



irc 2021
XV. international research conference
proceedings

open science index 15 2021

october 18-19, 2021 dubai united arab emirates
international scholarly and scientific research & innovation



Open Science

Open Science Philosophy

Open science encompasses unrestricted access to scientific research articles, access to data from public research, and collaborative research enabled by information and communication technology tools, models, and incentives. Broadening access to scientific research publications and data is at the heart of open science. The objective of open science is to make research outputs and its potential benefits available to the entire world and in the hands of as many as possible:

- Open science promotes a more accurate verification of scientific research results. Scientific inquiry and discovery can be sped up by combining the tools of science and information technologies. Open science will benefit society and researchers by providing faster, easier, and more efficient availability of research outputs.
- Open science reduces duplication in collecting, creating, transferring, and re-using scientific material.
- Open science increases productivity in an era of tight budgets.
- Open science results in great innovation potential and increased consumer choice from public research.
- Open science promotes public trust in science. Greater citizen engagement leads to active participation in scientific experiments and data collection.

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Open Society

An open society allows individuals to change their roles and to benefit from corresponding changes in status. Open science depends to a greater or lesser extent on digital technologies and innovations in structural processes by an open society. When realized, open science research and innovation can create investment opportunities for new and better products and services and therefore increase competitiveness and employment. Open science research and innovation is a key component of thematic open science priorities. Central to the open science digital infrastructure is enabling industry to benefit from digital technology and to underpin scientific advances through the development of an open society. Open science research and innovation can also contribute to society as a global actor because scientific relations can flourish even where global relations are strained. Open science has a critical role across many areas of decision making in providing evidence that helps understand the risks and benefits of different open science choices. Digital technology is making the conduct of open science and innovation more collaborative, more global, and more open to global citizens. Open society must embrace these changes and reinforce its position as the leading power for science, for new ideas, and for investing sustainably in the future.

It is apparent in open society that the way science works is fundamentally changing, and an equally significant transformation is taking place in how organizations and societies innovate. The advent of digital technology is making research and innovation more open, collaborative, and global. These exchanges are leading open society to develop open science and to set goals for research and innovation priority. Open science goals are materializing in the development of scientific research and innovation platforms and greater acceptance of scientific data generated by open science research. Open science research and innovation do not need help from open society to come up with great ideas, but the level of success ideas ultimately reach is undoubtedly influenced by regulation, financing, public support, and market access. Open society is playing a crucial role in improving all these success factors.

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Open science represents a new approach to the scientific process based on cooperative work and new ways of diffusing knowledge by using digital technologies and collaborative tools. These innovations capture a systemic change to the way science and research have been carried out for the last fifty years. Science is shifting from the standard practice of publishing research results in scientific publications after the research and reviews are completed. The shift is towards sharing and using all available knowledge at an earlier stage in the research process. Open science is to science what digital technology is to social and economic transactions: allowing end users to be producers of ideas, relations, and services and in doing so, enabling new working models, new social relationships and leading to a new modus operandi for science. Open science is as important and disruptive as e-commerce has been for the retail industry. Just like e-commerce, the open science research paradigm shift affects the whole business cycle of doing science and research. From the selection of research subjects to the carrying out of research, to its use and re-use, to the role of universities, and that of publishers are all dramatically changed. Just as the internet and globalization have profoundly changed the way we do business, interact socially, consume culture, and buy goods, these changes are now profoundly impacting how one does research and science.

The discussion on broadening the footprint of science and on novel ways to produce and spread knowledge gradually evolved from two global trends: Open Access and Open Source. The former refers to online, peer-reviewed scholarly outputs, which are free to read, with limited or no copyright and licensing restrictions, while open source refers to software created without any proprietary restriction and which can be accessed and freely used. Although open access became primarily associated with a particular publishing

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or scientific dissemination practice, open access already sought to induce a broader practice that includes the general re-use of all kinds of research products, not just publications or data. It is only more recently that open science has coalesced into the concept of a transformed scientific practice, shifting the focus of researchers' activity from publishing as fast as possible to sharing knowledge as early as possible. Open science is defined as the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process. As a result, the way science is done in the future will look significantly different from the way it is done now. Open science is the ongoing evolution in the modus operandi of doing research and organizing science. This evolution is enabled by digital technology and is driven by both the globalization of the scientific community and increasing public demand to address the societal challenges of our times. Open science entails the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organized.

Open science impacts the entire research cycle, from the inception of research to its publication, and on how this cycle is organized. The outer circle reflects the new interconnected nature of open science, while the inner circle shows the entire scientific process, from the conceptualization of research ideas to publishing. Each step in the scientific process is linked to ongoing changes brought about by open science, including the emergence of alternative systems to establish a scientific reputation; changes in the way quality and impact of research are evaluated; the growing use of scientific blogs; open annotation; and open access to data and publications. All institutions involved in science are affected, including research organizations, research councils, and funding bodies. The trends are irreversible, and they have already grown well beyond individual projects. These changes predominantly result from a bottom-up process driven by a growing number of researchers who increasingly employ social media in their research and initiate globally coordinated research projects while sharing results at an early stage in the research process.

Open science is encompassed in five schools of thought:

- the infrastructure school, concerned with technological architecture
- the public school, concerned with the accessibility of knowledge creation
- the measurement school, concerned with alternative impact assessment
- the democratic school, concerned with access to knowledge
- the pragmatic school, concerned with collaborative research

According to the measurement school, the reputation and evaluation of individual researchers are still mainly based on citation-based metrics. The h-index is an author-level metric that attempts to measure both the productivity and citation impact of the publications of a scientist or scholar. The impact factor is a measure reflecting the average number of citations to articles published in an academic journal and is used as a proxy for the relative importance of a journal.

Numerous criticisms have been made of citation-based metrics, primarily when used, and often misused, to assess the performance of individual researchers. These metrics:

- are often not applicable at the individual level
- do not take into account the broader social and economic function of scientific research
- are not adapted to the increased scale of research
- cannot recognize new types of work that researchers are performing

Web-based metrics for measuring research output, popularized as altmetrics, have recently received much attention: some measure the impact at the article level, others make it possible to assess the many outcomes of research in addition to the number of scientific articles and references. The current reputation and evaluation system has to adapt to the new dynamics of open science and acknowledge and incentivize

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engagement in open science. Researchers engaging in open science have growing expectations that their work, including intermediate products such as research data, will be better rewarded or taken into account in their career development. Vice-versa, the use, and reuse of open data will require appropriate codes of conduct requiring, for example, the proper acknowledgment of the original creator of the data.

These ongoing changes are progressively transforming scientific practices with innovative tools to facilitate communication, collaboration, and data analysis. Researchers that increasingly work together to create knowledge can employ online tools and create a shared space where creative conversation and collaboration can occur. As a result, the problem-solving process can be faster, and the range of problems that can be solved can be expanded. The ecosystem underpinning open science is evolving very rapidly. Social network platforms for researchers already attract millions of users and are being used to begin and validate more research projects.

