to lose its fertility, and the presence of too many chemicals, which raise the acidity or alkalinity of the soil and so degrade its quality. The preservation or improvement of soil health or quality is crucial for agricultural sustainability.

Soil contamination in Delhi/NCR

Soil contamination in Delhi/NCR (National Capital Region) is a significant environmental challenge with far-reaching implications. The rapid urbanization, industrialization, and population growth in this metropolitan area have led to the release of various pollutants into the soil. Industrial activities contribute to the presence of heavy metals, chemicals, and toxins in the soil, while improper waste disposal practices further exacerbate the problem. One major contributor to soil contamination in Delhi/NCR is air pollution. The region faces severe air quality issues, with high levels of particulate matter and pollutants. These airborne pollutants eventually settle onto the soil, introducing harmful substances and affecting soil quality. Vehicular emissions, industrial discharges, and construction activities release pollutants like lead, cadmium, and hydrocarbons into the environment, impacting both urban and rural soil areas. Agricultural practices also play a role in soil contamination as the use of fertilizers, pesticides, and herbicides can introduce chemicals into the soil. Improper disposal of electronic waste and hazardous materials further compounds the issue.

The researchers examined soil samples from Krishna Vihar in Mandoli, which is home to multiple mounds of unprocessed electronic garbage, and discovered a variety of contaminants, including copper at a level of roughly 283 mg/kg in the topsoil. The comparison site was only 5 km away, where copper levels were about 8.39 mg/kg. Like this, the reference location had lead levels of 0.43 mg/kg while the waste yard had 183 mg/kg. Plants establish their roots in the subsoil. Therefore, contamination in this area could imply that these residues could enter plant systems and eventually end up in human tissues. Significant levels of heavy metal contamination were found in groundwater samples from the region. Average levels of metals like lead, cadmium, and copper were 20 times higher than those the Central Pollution Control Board deemed safe (CPCB). The CPCB's safe limit for nickel and chromium was exceeded by roughly five times. The heavy metals could pose a risk to health through direct exposure and water drinking.

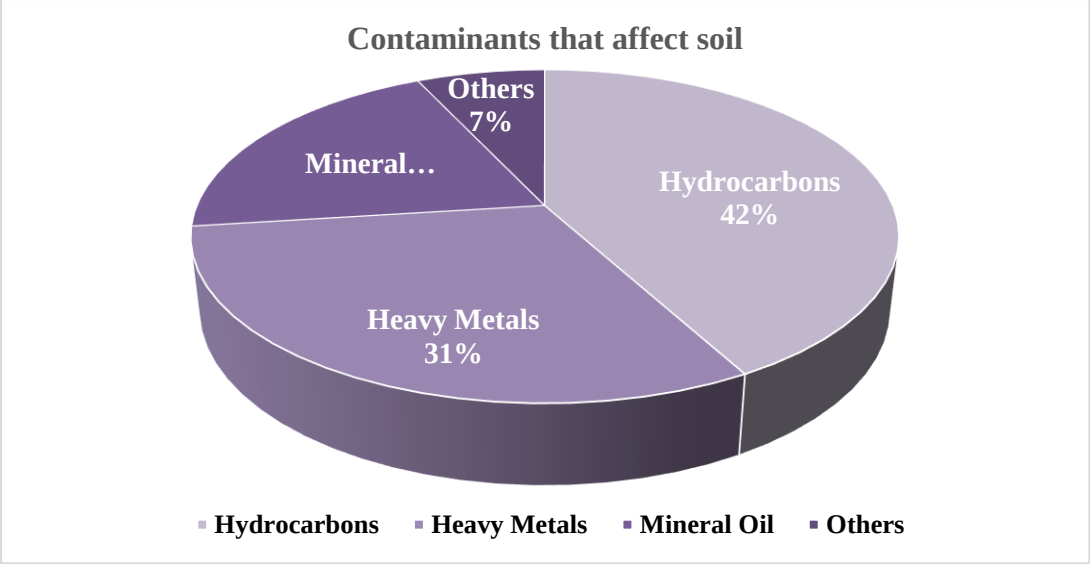

Figure 1: Contaminants that affect soil

Origin of soil pollution

Soil is considered contaminated when the amount of one or more of these harmful substances as shown in Fig. 1 is high enough to harm living things. Numerous natural and man-made factors contribute to soil pollution. The natural creation of minerals and the buildup of salt compounds in the soil, particularly in arid areas, are some of the natural sources of soil pollution. Chemicals such as pesticides, herbicides, ammonia, petroleum hydrocarbons, lead, nitrate, mercury, naphthalene, etc. can contaminate soil in significant quantities. Soil pollution is caused by some other man-made waste items that contain chemicals that are not naturally occurring. The untreated discharge of industrial wastes into the soil, which contains high levels of harmful pollutants, causes soil pollution. Industrial wastes contain varying amounts of poisonous substances and dangerous compounds, so when they are dumped in soil, they damage the strength of the soil layer in the top soil, lowering the soil fertility and biological activity. Additionally, a harmful influence causes ecological imbalances, which interfere with crop production. Aside from that, eating such crops could seriously harm a person's health because the land and crops are tainted with dangerous substances.

The uncontrolled discharge of sewage and other liquid wastes from home water use, industrial wastes containing a range of contaminants, agricultural effluents from animal husbandry and drainage of irrigation water, and urban runoff are all common contributors to soil pollution. The irrigated soils undergo significant modifications because of sewage water irrigation. Among the many changes that sewage irrigation causes in the soil are chemical changes like soil reaction, base exchange status, salinity, and quantity and availability of nutrients like nitrogen, potash, phosphorus, etc. Physical changes like leaching, changes in humus content, and porosity, among others. Due to the buildup of metals like lead, nickel, zinc, cadmium, etc., sewage sludges damage the land. This could result in Phyto-toxicity. Chemicals

and wastes from Factories, Farms, are dumped into the soil. These chemicals and wastes make soil poisonous for plants, animals, and people. Excess application of pesticides, herbicides, and fertilizer.

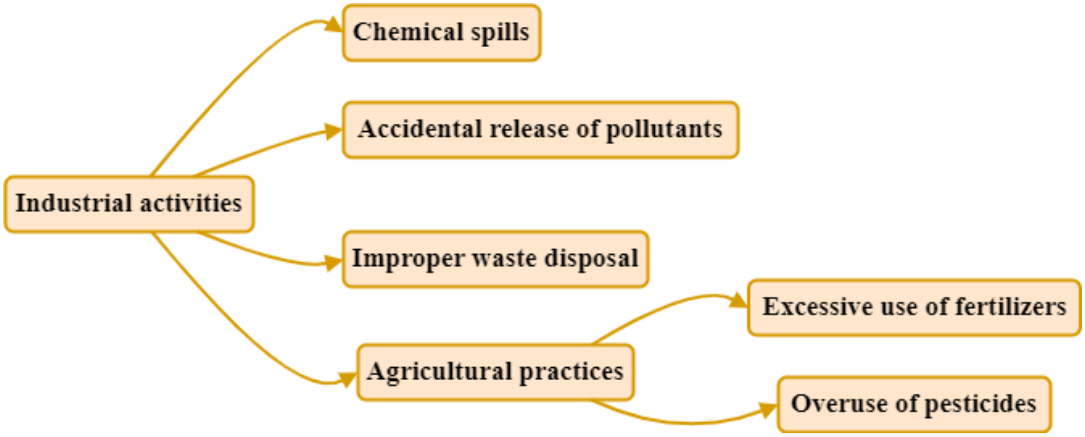

Figure 2: Causes of soil pollution

Artificial pollutants

Anthropogenic (man-made) soil pollution is the result of a variety of processes, some of which are intentional (industrial) and others which are unintentional. The levels of hazardous contamination in the soil can rise because of both natural and human-caused soil pollution due to-

- **Commercial garbage:** With all the chemicals they dump into the environment, whether they be in liquid or solid form, industries are by far the greatest polluters of the soil as shown in Fig. 3. Almost any chemical used on construction sites has the potential to contaminate the soil. However, the compounds that can disperse more readily in the air as fine particulate matter pose the greater risk. Chemicals that are transported as particulate matter, like PAHs, are more resistant to breakdown and bioaccumulate in living things.

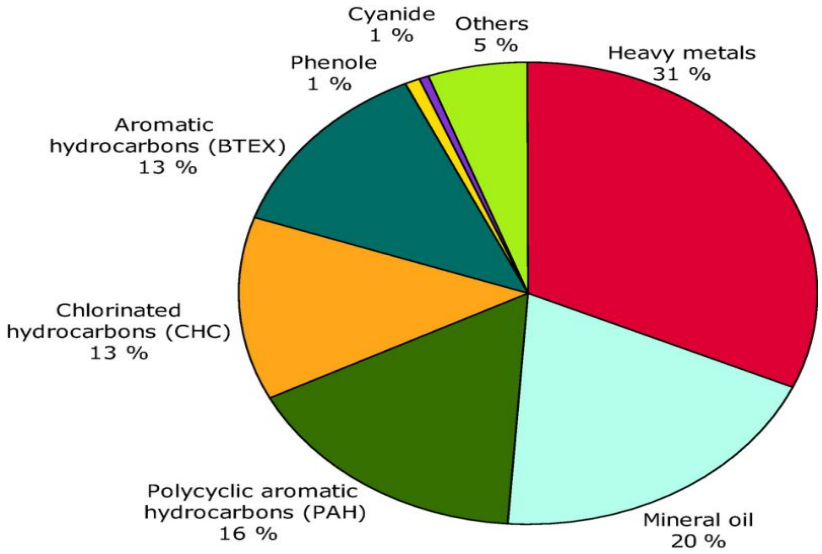

Figure 3: Pollutants coming from commercial garbage

- **Deforestation:** When trees are cut down, the soil is exposed to the elements, making it more susceptible to soil erosion. As a result, the land becomes sterile and unfit for supporting vegetation.
- **Excessive application of insecticides and fertilizers:** Farmers are being compelled by the rising need for food to employ pesticides and fertilizers that only discharge toxins into the soil, killing beneficial microbes vital to plant growth.
- **Pollution from garbage:** Waste that cannot be recycled is recklessly dumped, which not only looks bad but also pollutes the environment.

Due to their practically universal presence, construction sites are the most significant causes of soil contamination in urban areas. Due to its smaller particle size, construction dust is particularly harmful and can readily spread through the air (less than 10 microns). Such building dust can lead to cancer as well as respiratory conditions like bronchitis and asthma. In addition, poisonous asbestos can be released at construction sites where older structures are being demolished, mineral that has the potential to harm soil. The wind can re-distribute asbestos particles.

Biological pollutants

Natural processes may also affect harmful chemicals discharged into the soil by humans, diminishing or increasing the pollutant's toxicity and/or the degree of contamination of the soil overall. This is in addition to the rare instances where a natural accumulation of chemicals results in soil pollution. Due to the complex soil ecosystem, which includes the presence of additional chemicals and other natural factors that may interact with the released contaminants, this is conceivable.

- Compounds naturally accumulating in soil because of an imbalance between atmospheric deposition and water leaking away during precipitation (e.g., concentration and accumulation of perchlorate in soils in arid environments)
- Under specific environmental circumstances, natural production occurs in soil (e.g., natural formation of perchlorate in soil in the presence of a chlorine source, metallic object and using the energy generated by a thunderstorm).
- Sewer line leaks that enter the ground (e.g., adding chlorine which could generate trihalomethanes such as chloroform).

Negative consequences of soil contamination

The consequences of soil contamination in Delhi/NCR are diverse, affecting human health, biodiversity, and agricultural productivity. Contaminated soil can lead to the uptake of pollutants by plants, potentially compromising food safety. Additionally, polluted soil poses risks to groundwater quality as contaminants can leach into underground water sources. Consumption of heavy metals is known to carry dangers. Kidneys and livers are the organs most susceptible to

excessive metal levels. Long-term exposure to these metals can also result in the physical, muscular, and neurological degenerative conditions multiple sclerosis, Parkinson's disease, Alzheimer's disease, and muscular dystrophy. Only a fifth of the world's electronic garbage is properly collected or recycled, according to a report sponsored by the UN released in December. Of the 44.7 million tonnes of electronic garbage, approximately two million tonnes were produced in India. The main issue of soil pollution is excessive use of Aerosol in Delhi and deforestation.