Furthermore, the trends towards open access are redefining the framework conditions for science and thus have an impact on how open innovation is produced by encouraging a more dynamic circulation of knowledge. It can enable more science-based startups to emerge thanks to the exploitation of openly accessible research results. Open science, however, does not mean free science. It is essential to ensure that intellectual property is protected before making knowledge publicly available in order to subsequently attract investments that can help translate research results into innovation. If this is taken into account, fuller and broader access to scientific publications and research data can help to accelerate innovation. Investments that boost research and innovation in open science would benefit society with fewer barriers to knowledge transfer, open access to scientific research, and greater mobility of researchers. In this context, open access can help overcome the barriers that innovative organizations face in accessing the results of research funded by the public.

Open innovation

An open society is the largest producer of knowledge, but the phenomenon of open science is changing every aspect of the scientific method by becoming more open, inclusive, and interdisciplinary. Ensuring open society is at the forefront of open science means promoting open access to scientific data and publications alongside the highest standards of research integrity. There are few forces in this globe as engaging and unifying as science. The universal language of science maintains open channels of communication globally. Open society can maximize its gains through maintaining its presence at the highest level of scientific endeavor, and by promoting a competitive edge in the knowledge society of the information age. The ideas and initiatives described in this publication can stimulate anyone interested in open science research and innovation. It is designed to encourage debate and lead to new ideas on what and open society should do, should not do, or do differently.

An open society can lead to a research powerhouse; however, open society rarely succeeds in turning research into innovation and in getting research results to the global market. Open society must improve at making the most of its innovation talent, and that is where open innovation comes into play. The basic premise of open innovation is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into products and services that create new markets while fostering a stronger culture of entrepreneurship. Open innovation is defined as the use of purposive inflows and outflows of knowledge to accelerate internal innovation. This original notion of open innovation was primarily based on transferring knowledge, expertise, and even resources from one company or research institution to another. This notion assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they seek to improve their performance. The concept of open innovation is continually evolving and is moving from linear, bilateral transactions and collaborations

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towards dynamic, networked, multi-collaborative innovation ecosystems. This means that a specific innovation can no longer be seen as the result of predefined and isolated innovation activities but rather as the outcome of a complex co-creation process involving knowledge flows across the entire economic and social environment. This co-creation takes place in different parts of the innovation ecosystem and requires knowledge exchange and absorptive capacities from all the actors involved, whether businesses, academia, financial institutions, public authorities, or citizens.

Open innovation is a broad term, which encompasses several different nuances and approaches. Two main elements underpin the most recent conceptions of open innovation: the users are in the spotlight and invention becomes an innovation only if users become a part of the value creation process. Notions such as user innovation emphasize the role of citizens and users in the innovation processes as distributed sources of knowledge. This kind of public engagement is one of the aims of open science research and innovation. The term 'open' in these contexts has also been used as a synonym for 'user-centric'; creating a well-functioning ecosystem that allows co-creation and becomes essential for open innovation. In this ecosystem, relevant stakeholders are collaborating along and across industry and sector-specific value chains to co-create solutions for socio-economic and business challenges. One important element to keep in mind when discussing open innovation is that it cannot be defined in absolutely precise terms. It may be better to think of it as a point on a continuum where there is a range of context-dependent innovation activities at different stages, from research to development through to commercialization, and where some activities are more open than others. Open innovation is gaining momentum thanks to new large-scale trends such as digitalization and the mass participation and collaboration in innovation that it enables. The speed and scale of digitalization are accelerating and transforming the way one designs, develops, and manufactures products, the way one delivers services, and the products and services themselves. It is enabling innovative processes and new ways of doing business, introducing new cross-sector value chains and infrastructures.

Open society must ensure that it capitalizes on the benefits that these developments promise for citizens in terms of tackling societal challenges and boosting business and industry. Drawing on these trends, and with the aim of helping build an open innovation ecosystem in open society, the open society's concept of open innovation is characterized by:

- combining the power of ideas and knowledge from different actors to co-create new products and find solutions to societal needs
- creating shared economic and social value, including a citizen and user-centric approach
- capitalizing on the implications of trends such as digitalization, mass participation, and collaboration

In order to encourage the transition from linear knowledge transfer towards more dynamic knowledge circulation, experts agree that it is essential to create and support an open innovation ecosystem that facilitates the translation of knowledge into socio-economic value. In addition to the formal supply-side elements such as research skills, excellent science, funding and intellectual property management, there is also a need to concentrate on the demand side aspects of knowledge circulation, making sure that scientific work corresponds to the needs of the users and that knowledge is findable, accessible, interpretable and reusable. Open access to research results aims to make science more reliable, efficient, and responsive and is the springboard for increased innovation opportunities, e.g. by enabling more science-based startups to emerge. Prioritizing open science does not, however, automatically ensure that research results and scientific knowledge are commercialized or transformed into socio-economic value. In order for this to happen, open innovation must help to connect and exploit the results of open science and facilitate the faster translation of discoveries into societal use and economic value.

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Collaborations with global partners represent important sources of knowledge circulation. The globalization of research and innovation is not a new phenomenon, but it has intensified in the last decade, particularly in terms of collaborative research, international technology production, and worldwide mobility of researchers and innovative entrepreneurs. Global collaboration plays a significant role both in improving the competitiveness of open innovation ecosystems and in fostering new knowledge production worldwide. It ensures access to a broader set of competencies, resources, and skills wherever they are located, and it yields positive impacts in terms of scientific quality and research results. Collaboration enables global standard-setting, allows global challenges to be tackled more effectively, and facilitates participation in global value chains and new and emerging markets.

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Scholarly Research Review

The scholarly research review is a multidimensional evaluation procedure in which standard peer review models can be adapted in line with the ethos of scientific research, including accessible identities between reviewer and author, publishing review reports and enabling greater participation in the peer review process. Scholarly research review methods are employed to maintain standards of quality, improve performance, provide credibility, and determine suitability for publication. *Responsible Peer Review Procedure:* Responsible peer review ensures that scholarly research meets accepted disciplinary standards and ensures the dissemination of only relevant findings, free from bias, unwarranted claims, and unacceptable interpretations. Principles of responsible peer review:

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- Scholarly Research Review Platforms: The scholarly research review process is independent of the final publication of the manuscript and it is facilitated by a different organizational entity than the venue of publication

All submitted manuscripts are subject to the scholarly research review process, in which there are three stages of evaluation for consideration: pre-review manuscripts, chair-review presentation, and final-review manuscripts. All submitted full text papers, that may still be withstand the editorial review process, are presented in the conference proceedings. Manuscripts are tracked and all actions are logged by internal and external reviewers according to publication policy. External reviewers' editorial analysis consists of the evaluation reports of the conference session chairs and participants in addition to online internal and external reviewers' reports. Based on completion of the scholarly research review process, those manuscripts meeting the publication standards are published 10 days after the event date.

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Infrastructure Project Management and Implementation: A Case Study of the Mokolo-Crocodile Water Augmentation Project in South Africa

Elkington Sibusiso Mnguni

Abstract — The Mokolo-Crocodile Water Augmentation Project (MCWAP) is located in the Limpopo Province in the northern-western part of South Africa. Its purpose is to increase water supply by 30 million cubic metres per year to meet current and future demand for users including power stations, mining houses and the local municipality in the Lephalale area. This paper documents the planning and implementation aspects of the MCWAP infrastructure project. The study will add to the body of knowledge with respect to bulk water infrastructure development in water-scarce regions. The method used to gather and collate relevant data and information was the desk top study. The key finding was that the project was successfully completed in 2015 using conventional project management and construction methods. The project is currently being operated and maintained by the national Department of Water and Sanitation.