DOUBLE TROUBLE: OVER AND UNDER THE GROUND

GROUNDWATER SITUATION AT DELHI'S THREE LANDFILLS

Location	TDS (mg/l)	Chlorine (mg/l)	Hardness as $CaCO_3$ (mg/l)
Ghazipur landfill			
Desirable limit for drinking water	500	250	300
Ghazipur dairy farm, lane no. 4	1,370	1,540	490
Ghazipur landfill site, near entry gate	890	1,625	420
Bhalswa landfill			
Desirable limit for drinking water	500	250	300
Bhalswa landfill site	5,280	2,390	1,060
Bhalswa dairy	3,330	1,495	900
Okhla landfill			
Desirable limit for drinking water	500	250	300
Okhla landfill site	1,990	965	1,090
Okhla bus depot	2,080	990	1,150

- DPCC report shows groundwater near the three landfill sites is contaminated
- Experts say the unsegregated waste at the landfill sites is leaching into the soil and contaminating groundwater
- DPCC has submitted the report to the water ministry

TDS: Total dissolved solids, $CaCO_3$: Calcium carbonate

Figure 4: Soil contamination in Delhi/NCR

Impacts on humans

All three stages can have soil pollutants (solid, liquid, and gaseous). As a result, there are several ways that these toxins might enter the human body, either through direct skin contact or by being inhaled along with contaminated soil dust.

The immediate impacts of being exposed to dirty soil on people include

- Nausea, dizziness, and vomiting.
- Wheezing, chest discomfort, and coughing.
- Skin irritation and eyes irritation
- Weakness and exhaustion.

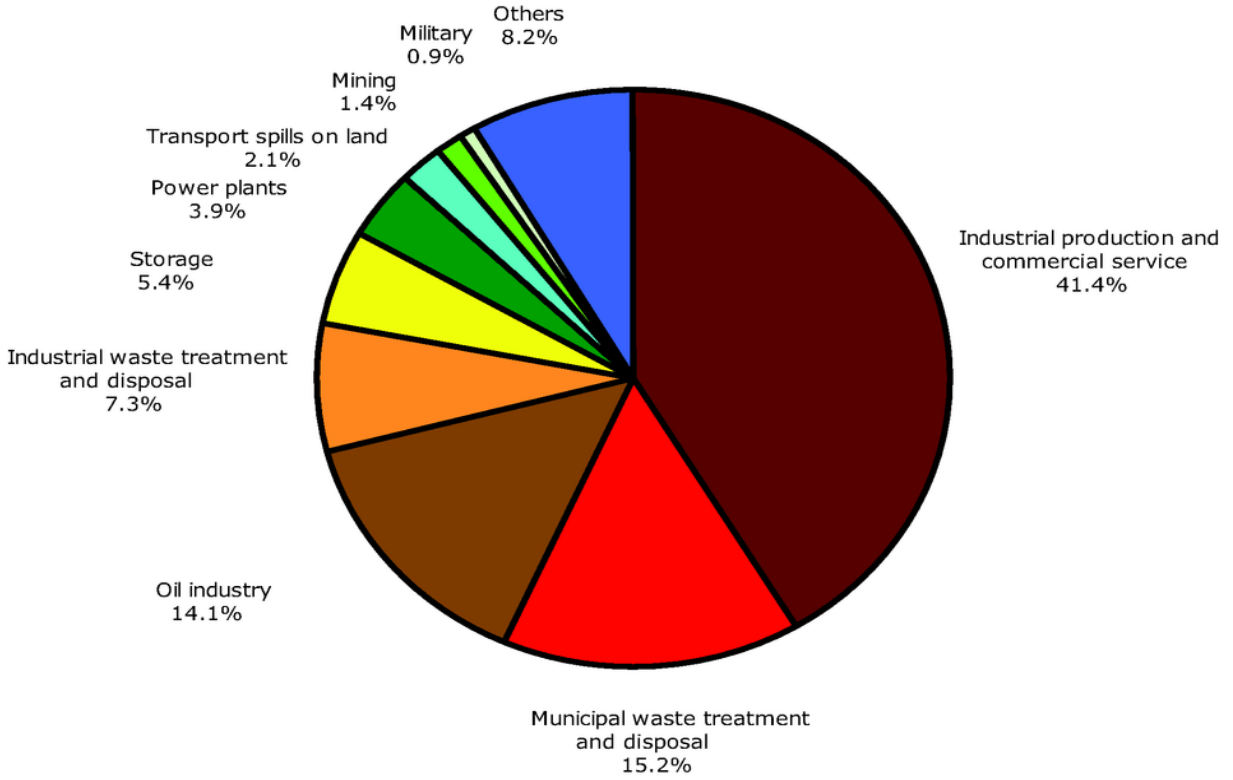

Figure 5: Types of soil contaminants harming human health

Soil contamination has been connected to several chronic illnesses. Humans eating food produced on hazardous soils has resulted in countless fatalities. The neurological system may suffer lasting harm if exposed to high amounts of lead. Children are especially susceptible to lead exposure. Below is a list of a few of these ailments.

- Decrease in CNS function (central nervous system).
- Damage to important organs including the liver and kidney.
- Greater chance of getting cancer.

It should be emphasized that several soil contaminants, including industrial solvents and petroleum hydrocarbons, have been connected to a variety of human congenital diseases. The various types of soil contaminants might harm people's health as shown in Fig. 4.

Effects on animals and plants

Plant life stops thriving in such soils because soil contamination is frequently accompanied by a reduction in the availability of nutrients. Plants may become poisonous from inorganic aluminum-contaminated soil. Additionally, this kind of pollution frequently raises the soil's salinity, which makes it unsuitable for the development of plant life. Through a process called bioaccumulation, plants grown in polluted soil may collect significant amounts of soil pollutants. All the accumulated contaminants are transferred up the food chain when herbivores eat these plants. This may cause several beneficial animal species to disappear or go extinct. Additionally, these contaminants may ultimately reach the top of the food chain and cause illnesses.

Consequences for the ecosystem

- A clear link between soil pollution and air and water pollution exists because volatile chemicals in soil can be blown into the sky by winds or seep into subsurface water reservoirs.
- Additionally, it may cause acid rain (by releasing huge quantities of ammonia into the atmosphere).
- Several microorganisms that enhance soil texture and aid in the breakdown of organic materials are hostile to acidic soils. Thus, the detrimental impacts of soil contamination also affect the texture and quality of the soil.
- This type of pollution has a significant impact on crop productivity. Heavy metal contamination has rendered about 12 million tonnes of grain (worth around 2.6 billion USD) unsuitable for human consumption.
- **Changing weather:** Changes in the rain cycle brought on by deforestation contribute to global warming and the destruction of ecosystems.
- **Soil fertility decline:** We require every bit of food we can acquire due to the tremendous expansion in the human population. Chemicals applied to soils decrease soil fertility, which lowers food output.

Solutions for soil contamination in Delhi/NCR

Addressing soil contamination in Delhi/NCR necessitates a multifaceted approach involving stringent regulatory measures, effective waste management strategies, and community engagement. Stringent environmental regulations should be enforced to curb industrial emissions, improper waste disposal, and the use of harmful agrochemicals. Improving waste management systems and promoting recycling practices are crucial for reducing the release of hazardous materials into the environment. Encouraging sustainable agricultural practices, such as organic farming, can minimize the reliance on chemical inputs, thus preserving soil health. Urban planning initiatives, including the integration of green spaces, afforestation, and permeable surfaces, can aid in mitigating soil contamination. Public awareness campaigns are essential to educate the community about responsible waste disposal and the far-reaching consequences of soil pollution.

- **Regulated farming techniques:** Anything in excess is dangerous. The idea that farming operations should be used moderately is applicable here as well. Overgrazing and overcropping should be avoided since they worsen soil erosion.
- **Bioremediation**: This is the process by which microorganisms that degrade pollutants are introduced into the soil. This method restores equilibrium by letting nature run its course, making it completely environmentally friendly.

- **Reducing, recycling, and reusing:** Items that may be reused again shouldn't be thrown away; items made of paper, glass, aluminum, and similar materials should be recycled; and, when possible, cut back on excesses like the usage of polythene paper.
- **Utilize biodegradable goods:** Use biodegradable items whenever possible, such as cardboard for packing; if they were to be discarded, they would quickly decompose and become a component of the soil.

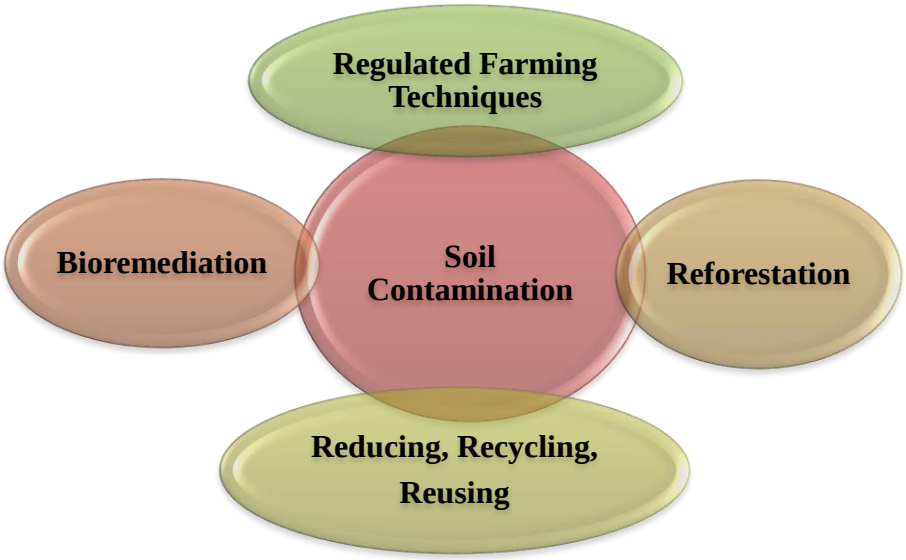

Figure 6: Possible solutions to soil contaminations

- **Cut back on the use of fertilizers and pesticides:** Reduced use of pesticides and fertilizers, which are major sources of soil contamination, would be extremely beneficial for the soil.
- **Collaboration and partnerships:** Foster collaboration between government agencies, private industries, non-governmental organizations, and research institutions is required to collectively address soil contamination challenges. Establish partnerships with international organizations to benefit from global expertise and resources.

By implementing a combination of these solutions, it is possible to mitigate soil contamination in Delhi/NCR and promote a healthier environment for current and future generations.

Conclusion:

This analysis of Delhi-NCR's soil pollution highlights a serious and intricate environmental issue. Pollutants in the soil have accumulated because of this region's fast industrialization and urbanization, endangering both human health and ecological integrity. The pollution is mostly caused by vehicle emissions, industrial discharges, and inappropriate waste disposal techniques. The widespread effects of heavy metal, pesticide, and other hazardous chemical contamination in soil include decreased fertility, contamination of groundwater, and

decreased agricultural yield. The impact on agricultural livelihoods and the strain on healthcare systems are clear socioeconomic consequences. Long-term soil health depends on encouraging organic farming and reducing the use of chemical inputs in agriculture. Furthermore, to create and use efficient remediation solutions, cooperation between government agencies, business associations, and academic institutions is essential as well as public awareness campaigns.

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ALTERNATIVE PROTEIN

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Abstract:

Proteins are macromolecules, which is madeup of amino acids as it plays an important role in structure and function of living organisms. They serve as enzyme, catalyst for biochemical reactions, contribute to cell structure, and functions as signaling molecules. The intake of protein for humans are classified bsed on their age, gender, weight, physical activity and over all health. Good sources of protein which include egg, fish, dairy, etc. and it is essential to include a variety of protein in the regular intake of foods to ensure a balance proteins in the body. Generally an average adult can consume around 0.8g of protein per kilogram of body weight per day. Due to the regular consumptions of conventional proteins as a protein supplement, it may leads to several health problems like cardio-vascular disease, cancer, obesity, and some digestive issues. In order to reduce the problems, we suggest a usage of alternative proteins among consumers and create awareness about the alternative proteins with the basic knowledge. In this chapter, we discuss about proteins, alternative proteins with its sources, need of alternative proteins, characterizations, functions, applications.