Keywords — construction, contract management, infrastructure project, project management

Extending feature models with Non-Functional Feature Modeling in Software Product Line Evolution

O.Ferchichi, R.Beltaifa, L.Elabet

Abstract— In the context of the Software Product Line Engineering (SPLE), unplanned evolution are important throughout the family's life cycle, thanks to the birth of new technology platforms, the emergence of new operational requirements for user satisfaction. The Feature Model (FM) is the basic instrument that supports the evolution of SPL at the variability level. As a result, FM as a basic model, may be supplemented by other techniques to express various non-functional requirements. As a result, FM as a basic model, may be supplemented by other techniques to express various non-functional requirements. Evolution is triggered by changes in the FM's features by managing non-functional requirements such as quality and constraints. [Problem]: Given the general context presented above, a key question arises, namely: 1) How to improve the FM diagram to make quality modeling and features constraints understandable at the time of SPL evolution? .[Contribution]: In this paper, we propose a metamodel for feature modeling extensions FM, which integrates of quality/constraint feature for supporting FM evolution. We then developed rules to transform the different requirements addressed by the extension of FM FODA into FeatureIDE using the Xtext language.

Keywords— Software Product Line Engineering (SPLE), Variability, Management Variability, Modeling Variability, Feature, Feature Models (FM), FODA, Feature non functional.

Hybrid Method for Smart Suggestions in Conversations for Online Marketplaces

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Abstract—Online / offline chat is a convenient approach in the electronic markets of second-hand products in which potential customers would like to have more information about the products to fill the information gap between buyers and sellers. Online peer in peer market is trying to create artificial intelligence-based systems that help customers ask more informative questions in an easier way. In this article, we introduce a method for the question / answer system that we have developed for the top-ranked electronic market in Iran called Divar.

when it comes to secondhand products, Incomplete product information in a purchase will result in loss to the buyer. One way to balance buyer and seller information of a product, is to help the buyer ask more informative questions when purchasing. Also, the short time to start and achieve the desired result of the conversation was one of our main goals, which was achieved according to A/B tests results.

In this paper we propose and evaluate a method for suggesting questions and answers in the messaging platform of e-commerce website Divar. of creating such systems is to help users gather knowledge about the product easier and faster, All from Divar database.

We collected a dataset of around 2 million messages in Persian colloquial language and for each category of product we gathered 500K messages, of which only 2K were Tagged and semi-supervised methods were used.

In order to publish the proposed model to production, it is required to be fast enough to process 10 million of messages daily on CPU processors. In order to reach that speed, in many subtasks faster and simplistic models are preferred over deep neural models. The proposed method which requires only a small amount of labeled data, is currently used in Divar production on CPU processors and 15% of buyers and seller's messages in conversations is directly chosen from our model output and more than 27% of buyers have used this model suggestions in at least one daily conversation.

Keywords— Smart Reply, Spell Checker, Information Retrieval, Intent Detection, Question Answering

I. INTRODUCTION

What is the most popular type of communication in online marketplace. Our study shows that about 70% of users prefer to use chat rather than text messages and voice calls. As a result of increasing chats, it has become challenging for users to process and respond to incoming messages. It can be especially time-consuming to reply conversations on chat instead of calls.

An initial study covering millions of conversations from Divar conversations showed that 34% of messages are about technical questions. Thus, we raised the following two questions: can we assist users with more informative questions? Can we

accelerate communications with a recommender system? To address this problem, we leverage hybrid models to find technical and common intents, retrieve messages, and lead conversation scheme to reach to dealing. We present a system that can automatically make innovative and informative questions about a seller's product and retrieved seller's answers to the same questions about same or former products. Current question answering methods consist of generative and extractive techniques. For example, Yin et al [1] presents a generative approach that uses a recurrent neural network (RNN) or Gmail [2] uses end to end LSTM model for short responses, for learning model they used semi supervised tagging and a good deal of intent detection and as result They get 10% usage over implanted users.

Other related work was question answering of similar application Carousel, which adds LSTM networks from product description and buyer question to find sellers answers [3] Similarly, LinkedIn uses an extractive statistical model for predicting responses to incoming messages. In contrast, instead of predicting responses directly, our experiment techniques that perform language understanding (i.e., intent detection) and reply retrieval separately with ordering. we preferred this hybrid model because of appreciable its shorter running time in despite of generative model. In addition, streamline communications between sellers and buyers for each seller advertisement (which we call post) is domain-specific, that makes this model more applicable for Divar use case.

the success of a commercial application is measured by the benefit brings to the users (e.g., improved user engagement) relative to the cost of development and maintenance. As a result, our development progress needs to be frequently validated through A/B experiments with live user trac.

In this paper, we describe our approach to deploy a smart suggestion system with those two challenges in mind. We make two main contributions:

- our first contribution is to present our scalable and cost-effective intent detection method¹. Which was built on distributed model.
- Our second contribution is to deploying our smart suggestions in conversations method and after deploying the end-to-end system, we use A/B tests to measure user engagement on live trac.

Here we define the terms we used.

1- University of Tehran, Department of Engineering (<https://enginter.ut.ac.ir>).

2- Divar, Biggest platform of second-hand products in Iran (Divar.ir)

¹ <https://github.com/Yasaminrahimi/categorized-keyword-extractor>

Definition 1. Category: category $C = \{c_1, c_2, \dots, c_n\}$ is a set of all product categories such as vehicle, apartment, cloths, etc.

Definition 2. Post: post $P = \{p_1, p_2, \dots, p_n\}$ is a set of all product ads in our platform.

Definition 3. Description: is a function $P \rightarrow D$ which maps each post p to a description d .

II. THE ARCHITECTURE OF THE SYSTEM

A. Sentence Embedding

Divar is a local ecommerce platform in Iran, so all of our data is in Persian language. Therefore, we had lack of pertained model and labeled data, because of that in each part of our model we had challenged with unsupervised data and we design our model based on this fact.

Also, in NLP tasks most of the time we need to translate our data to numerical format, for this purpose we embedded messages using the FastText model [4], an unsupervised algorithm that learns fixed-length feature representations from variable-length pieces of text, such as sentences, paragraphs and documents. To embed our messages, we had many choices and many limitations. We had the limitation to use transformer-based language model like Bert [5] and GPT-2 [6] because of our server limitations and training time, and also among word2vec, doc2vec glove and other fundamental models we chose FastText because our messages are domain-specific and contain a lot of typos, summarization and misspellings.

On the other hand, our messages contain a lot of typos, summarization and misspellings and FastText has benefits of using n-gram of words to make neural networks and it handles this problem of our dataset.

For evaluation of language models, we used ROC curve and mAP on labeled dataset.

1) Labeled Dataset:

To Find best language model for our purpose and fine tuning of this model we labeled similarity of 2000 buyers first messages in one category with main intents of this category by these three labels:

[same, different, comparable]

Then we evaluate model performance by cosine distance of model's representation vector of messages and intents.

2) Language Model Selection:

After annotation we select best language model by ROC curve on cosine similarity of messages and intent and labeled value of their similarity. By this Examination we find that fastText is best language model for our purpose. At this Examination, we tested fastText, Glove and TF-IDF representations.