Keywords: Proteins, Health Problems, Alternative Proteins.

Introduction:

Proteins are essential large and complex molecules that play a crucial role in the structure and function of cells in the human body. They are made up of amino acids and are involved in various biological processes, including building and repairing tissues, supporting immune function, and serving as enzymes and signal molecules. Proteins are fundamental biological molecules crucial for the structure and function of cells in living organisms. Dietary protein, obtained from sources like meat, fish, eggs, legumes, and nuts, is essential for maintaining muscle mass, supporting immune function, and overall health. Adequate protein intake varies based on factors such as age, weight, and activity level. Protein supplements, available in various forms like casein, soy, and pea protein, are commonly used to meet specific nutritional or fitness goals. There are certain problems may result by persistant consumption of conventional proteins like heart disease, cancer risk, obesity, type 2 diabetes, hypertension, digestive issues and kidney problems. Understanding the significance of proteins and incorporating diverse protein sources into your diet contributes to a well-rounded and nutritionally balanced lifestyle.

Beyond the conventional animal-based sources, alternative proteins provide creative and sustainable solutions. They provide a varied and environmentally sustainable protein composition, including plant-based proteins from legumes, tempeh, and tofu. Furthermore, cutting-edge substitutes like insect-based proteins and cultured meat made from cellular agriculture provide distinctive, eco-friendly results. By include these substitutes in your diet, you may balance your intake of nutrients while also taking care of issues pertaining to the environmental effects of conventional animal rearing. Generally, different protein sources provide vary in the amounts of essential amino acids, so having a diverse diet that includes a mix of animal and plant-based proteins can help ensure you get a well-rounded intake of amino acids. These days, the amount of protein required in a diet varies depending on factors including age, health, and lifestyle. For individualized nutrition recommendations, always seek the advice of a qualified dietiation or healthcare practitioner.

Major source of protein:

Proteins are essential macromolecules that play a crucial role in the structure and function of cells in the human body. They are made up of amino acids and are involved in various biological processes, including building and repairing tissues, supporting immune function, and serving as enzymes and signaling molecules. Here are some major sources of protein:

Table: Sources of proteins

S. No.	Protein Source	Examples
1	Meat And Poultry	Chicken, Turkey, Beef, Pork, Lamb.
2	Fish And Seafoods	Salmon, Tuns, Cod, Shrimp, Crab.
3	Eggs And Dairy	Eggs, Milk, Cheese, Yogurt, Cottage Cheese.
4	Plant Based Sources	Legumes, Seeds, Nuts, Tofus, Tempeh, Edamame.
5	Grains	Qinoa, Brown Rice, Barley, Bulgur, Oats.
6	Dairy Alternatives	Soy Milk, Alomond Milk, Oat Milk.
7	Processed Protein Products	Protein Bars, Protein Powders, Processed Meat Alternatives
8	Vegetables	Broccoli, Brussels Sprouts, Spinach, Peas.
9	Animal Organs	Liver, Kidney, Heart.

Protein sources vs Human population alternative protein:

The sources of protein in a diet can vary significantly across different cultures and regions due to factors such as dietary preferences, cultural practices, and availability of certain foods. Here's a brief overview of how protein sources may differ based on the human population and some emerging alternative protein sources:

Protein Sources across different populations:

1. Western countries:

Western countries Diets often include a significant amount of animal-based proteins such as beef, chicken, pork, dairy products, eggs. Protein supplements, including whey and casein protein powders, are also commonly used in fitness and bodybuilding communities.

2. Asian countries:

Many Asian diets traditionally include a variety of plant-based proteins such as soy (tofu, tempeh), legumes, and rice. Whereas Fish and seafood are often major protein sources in coastal regions.

3. Middle eastern countries:

Diets in the Middle East commonly include proteins from sources like lamb, poultry, yogurt, and legumes such as chickpeas.

4.Vegetarian and vegan diets:

Vegetarian and vegan diets rely on plant-based protein sources such as beans, lentils, tofu, nuts, seeds, grains, and plant-based meat alternatives, made from ingredients like soy, peas, or mushrooms, are becoming more popular.

Health problems of conventional proteins

Conventional proteins can offer health benefits and have a lower environmental impact. Maintaining a varied and balanced diet is crucial, and eating decisions should take into account one's overall health as well as the wider environmental effects.

1. Cardiovascular issues: High consumption of red and processed meats has been linked to an increased risk of heart disease. These meats often contain saturated fats and cholesterol, which can contribute to elevated cholesterol levels and cardiovascular problems.

2. Cancer risk: Some studies suggest that a diet high in red and processed meats may be associated with an increased risk of certain cancers, particularly colorectal cancer. Cooking methods, such as grilling or smoking, can produce compounds that might be carcinogenic.

3. Environmental impact: Conventional protein sources, especially meat production, contribute significantly to environmental problems. Livestock farming is resource-intensive, requiring large amounts of water and land, and it contributes to deforestation and greenhouse gas emissions.

Need for the alternative protein

There are many different reasons to employ alternative proteins, including dietary preferences, environmental concerns, health advantages, moral dilemmas, and creative cooking. The future of sustainable and ethical food consumption is greatly influenced by these alternatives as they develop further. It includes,

1. **Plant-based diets:** In vegetarian and vegan diets, a lot of people select other proteins as their main source of nutrition. Sources of plant-based proteins include seitan, tofu, tempeh, beans, and lentils.

2. **Minimizing environmental impact:** When compared to conventional animal agriculture, alternative proteins - especially those derived from plants—generally have a smaller environmental impact. It often takes less land, water, and greenhouse gas emissions to produce plant-based proteins.
3. **Health and nutrition:** Lower saturated fat and cholesterol: Compared to some animal-based proteins, plant-based proteins often have lower levels of saturated fat and cholesterol. Both general health and heart health may benefit from it.
4. **Rich nutrient profile:** Fiber, vitamins, and minerals are just a few of the nutrients found in alternative protein sources. A varied intake of plant-based proteins can enhance the nutritional value and overall well-being of one's diet.
5. **Food innovation and technology:** Beyond Meat and Impossible Foods: Businesses such as these employ cutting-edge food technology to produce plant-based goods that remarkably resemble the flavor and texture of conventional meat. This invention contributes to the increased acceptability of alternative proteins among consumers.
6. **Allergen-conforming choices**: Considering Allergens: Allergies to common animal proteins, like milk and eggs, affect some people. People with allergies can still get the protein they need thanks to alternative proteins, which offer solutions that are friendly to allergens.
7. **Cultural and ethical considerations:** People may select other proteins because they have moral reservations about the treatment of animals. Alternatives to the customary practice of rearing and killing animals include plant-based diets and meats produced in labs.
8. **Diversifying protein sources:** Reducing Dependence on Animal Agriculture: Incorporating alternative proteins helps reduce dependence on traditional animal agriculture, promoting a more diversified and sustainable food system.
9. **Global food security**: Alternative proteins, especially those derived from plants, can be more resource-efficient in terms of land and water use. This efficiency becomes crucial as the global population grows, and demands on food resources increase.
10. **Culinary innovation:** Chefs and food innovators are exploring creative ways to incorporate alternative proteins into a wide range of dishes, providing new and exciting culinary experiences for consumers.

Alternative protein sources:

1. Plant-based proteins:

Beyond Meat and Impossible Foods are examples of companies which produce plant-based meat substitutes Alternative protein sources increasingly include plant-based options like pea protein, hemp protein, and rice protein.

2. Insect proteins:

Insects, such as crickets and mealworms, are rich in protein and are considered a sustainable alternative protein source. They are consumed in various forms, including protein bars and powders.

3. Cultivated meat:

Lab-grown or cultured meat involves producing animal meat from cells in a controlled environment. This technology has the potential to address environmental and ethical concerns associated with traditional meat production.

4. Algae and seaweed:

Some types of algae and seaweed are good sources of protein. Algal protein supplements are emerging as a plant-based protein alternative.

5. Fungi (Mycoprotein):

Mycoprotein is a protein-rich substance derived from fungi. Products like Quorn use mycoprotein as a meat substitute.

6. Single-cell proteins:

Proteins produced by microorganisms or fungi, such as yeast or bacteria, can be used as alternative protein sources. The interest in alternative protein sources is driven by concerns about sustainability, environmental impact, and the need to find protein sources that can meet the growing global demand for food. However, it's important to consider nutritional quality, taste, and cultural acceptance when introducing alternative protein sources into diets. Additionally, ongoing research and development are essential to improving the affordability and accessibility of these alternatives.

A) Plant based protein:

Plant-based protein extraction process:

1.Selection of raw material: Choose plant sources rich in protein content, such as soybeans, peas, lentils, chickpeas, or hemp seeds.

2.Cleaning and preparation: Remove impurities, debris, and foreign materials from the raw plant material.

3.Milling or grinding: Reduce the size of the plant material to increase the surface area for extraction.

4. Extraction:

- Solvent extraction: Use organic solvents like hexane to dissolve and separate proteins from the plant material.
- Aqueous extraction: Utilize water as a solvent, often in combination with pH adjustments or enzymes.
- Mechanical extraction: Use pressure or mechanical methods to extract proteins, common in oilseed processing.

5. Separation and filtration: Separate the protein-rich solution from the residual plant material through processes like centrifugation or filtration.

6. Precipitation: Adjust the pH or add salts to induce protein precipitation, separating proteins from other components.

7. Centrifugation: Further separate and concentrate proteins using centrifugal force.

8. Drying: Remove water from the protein solution, yielding a dry and concentrated protein powder.

Characterization of plant-based proteins:

1. Amino acid profile: Determine the types and amounts of amino acids present, essential for assessing nutritional quality.

2. Solubility: Assess the solubility of the protein in water or other solvents, impacting its application in different food and beverage products.

3. Digestibility: Evaluate how easily the protein is broken down and absorbed in the digestive system.

4. Texture and mouthfeel: Examine the protein's contribution to the texture and mouthfeel of food products, particularly in meat alternatives.

5. Color: Analyze the color of the protein, as it can influence the appearance of the final product.

6. Flavor: Evaluate the taste of the protein, which can impact the overall flavor of food products.

Functional properties of plant-based proteins:

1. Emulsification: Plant proteins can stabilize emulsions, enhancing the texture and mouthfeel of products like plant-based dressings and mayonnaise.

2. Foaming: Some plant proteins can create stable foams, useful in products like meringues and plant-based whipped toppings.

3. Gelling: Certain plant proteins have gelling properties, contributing to the structure and texture of products like plant-based gummies or desserts.

4. Water-holding capacity: Assess the protein's ability to retain water, influencing the juiciness and moisture content of meat alternatives.

5. Binding: Plant proteins can act as binders, helping ingredients stick together in products like veggie burgers or meat analogs.

Applications of plant-based proteins:

1. Meat alternatives: Utilized in the production of plant-based burgers, sausages, nuggets, and other meat substitutes.

2. Dairy alternatives: Formulated into plant-based milk, yogurt, cheese, and ice cream.

3. Protein supplements: Used in the production of protein powders, bars, and shakes for fitness and nutrition purposes.

4. Bakery products: Incorporated into bread, cookies, muffins, and other baked goods to enhance protein content.

5. Snacks: Added to snacks like protein chips, crackers, and granola bars.

6. Beverages: Used in smoothies, protein drinks, and other beverages to boost protein content.

7. Infant nutrition: Formulated into plant-based infant formulas as an alternative protein source.

8. Cereals and breakfast foods: Added to cereals, oatmeal, and granola for increased nutritional value.

9. Soups and sauces: Incorporated into soups, sauces, and gravies for protein fortification.

10. Pet food: Used in the formulation of plant-based protein options for pet food.

The growing demand for plant-based products has led to increased innovation in extracting, characterizing, and utilizing plant-based proteins across a wide range of food and beverage applications.