3) Hyper Parameter Tuning:

For Hyper parameter tuning we used the previous method (Roc Curve) to find best parameters for our model, we compared AUC of cbow or skip-gram, dimension, distance metric, etc. to tune fastText hyper parameters for our unsupervised language representation model.

But the most important thing in fastText model was the train dataset. We train fastText model with 2 datasets:

- fastText pretrained model (Persian Wikipedia Dataset)
- In-house dataset of Divar Messages

We find our Dataset was more impressive on mentioned Roc curve, you can see this margin in below figure:

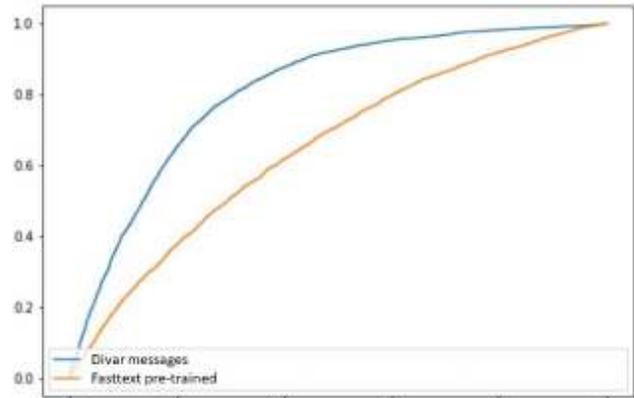


Fig. 2. Roc curve of cosine similarity of messages and intents on pre-trained fastText (wiki.fa.bin) and our in-house data

This gap was happened because of our Domain specific, misspelled and Colloquial text.

Our FastText model was trained on millions of in-app chat messages of each category and was then used to map each message to a dense vector embedding space. But fastText model just has a word embedding and it returns average of text words vector for getting text embedding. But we tested some other methods by fastText vector, and most impressive result was combining fastText with word idf [7] and getting sentence vector by weighted average of word vectors and their idf score.

B. Intent Detection

1) Clustering Phase for Data Preparation:

For Finding keywords we have to not share scores of the same intent words between synonyms word or misspelled words so we need to aggregate score of synonyms and misspelled words to find separate important intents in each category. For this purpose, we clustered words vector with different methods which is described below:

For intent detection we trained many methods, first we used clustering with centroid base method like K-means, and density-based method like DBSCAN, at least we find HDBSCAN best clustering method for our purpose. mainly because:

- For text representation vector, symmetric is not valid consideration and density is more important.
- We are blind for important clusters so hierarchical clustering is more informative than unstructured set of clusters.

For mapping synonyms and misspelled words, we map each word in cluster to most frequent word in cluster if they had less than 0.2 cosine distance. (This threshold was measured by having 0.85 precision on annotated data)

2) Keyword Detection:

For finding keywords or key intents in each category, working with unsupervised clustering had lots of problems. For example, each category has different distribution because in some categories we have a wholesaler but some of them just have a retailer so word distribution is different. Another problem is that some categories have lots of clusters and others have a few clusters. So, for each category we should train too much to tune clustering parameters.

instead of handling these problems we tried Statistical models like Entropy [9] and chi-square test [11] to find dependence of each word(1-gram) or sentence (more than bi-gram) to categories.

We have this formula for Entropy:

$$E_{w_i} = - \sum_{c \in Q} P(c|w_i) \log P(c|w_i)$$

Here Q denotes set of categories, c denotes to each category and w_i denotes word i in our word set. The larger E_w is, the more likely w_i is a background topic and smaller E_w more likely w_i is noisy, specific names or incorrect word. But we had problem with this score, first the noisy or incorrect words should be removed. We removed them by packetizing words frequency and removing abnormal words which not follow frequent word distribution.

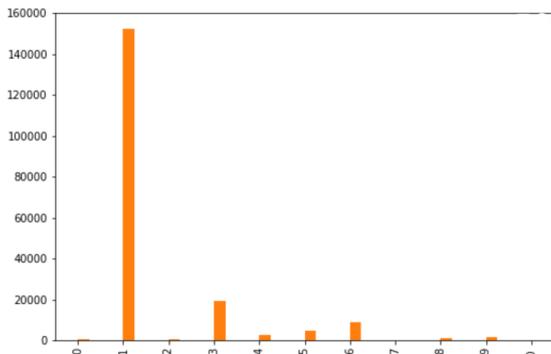


Fig. 3. Bucketized word distribution in Phone category,

buckets are in $[e^0, e^1, e^2, \dots, e^{10}]$.

As you see in figure 5 more than 80% of words are noisy and specific names.

a) Entropy base formula.

As a result, we found that in each category we have many users which advertise their store, brand, social media pages, etc. So, with entropy formula we had problems with proper nouns and specific names. Consequently, we add user sparsity to our entropy formula.

Also, the number of rare words is not specified in above formula so after many examinations we generated this formula for our use case which is shown below:

$$S_{(w_i)} = \frac{\log^{(d(w_i))} \left(\frac{F(w_i, c_j)}{\sum_j F(w_i, c_j)} \right)}{E_{(w_i)}}$$

which S_w denotes the score of word w_i , and F denotes to frequency of word w_i in category of c_j and d denotes to count of distinct users who used word w_i in their messages.

b) Chi-Square

In feature selection, we aim to select the features which are highly dependent on the response. When two features are independent, the observed count is close to the expected count, thus we will have smaller Chi-Square value. So high Chi-Square value indicates that the hypothesis of independence is incorrect. In our project we considered features are words and categories and we measured score of dependence of each pair of word and category. This score works better than entropy but we use both of them because chi-square has a problem to considering common dependent words in many categories.

As a final result of our mixed formula, we find out important intent and keyword by score of words and there it is a word-cloud of 1-gram and bigram keywords in category of mobile/phone:



Fig. 4. keywords in phone category translated to English

Here for bigram, we don't remove some stop words, for example with-Xiaomi means exchange with Xiaomi phones and we can also see trend phones in this word cloud.

Because of our massive dataset we implant all algorithms in spark for its distributed system.

Common important intent.

As we said before words which have a large entropy in most categories are common topic or common important intent, these words are not shown in our formula because they have high frequency in each category. Like Exchange, Asking the price, Asking Addresses and etc. we add most of these intents to intent list of each category.

By this normalization we gave score to each word:

$$score_{(w_i)} = \left(\sum_j F(w_i, c_j) \right) / \left(var \left(F(w_i, c_j) \right) \right)$$

Most important common intents between all categories were:

- Asking price
- Asking address
- Exchange ability
- Asking for discount

C. Annotation Phase.

After extracting key words by made list of word with highest score in wanted category, we cleaned text messages of one week then with some basic query we found corresponding buyer questions which include our keywords and we prepared this question for global usage, without misspelled and specific. Also, in this phase we used data augmentation to generate different data and cover a variety of questions. In this way, we translated the corresponding sentences of the found keywords into other languages with Python packages and translated them again into Persian so that we can have different ways of expressing a question.