B. Insect based:

Insect-based protein refers to protein derived from insects for use in human or animal consumption. It involves harvesting, processing, and extracting protein from various insect species, such as crickets, mealworms, grasshoppers, and more. Insects are valued for their high protein content, essential amino acids, vitamins, minerals, and healthy fats. The extraction process typically includes steps like cleaning, heat treatment, drying, milling, and extraction. The resulting insect protein can be further processed into various forms, such as powders, flakes, or pastes, making it versatile for use in different food and feed applications.

Insect-based protein is gaining attention as a sustainable and efficient protein source due to the relatively low environmental impact of insect farming compared to traditional livestock. It has potential applications in products like protein bars, snacks, baked goods, and even as an ingredient in plant-based meat alternatives. Research in this field continues to explore ways to optimize production, processing, and utilization of insect-based protein to address global challenges related to food security and sustainability.

C. Microbes based:

Microbes-based protein refers to proteins produced through the cultivation and fermentation of microorganisms such as bacteria, yeast, fungi, or algae. These microorganisms serve as protein factories, generating proteins through biological processes. The proteins produced from microbes can have various applications, including food and feed production, as well as in the development of alternative protein sources.

The production of microbial based proteins:

1. Microbial strain selection: Choosing specific strains of microorganisms that are capable of efficiently producing the desired proteins.

2. Fermentation: Cultivating the selected microorganisms in controlled fermentation tanks or bioreactors, providing them with a suitable environment for protein production.

3. Harvesting: After a certain period of fermentation, the microorganisms are harvested, and the protein-rich biomass is separated.

4. Processing: The harvested biomass undergoes processing steps such as extraction and purification to isolate the protein of interest.

5. Formulation: The purified protein can be processed into different forms, such as powders or concentrates, making it suitable for various applications.

Microbes-based proteins have gained attention for their potential to provide a sustainable and resource-efficient protein source. They offer advantages such as rapid growth, reduced environmental impact, and the ability to produce proteins with specific functionalities.

Examples of microbes-based proteins include:

- Single-Cell Proteins (SCP): Proteins derived from the cultivation of microorganisms like yeast, bacteria, or algae.
- Fungal Proteins: Proteins produced through the fermentation of fungi, such as mycoprotein, which is used in products like Quorn.
- Algal Proteins: Proteins sourced from microalgae, which are rich in essential amino acids and can be used in various food and feed applications.

Microbes-based proteins are being explored as a part of the broader effort to diversify protein sources, reduce environmental impact, and address global food security challenges.

Conclusion:

The exploration and development of alternative protein sources address global challenges such as food security, environmental sustainability, and changing consumer preferences. Plant-based, insect-based, and microbes-based proteins offer diverse and sustainable solutions, catering to the increasing demand for protein while minimizing the environmental impact of traditional livestock farming. Plant-based proteins, derived from sources like legumes and grains, provide nutritional diversity and versatility in food products. Insect-based proteins show promise as sustainable and nutrient-rich sources with various culinary applications. Microbes-based proteins, produced through fermentation, offer resource-efficient and customizable production. These alternatives contribute to food security, diversify protein supplies, and mitigate concerns about land use, water consumption, and greenhouse gas emissions. Aligned with evolving consumer preferences, they promote sustainability and ethical sourcing. Collaboration among scientists, policymakers, and the food industry is essential for scalable and economically viable solutions. Public awareness and acceptance, alongside advancements in processing technologies, are crucial for mainstream integration. In summary, the pursuit of alternative protein sources represents a multifaceted approach to creating a more sustainable and resilient food system, holding promise for a healthier planet and a secure food future.

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CHALLENGE POSED BY MICROBES DUE TO DEVELOPMENT OF ANTIMICROBIAL RESISTANCE

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Abstract:

The development of antimicrobial resistance (AMR) in this millennium has posed a new challenge to humans living in the digital world. There are more than 700,000 people losing their lives because of antimicrobial resistance every year and number can go upto 10 millions by 2050, which is more than by cancer and road accidents combined together. The misuse of antibiotics in the medical, veterinary and agricultural sectors due to inappropriate prescribing of antibiotics, their unwanted use for livestock and insufficient hygienic practices in hospitals

Introduction:

Antimicrobial compounds have contributed in the reduction of infectious diseases in humans' animals and plants saving lives and increasing productivity, their effectiveness is now in danger as microbes evolve and become resistant. antimicrobial treatments are less effective, anti microbial compounds released into the environment together with other factors create a selection pressure on natural microbial community such that those with inherited or acquired resistance have pollution containing minimal selective concentration of antimicrobial compounds contributes to antimicrobial resistance (AMR) in the environment use and misuse of antimicrobials and other stress example the presence of heavy metals and other pollutants create favourable conditions for resistant microbes to develop . This can happen in the digestive tracks of humans and animals 2019 this is strong evidence that anti microbials increasingly failing to cure infections, the pipeline of novel antimicrobials to take the place has faltered and therefore poses a significant threat to human, animal and plant help and food security. It is estimated that by 2050 AMR could be responsible for a loss of 3.8 of the world's annual Gross Domestic Product (GDP). Failing to address the Global burden of AMR including its environmental dimensions could take humanity back to any when even mild infections become deadly.

The highest number of AMR attributable deaths is caused by six main pathogen–drug combinations: third-generation cephalosporin-resistant *Escherichia coli*, methicillin-resistant *Staphylococcus aureus* (MRSA), third-generation cephalosporin-resistant *Klebsiella pneumoniae*; and carbapenem-resistant *K. pneumoniae, Acinetobacter baumannii and Pseudomonas aeruginosa.* There is an increasing resistance trend for all drugs, in particular carbapenem resistance in A. *baumannii*, a worrying scenario given that carbapenems are considered a last-resort class of antibiotics. Non-bacterial AMR includes antiviral drug resistance in immunocompromised HIV/AIDS patients, drug-resistant malaria parasites, and drug-resistant Candida (a fungal infection). 2 An antibiotic that acts against the two major bacterial groups (Gram-positive and Gram-negative) and against a wide range of disease-causing bacteria (3).