After annotation we find that about 79% of these messages were in correct intent

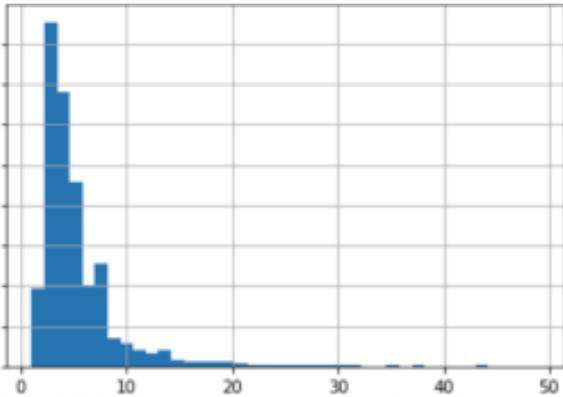


Fig. 5. Distribution of messages length, in this sample 0.95% of messages are shorter than 7 words

We used these sentences as message suggestion in our model and for detecting intent of each coming messages we used Faiss algorithm [10].

FAISS answers the question of “what are the closest database points to the query point” by constructing a 2-level tree. Database vectors are further compressed to make the tree smaller.

Given n database vectors, they cluster with k -means for the top level, getting about \sqrt{n} centroids. Then, at search time, it uses exact search to find the closest centroids, and then among the closest centroid’s clusters look for the closest clusters overall.

D. Base Model:

As we described in previous session, the intents are gathered by entropy base formula and for each text messages we find nearest intent with Faiss algorithm. But something was so important in dialogue, order of messages and also correlation of intents. For covering these features, we used Markov Model.

1) Markov Base Model.

The Markov model is a probabilistic model which assumes future outcome just depends on the last previous outcome. Our goal is to suggest the most suitable text as a smart suggestion for users based on the state of conversation. Here instead of generating text we simplify the problem by predicting next message intent and

apply the Markov assumption in our model. Before this We’ve trained a model to classify intent of messages by text of message, and we used this model to create a data set of messages and their intents. by having this data set, in our framework last state is a structure of two features, last intent and message count. And we want to predict the next message intent. We’ve used Bayes and Naive Bayes models for implementing Markov. Evaluations are based on two types of quality and diversity metrics. For quality metrics macro and weighted average of recall, precision and f1 score are used and for diversity metric we used entropy of predictions. Since advertisements on Divar have various categories, we trained our smart suggestion model on multiple categories of advertisements like cloth, vehicle, smartphone and etc. as the model predicts next, intent we suggest some manually prepared texts suitable for each intent to users.

Bayes and Naive Bayes.

Both of these models are based on Bayes formula:

$$p(y|x_1, \dots, x_n) = \frac{p(y) p(x_1, \dots, x_n|y)}{p(x_1, \dots, x_n)}$$

y is the label of our samples and x_i is the value of feature i . For Naive Bayes there is extra assumption which implies independence of features from each other.

Here is the formula for Naive Bayes:

$$p(y|x_1, \dots, x_n) = \frac{p(y) \prod_{i=1}^n p(x_i|y)}{p(x_1, \dots, x_n)}$$

Before using Bayes, you should define distribution of each feature, $p(x_i|y)$. Here because of simplicity and our features nature we used categorical distribution.

III. EVALUATION

We prepared a data set of messages in conversations with their intent class. We trained and evaluated both Bayes and naive Bayes models. The features used in models are message sum bin and last message intent. Message sum bin is the categorized version of message sum which indicates the number of sent messages so far. And because of the imbalance distribution of classes, we trained our models on both balanced and imbalanced data sets.

As said before we evaluated our models on two types of metrics:

- Quality
- Diversity

For quality metrics we use macro and weighted average of f1_score of all classes. And for the diversity metric we use entropy. For quality metric we compare our model with a simple sampling model which samples from all classes based on the frequency of those classes. For the diversity metric we compare our results with diversity of message intents in the real data set.

The table below is results of evaluations for both Bayes and Naive Bayes models trained on balanced and imbalanced data set for mobile/phone category.

In this table we test our model to detect next intent by last message intent and index.

Models	Training Data Set	Macro f1	Weighted f1	Entropy
Diversity Baseline	balanced	-	-	3.21
	imbalanced	-	-	2.62
Quality Baseline	balanced	0.09	0.14	3.21
	imbalanced	0.11	0.27	2.62
Naive Bayes	balanced	0.24	0.46	2.58
	imbalanced	0.23	0.50	1.94
Simple Bayes	balanced	0.24	0.46	2.58
	imbalanced	0.23	0.51	2.02

Before designing this model, we had another question-and-answer suggestion in our model which was founded by user researcher of our product. In this suggestion method in each round of the conversation we showed all suggestion to buyers or sellers (about 10 suggestion). But in our model, we just show 3 suggestions in each round by intent detection of each message in real time and Markov model for find ordering of intents. For example, in below figure we have 26 intents for mobile/phone category and you can see its relation to message_sum_bin (count of previous messages).

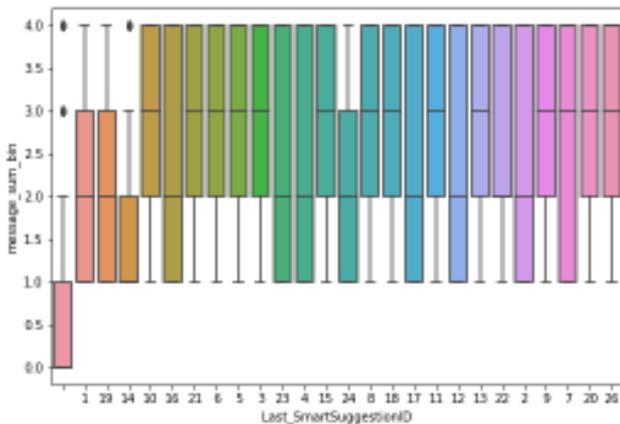


Fig. 6. Message Intent distribution by count of previous messages

For example, Intent 1 is greeting and 14 is about price asking and you can see these intents should be in first rounds of conversations.

For evaluation of our model, we used A/B test method on our model and old which had more suggestion to show and was defined by user researchers in each category.

Semi-Automate Smart suggestion > B
Expert defined Smart suggestion > A

1) Usage Result

A-buyers	A-sellers	B-sellers	B-buyers
0.21%	0.15%	22%	18%

2) Initializing conversations

Another of our assumptions was that buyers should create more conversations because of the presence of the desired message suggestion.

A	B	improvement
2.66	2.75	3.3%

3) Conversation length

One of our purpose was to have more in detailed conversations and have more technical question because it will give more knowledge and makes better choice to buyers. We measured this score with length of conversation and messages diversity. In both of them we have increasing related metrics.

You can see conversation length mean in below table:

A	B	improvement
2.33	2.40	3%

B. Hypothesis testing

1) Paired T-Test.

One way to know you have made significantly improvement, is Paired T-Test. With this method we compared each day measurement of two methods metrics and here is the result of this test:

P-Value	T-Value
0.0001	6.087

2) Bootstrap hypothesis testing.

Another method was to bootstrapping the different people in case A and case B several times a day and calculate the average of these samples and then T-test on these averages obtained in different categories. To do this, we took 100 samples from each case 500 times each time, and the results were as follow:

T-value	P-value
3.004	0.0027

In all of these experiments, our automated model performed better than the man-made model, and this was very impressive in terms of achieving the goals and speeding up the pipeline.

IV. FURTHER WORK

A. Cold Starting:

In our model we had a little cold starting problem and it handles it by most common intent on starting chat but it is not sufficient because there is probability of biases in our data set, for example we collect our data in Corona virus disease, so we had more than usual shopper product and because of those buyers were asking for registration or guarantee but this situation will be changed, so we should not persist just on our previous data. For handling this problem, we add product description to our model.

Just with annotated data of explained 26 intents we find that about 52% of post description has at least one intent and in average each post have a 10.73 intent, detected from 26 intents. Also, each post has other features like Price, Brand Model, Addresses and etc.

In this step we train Catboost model on more than 2000 posts, and we get about 57% accuracy to predict first messages intent in top 3 result, and we hope to raise this result by improving intent detecting in posts and do multi labeling models. Also, finding post representation by sequence-to-sequence methods like Carousell and add this representation to model input.

B. Seller Response:

Unlike Carousell [10] platform we find out that most of the sellers tells product features exactly in description and buyers has seen this therefore buyer questions are not about described features but it's about undefined concepts, in cold starting solution and keyword detection we find out these concepts to guide buyers to gathering comprehensive details of product, but in seller side we retrieval usual response to each intent. but for a little Personalization we test one-week conversations of each product and find this result:

Sellers use about 16% of their previous messages in newer conversations (find that with cosine similarity on sentence representation, not exact matching) and this percent is different in each category, so with just showing related responses (be in same intent with buyer questions) to sellers, we can improve our suggestion usage from 14% to 30% just in offline model, and we expect more than this participation because the writing style could be so different for detecting.

V. ACKNOWLEDGMENTS

The authors wish to thank Divars' communication Team, Divars' Data Team and specially to Mohammad Hossein Keshavarz, Arman Isakhani, Ali Hanzakian, Ali Cholmaghani, Danial Erfanian, Davood Sheikhan and also specially thanks from Ali Kashani, Annotation Team, CEO and VP of Divar and Hezardastan Group.

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English Language Teaching in Moroccan Higher Education: Achievements and Challenges

Elhoussain Idbahsine

Abstract— After several years of introducing English as a second foreign language in the school curriculum, what has been achieved? This paper discusses the status quo of English teaching and learning in Moroccan higher education institutes. This paper explores challenges facing English learning and teaching at the Moroccan university with a special focus on the departments of English in Agadir. Departments affected by overcrowdedness and arbitrary educational policies of successive Moroccan governments. This paper is based on empirical data gathered by me during my first-hand experience as a part-time and now a full-time professor at the departments of English both in Agadir and Ait Meloul. The paper also provides the educational and political analysis of the challenges facing English learners and instructors and finally suggest some practical measures to ease off the problems and create a better environment for both learners and instructors at the academic setting.

Keywords— practical solutions, challenges, high educations, achievements.

Motivational Strategies and Job Satisfaction as Correlates of Library Service Delivery in Selected Tertiary Institutions in Southwest Nigeria

Esther Kelechi Soyele

Abstract— Job satisfaction is the expression of an organisation's fulfillment of work output. In order to achieve effective job satisfaction, the motivation of employees is very essential in stimulating their obligation towards their work. The study examined the motivational strategies, job satisfaction as a correlation of library service delivery in some selected tertiary institutions in southwest Nigeria. The study adopted a descriptive survey research design. A simple random sampling method was employed to select 200 library staff consisting of both library professionals and para-professionals. Two hundred (200) questionnaires were given out, but only one hundred and twenty-nine 129 (96% response rate) were used for the study. Both simple percentage and one and two way ANOVA was used for data analysis. Findings revealed that 60.4% of the respondents were males while 39.6% were female; most of the respondents' relatively belong to the age group of 31-40 and 41-50, 93.3% were within the age range of 21-50 years, and 43.2 % were M.Sc degree holders. The result revealed a ($p < 0.05$) significant relationship between work motivational strategies and library service delivery. The results also revealed that motivational development program strategies and job satisfaction have ($p < 0.05$) a positive significant relationship with library service delivery. It was concluded that work motivation strategies are essential for job satisfaction which is very important in any organization in the attainment of its goals and objectives and helps in maintaining a high standard. The study recommended that more incentive plans that will enhance job satisfaction should be put in place to encourage employees to be more active in carrying out their job effectively.

Keywords— job satisfaction, library, library services, motivational strategies.

Predictive Justice, Algorithmic Justice and Legal Decision-Making Computer Science: The Application of Artificial Intelligence to Italian Justice Towards a Perfect Law?

Snezana Lazovic¹

Summary: 1. The general requirements of legal certainty, objectivity and stability towards the introduction of jurimetry: mathematics applied to the judicial system - 2. The interpretation of prof. Luigi Viola: an implicit provocation and criticism of the current Italian judicial system? - 3. The state of the art of the Italian legal system: the ambitious project of the Scuola Superiore Sant'Anna in Pisa and the challenge of the Brescia Court of Appeal, the Brescia Court and the University of Brescia - 4 The European and American experience: the success stories of Holland and France vs. the controversial Loomis case at the Supreme Court of Wisconsin - 5. A necessary technological transformation of the functioning of the judicial system for the birth of a new figure of jurist - 6. Predictive justice as a solution to the quality question of Italian justice - 7. Conclusions

1. The general requirements of legal certainty, objectivity and stability towards the introduction of jurimetry: mathematics applied to the judicial system

Law represents a branch of the humanities, having its basis in the guarantee of certainty.

The ultimate purpose of the law lies, in other words, in attributing certainty to the various human relationships, worthy of being protected by the legal system, through the introduction of a series of rights and duties.²

In this regard, art. 65 of the law on the judicial system, indicating the different attributions of the Supreme Court of Cassation, established that the Ermellini have the task of ensuring "*the exact observance and uniform interpretation of the law, the unity of objective national law, the compliance with the limits of the various jurisdictions* ", also in light of art. 101 of the Constitution which

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² Generally speaking, cf. on the subject of legal certainty, in doctrine, among many others, M. BARBERIS, Introduction to the study of law, Turin, 2014, p. 23; N. LIPARI - F. CAGGIA, Civil law. Volume 1, Milan, 2009, p. 157; S. CASTRO, The judgment of administrative compliance, Milan, 2012, p. 3; M. VILLANI, Abuse of tax law, Turin, 2017, p. 72 and B. SHEPHERD, Decisions and controls between power and reason. Materials for a course in philosophy of law, Turin, 2013, p. IX.

subjected the exercise of judicial power exclusively to the law, to ensure its impartiality and neutrality with respect to other powers, interests and subjective positions as well as art. 3 of the Constitution which establishes the principle of equality of all citizens, even before the judiciary.

Only through objectivity and legal certainty is it possible to guarantee the uniformity and unity of objective national law, for the purposes of control and stability, in the long term, of the law itself.

The judge cannot, therefore, depart from the law with an arbitrary interpretation, since it would violate the aforementioned general principles.

If, therefore, the law is presented as objective, certain and repeatable, its application may equally be certain or without any possibility for any arbitrary exercise, by the Judge, of his own jurisdictional power.

Hence, the birth of the theme of predictive justice³, based on the principle of legal certainty, or the birth of a system by virtue of which the outcome of legal disputes can be predicted, precisely on the basis of a mathematical mechanism (the so-called "algorithm").

Before delving into the perfect algorithm underlying the concept of predictive justice, it should be remembered that, within the Italian legal system, there are already valid examples in this area (just think, by way of example, of Article 348-bis cpc, entitled "*Inadmissibility of the appeal*", provides for the inadmissibility of the appeal that does not present a reasonable probability of acceptance⁴).