Wide spread environmental releases of biological AMR pollutants originate from discharges of untreated human and animal excreta into the environment as well as from anti microbial manufacturing this occurs when content of barriers for the pollutants is lacking such as toilets without confined barriers, use of water to irrigate farms and fertilization of crops with untreated animal manual or human was responsible for transmit anti microbial resist. Water, soil and air then serve as vehicles for spreading antimicrobial resistance microbes between and among people animals and other environmental reservoirs example food production environments including aquaculture says EFSA panel on biological hazards (2021) USDA considered historical and collective experience as well as comments received in developing the Strategy. While there are numerous aspects of AMR that could be addressed, this USDA Strategy reflects priorities for expanding our understanding of AMR and innovating on solutions to address AMR risks across the human, animal, and environmental spectrum, taking into consideration accomplishments as well as challenges faced in implementing the 2014 Plan. USDA is composed of multiple agencies and offices with differing missions that can contribute to addressing AMR from each of their perspectives.

The Strategy is organized around three Areas of Focus and 10 Priorities for collaborative action by USDA and its public and private partners (1):

Sr. No.	Area of Focus	Priority
1	Reduce disease and pathogen transmission	Improve animal and crop health
		Promote biosecurity
		Promote food safety
2	Improve the scientific knowledge base on AMR risk	Continuously improve data infrastructure using a One Health approach
		Support science and research across sectors to inform risk analysis
		Improve understanding of drivers of antimicrobial use (AMU)
		Enhance feedback loops between (1) monitoring and surveillance; (2) research; and (3) education and outreach
3	Improve communication and collaboration within USDA and with national, regional, and global partners to address AMR risk	Enhance partnerships through building trust
		Improve knowledge dissemination and include contextual information
		Develop and deliver science-based solutions locally

Tackling the main social determinants of health by reducing poverty and economic inequality, ensuring basic standards of living, education and health, could have direct impact on the burden of infection and the spread of AMR.

The R&D pipeline for antimicrobials has mostly dried up – in the past 30 years, no new classes have entered the market. Of the 27 antimicrobials currently in development that address World Health Organization (WHO) priority pathogens, only six are innovative. (3)

Transmission of resistance, rather than consumption of antimicrobials, might be the main factor in AMR development. AMR affects EU regions very differently: the overall burden of AMR infections is highest in southern and eastern Europe, particularly in Greece, Italy and Romania, and is strongly correlated with reduced public expenditure on good-quality public healthcare. 4 Worsening healthcare conditions lead to longer patient hospital stays, which foster transmission. Lack of diagnostics and infrastructure often force preventive prescriptions of antimicrobials, increasing the use and misuse of antimicrobials. (3)

Impact on the EU Despite increased policy action and awareness at Member State, EU and international levels, AMR keeps rising. It is emerging as a global threat to human, animal and environmental health, presenting multidimensional risks to healthcare, the global economy, climate policy and geopolitical balances, which can further tip the risk one way or another.

The WHO has declared AMR as a top 10 global public health threat. AMR affects medical procedures (such as standard surgeries, dental implants, Caesarean sections, cancer treatments and organ transplantations) and complicates the overall management of leading non-communicable diseases (e.g. cardiovascular diseases, dementias and tumours). If left unaddressed, AMR could push humankind back to a preantimicrobial era, where patients died from minor infections. (3)

Cooperation with international partners, including the WHO, the Food and Agriculture Organization of the United Nations (FAO), and through initiatives such as the Joint Programming Initiative on Antimicrobial Resistance (JPIAMR), the Global Antimicrobial Resistance and Use Surveillance System (GLASS), and the Transatlantic Taskforce on Antimicrobial Resistance (TATFAR) to address the global threat of AMR(BRIEFING EPRS | European Parliamentary Research Service Author: Luisa Antunes Scientific Foresight Unit (STOA) PE 740.238 – March 2023 EN Tackling antimicrobial resistance: From science to pharmaceuticals policy. Possible areas in need of further action include: investment in the environmental aspect of the One Health action plan; improved harmonisation of data collection, monitoring and surveillance, including improved data sharing between the agencies (EMA, ECDC, EFSA) and between different sectors and stakeholders, including human and animal health, food and the environment; tightening of controls and enforcement of existing legislation in both the livestock sector and public healthcare; further investment in research and innovation, including into alternative treatments, diagnostics and vaccines; support and assistance for EU Member States to address widespread national gaps in terms of capability, training and logistics, and in terms of the implementation of policies and action plans at national level; better response

coordination between the EU, Member States and global players; the evaluation of the current One Health action plan and the implementation of a new action plan.(3) Research into novel technologies for vaccines, antimicrobials and diagnostics, including antibiotics designed by artificial intelligence (AI) and DNA tools (genetic diagnosis, gene therapies) could be more effective than developing new antimicrobials. Vaccines contribute to disease mitigation and eradication, showing low resistance. With the innovation in RNA technologies and medical AI, new vaccines against cystic fibrosis pathogens and tuberculosis could soon be developed, relieving pressure on AMR.

The May 2015 World Health Assembly endorsed a global action plan on antimicrobial resistance (AMR), urging member states to develop their own national action plans within two years. In order to promote and strengthen domestic measures and international cooperation regarding antimicrobial resistance (AMR), the "Basic Guidelines for Strengthening Measures on Emerging Infectious Diseases" was formulated at the "Ministerial Meeting on Measures on Emerging Infectious Diseases" held on February 9, 2016, which includes description about the formulation of an action plan on antimicrobial resistance (AMR) (2).

Conclusion:

New antibiotics and drug treatments will not solve this health crisis alone, nor will the mere call for increased investments remedy the issue (although, new investments in monitoring and surveillance systems will be vital). AMR interventions must be tackled systemically. This systemic approach calls for new conservation strategies for appropriate use of antimicrobials, better regulation on antimicrobial use, reduced usage of antimicrobials in agriculture, increased global awareness of the issue, improved sanitation practices and better incentives for pharmaceutical companies to develop new antibiotics

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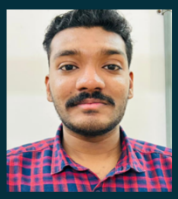
About Editors



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