The introduction of the predictive justice mechanism would also allow to increase the role of the current alternative dispute resolution systems, since, in the event of a forecast of the negative outcome of a particular dispute, the parties can directly opt for the so-called "A.d.r.", thus generating an

³ See E. RULLI, *Predictive justice, artificial intelligence and probabilistic models. Who is afraid of algorithms ?*, in *Legal Analysis of the Economy*, Bologna, 2018, pp. 533-546.

⁴ Art. 348-bis c.p.c. provides as follows: "*Apart from cases in which the inadmissibility or inadmissibility of the appeal must be declared by a sentence, the appeal is declared inadmissible by the competent judge when it does not have a reasonable probability of being upheld. The first paragraph does not apply when: a) the appeal is filed in relation to one of the causes referred to in Article 70, first paragraph; b) the appeal is filed in accordance with Article 702-quater*". With this provision, introduced by art. 54, first paragraph, lett. a), of the D.L. 22 June 2012, n. 83, converted into Law 7 August 2012, n. 134 (so-called "Development Decree"), a real filter of inadmissibility of the appeal has been established, operating on the basis of a prognosis assigned to the same judge of the appeal who can exercise a discretionary power and focus on the reasonable validity of the appeal. Therefore, a scheme based on a preventive selection of appeals worthy of being dealt with was introduced within the civil trial, in order to avoid, as happens in most cases, that the first instance sentence is subject to full confirmation also on appeal. For this reason, it was established that, in the event that the judge verifies the subsistence groundlessness of the appeal, he must proclaim, by order, its inadmissibility. Once this operation has been carried out, the first instance decision may be subject to appeal before the Supreme Court. Where, on the other hand, the judge deems the appeal admissible, he will proceed to its usual treatment. The same provision in question provides, in the next paragraph, that the aforementioned inadmissibility filter is not operative, where the encumbrance relates to: Article 70 of the Code of Civil Procedure, for example, matrimonial cases or cases concerning the state and capacity of persons) or (ii) the appeal to the ordinance referred to in art. 702-ter, sixth paragraph, c.p.c. Having considered this, it should be noted that, in doctrine, it was, for example, C. NOVELLI, *Justice in the age of its technical reproducibility, which affirmed the traceability of this procedural-civil law provision to the concept of predictive justice. The predictive algorithms and the process*, in *Il diritto debole. Mutation of law and new forms of normativity*, (edited by) M. TARONI - M. UBERTONE, Turin, 2020, p. 134 and A.F. CATERINO - D. FIORETTI, *Glossary of Forensic Linguistics. An interdisciplinary approach between linguistics and graphology*, Campobasso, 2021, p. 62.

incentive to save logistic, economic and temporal resources both of the parties and of the judicial circuit.

It is precisely here that mathematics enters, more and more insistently, in the judicial panorama, for the pursuit of the calculability of law.

A possibility that has been realized thanks to the development of artificial intelligence and predictive models applied to law.

This is not an easy issue to address, as it presents many obstacles, especially of an ethical and legal nature.

In the opinion of an orientation anchored to a traditionalist vision, the application of a mere mathematical formula, or rather of an algorithm, to a decision of the judge, would end up depriving the judge of his own free conviction and of his role of interpretation of the general provision of law applied to the concrete case; free conviction which, however, cannot mean free will, with contradictory changes in jurisprudential orientation.

Hence the birth of the term "jurimetry", for an ever more precise measurement of the law, of the rules and of the probability inherent in them⁵.

2. A doctrinal interpretation: an implicit provocation and criticism of the current Italian judicial system?

⁵ To a closer eye, however, it will not escape that this term is not of modern elaboration, drawing its origins in dating back to epochs. Specifically, it was GOTTFRIED WILHELM VON LEIBNIZ, in the distant 1666, to affirm "[d] the consequence when controversies arise between two philosophers, a discussion will no longer be necessary, as between two computers. In fact, it will be sufficient for them to pick up their pens, sit in front of the abacuses and say to each other: *Calcelemus!* " (GOTTFRIED WILHELM VON LEIBNIZ, *De arte combinatoria*, 1666), as mentioned by F. BIANCHINI, *Philosophical disciplines. Imitating the mind. A debate within the cognitive sciences*, 2011, Rome p. 179, spoke of the possibility of settling any disputes, through a calculation activity. The term "jurimetry" was instead proposed for the first time by the American jurist LEE LOEVINGER (*Jurimetrics. The next step forward*, in *Minnesota L. Rev.*, 1949, p. 455 ff.) Theorized the application of electronic techniques to the legal field, in order to solve the problems. For an in-depth analysis on the subject, see in doctrine, among the many, G. ZICCARDI, *Legal informatics. Short manual*, Milan, 2008, p. 85; G. TADDEI ELMI, *Computer skills for law*, Milan, 2006, p. 6 and G. SARTOR, *Legal informatics and information technologies*, Turin, 2016, p. 26. H.W. BAADE (*The Methodology of Legal Inquiry*, New York-London, 1963, p. 8 et seq.) Deepened the application of the methodology to the measurement of judicial decisions, to verify their predictability, thus creating predetermined decision-making models. BAADE's thesis, however, found no confirmation. For an in-depth study on the theories proposed by the scholar, see, in doctrine, among many, A.C. AMATO MANGIAMELI, *Legal informatics. Notes and materials for use in lectures*, Turin, 2015, p. 15 and following; F. FAINI, *Legal science and information technologies*, Turin, 2017, p. 7 and following; G. ROSSI - M. ROSSI - P. SOMMAGGIO, *The law in the society of semi-immortality. The fundamental principles*, Milan, 2010, p. 103 ff.

Art. 12 of the *Preleggi*⁶, entitled "*interpretation of the law*", states, in general, how the interpretation of the law is not completely discretionary but must be carried out in compliance with pre-established legislative criteria.

Precisely from the reading of the aforementioned provision, an extremely innovative vision of an Author⁷ took its first steps, according to which it is possible to identify four types of interpretation:

- literal interpretation (IL);
- interpretation by *ratio* (IR);
- interpretation by *analogia legis* (AL) and;
- interpretation by *analogia iuris* (AI).

In this sense, from the formulation of the standard, it is clear that the literal interpretation (IL), by reason of its positioning, is in a hierarchically superior position compared to the other interpretative variants that must be considered secondary (IS).⁸

Based on this principle, the Literal Interpretation (first criterion) will be considered as a criterion>, while

- IL> IR Interpretation by *ratio* (second criterion)
- IL> AL *Analogia legis* (third criterion)
- IL> AI *Analogia iuris* (fourth criterion).

It follows, therefore, that IL is in a hierarchically superior position with respect to the IS (with IL> IS).

In this sense, $IS \leq IL$ since

- (IL) = (IL)

⁶ We refer to art. 12 of the Royal Decree of 16 March 1942, n. 262, containing "*Provisions on the law in general*", where it is stated that "[n] In applying the law it cannot be attributed any other meaning than that made evident by the proper meaning of the words according to their connection, and by the intention of the legislator. If a dispute cannot be decided with a specific provision, it refers to the provisions governing similar cases or similar matters; if the case still remains doubtful, it is decided according to the general principles of the legal system of the State".

⁷ We want to refer to the monographic essay, entitled "*Interpretation of the law with mathematical models. Process, adr, predictive justice*", published in 2017 by Streetlib and the following year by Advanced Law as well as the volume, entitled "*Predictive justice and interpretation of the law with mathematical models*", published in 2019 by Advanced Law, which contains the Proceedings of the Conference, titled in the same way, which occurred in 2018, at the institute of the Italian Encyclopedia Treccani.

⁸ This assumption can also be derived from the jurisprudence of legitimacy and, specifically, from Cass. civ., Section work, sentence of 26.1.2012, n. 1111, in Ced Cassazione, 2012, where, the Ermellini affirmed that "[the] legal rule must be interpreted, first and foremost, from the literal point of view, since the text cannot attribute any other meaning other than the obvious fact from the proper meaning of the words according to their connection", therefore, in the hypothesis in which the literal interpretation of a rule of law is sufficient to identify, in a clear and univocal way, the relative meaning and the connected prescriptive scope, the interpreter must not resort to the subsidiary hermeneutic criterion constituted by research, as a result of the overall examination of the text, of the mens legis, especially if, through such a procedure, the result of modifying the will of the norm, as unequivocally expressed by the legislator, can be achieved; only if the letter of the norm itself is ambiguous (and the recourse to the aforementioned subsidiary hermeneutic criterion is also revealed to be fruitless), the literal element and the intent of the legislator, insufficient as they are used individually, acquire an equal role within the hermeneutic procedure, so that the second acts as a supporting and functional criterion to obviate the ambiguity of the text to be interpreted".

- $(IR) = (IR \leq IL)$
- $(AL) = (AL \leq IR \leq IL)$
- $(AI) = (AI \leq AL \leq IR \leq IL)$.

It is therefore clear that $IR + AL + AI \leq IL$ or the sum of the interpretation by *ratio legis* (IR), of the interpretation by *analogia legis* (AL) and of the interpretation by *analogia iuris* (AI), the so-called Secondary interpretations, cannot have a value greater than the literal one (IL).

Consequently, $IS \leq IL$.

Because of this assumption, prof. Viola has elaborated an application formula that would allow the outcome of the procedural events to be predicted.⁹

If $IS = IR + AL + AI$, the Perfect Interpretation (IP) is reached if $IL = IS$ or $IP = IL + IS \Leftrightarrow IL = IS$.

This occurs when there is total clarity of the rule, such as not to require any interpretation.

If the study of the equation relating to the perfect interpretation, based on art. 12 of the so-called *Preleggi*, is connoted to be a first degree inequality ($AI \leq AL \leq IR \leq IL$), this study was then absorbed by the study on legal interpretation, thus arriving at the algorithm for legal interpretation: $IP: (IL \pm IL_n) \wedge (IR \pm IR_n) \circ [IL = 0 \Rightarrow (AL \pm AL_n)] \circ [AL \approx 0 \Rightarrow (AI \pm AI_n)]$, where, in the absence of one of the following data, it may be applied the value 0:

- IP (legislative interpretation);
- IL (literal interpretation);
- IR (interpretation by *ratio*);
- AL (interpretation by *analogia legis*);
- AI (interpretation by *analogia iuris*);
- \pm corresponds to plus (sum or affirmative value) or minus (subtraction or negative value);
- \wedge means “and” (union or synthesis);
- \circ refers to the composition of several data;
- \Rightarrow corresponds to “if... then...”;
- \approx means “about”;
- n represents a variable equivalent to the number of possible interpretations of the same type.

This means that the interpretation of the law (IP) is equal ($=$) to the union (\wedge) between the addition or subtraction of multiple literal interpretations ($IL \pm IL_n$) with the addition or subtraction of multiple interpretations by *ratio* ($IR \pm IR_n$).

⁹ A first experimental application of this formula took place in the jurisprudence of legitimacy - Cass., Sec. Unite Civ., 5 July 2017, n. 16601, commented by prof. Luigi Viola, in www.scuoladirittoavanzato.com.

Where a legal provision is missing ($IL = 0$), interpretations are added or subtracted by *analogia legis* ($\Rightarrow (AL \pm AIn)$) while, when the matter is not yet clear ($AL \approx 0$), it is possible to add or subtract interpretations by *analogia iuris* ($\Rightarrow (AI \pm AIn)$).

The equation finds its foundation in different bases.

On a preliminary basis, a total abandonment of the right to the subjective discretion of the interpreter would be unacceptable, since the right should, at least on a theoretical level, present itself in the most objective and calculable way possible, precisely in order to avoid possible situations of abuse, abnormality and of bad justice, with the undue violation of interests and subjective positions worthy of legal protection.

Secondly, the law must be certain and stable, precisely in order to ensure an equally certain and stable interpretation. On this point, the Author focuses his focus on the essential character of art. 12 of the *Preleggi*, which represents the general positive data to refer to, identifying the four different interpretative canons applicable in the Italian legal system.

In the author's opinion, this provision may, therefore, be reduced to an algorithm, to be applied to the specific case, almost in order to "predict" the results of future disputes.

In this sense, the equation of the interpretation of the law is presented as an algorithm of predictive justice.

For prof. Viola, there are, however, limitations to the application of the equation or to cases of prohibition of analogy, in relation to criminal and exceptional provisions, or to value clauses.

Furthermore, the algorithm could not only be limited to art. 12 of the *Preleggi*, but should extend to the entire process, since every legal rule could be reduced to an algorithm.

Finally, again in the opinion of the aforementioned Author, predictive justice should be based not on a statistical-jurisprudential basis, but on an algorithmic-normative basis, by virtue of art. 12 of the *Preleggi*.

The criticisms that can be made of the algorithmic approach, proposed by prof. Luigi Viola, there are essentially three.

The first concerns the reduction of the long and tortuous decision-making process to the judicial phase only, that is the one linked to the moment of issuing the decision.

The second concerns the applicability of the software only to those cases in which a jurisprudential precedent has intervened.

The third, on the other hand, has as its object the possibility of repeating judicial or IT errors over time (just think, for example, of cases of bad justice or the erroneous IT translation of a sentence).

Furthermore, even if artificial intelligence has, above all, in recent years, made some appreciable developments, there would still be no room for its full equation with human intelligence and, in this

case, with power. evaluative, albeit "subjectivized" in its impartiality and neutrality, foreseen by the judge.

On the other hand, the software would be limited to a passive loading of jurisprudential data, without, however, possessing any specific and previous competence in the juridical field.

Furthermore, being the Italian civil law legal system, a software based on the experience limited to the single sentence, deprived of an adequate legal methodology, would make the system also in contrast with the fundamental principles on which the national legal system is based.

However, since the human character of the judge cannot be sacrificed in the name of the objectification of the law, we do not want to refer to an undue interference of the feelings, sensitivity, preferences and skills of the judge in the context of the evaluation process. decision making.

These characteristics will certainly be fundamental for a better understanding of the facts but they will not affect its autonomy, given that the reliability of the interpretation of the rule, made by the judge, is linked to its desubjectivization.

Therefore, the ideal software must not accept, in an unconditional and uncritical manner, any previous jurisprudential evaluation, labeling it as a facsimile model for a future similar case, but must, through a systematization of all the interpretative material, guarantee a continuous criticism of seriality , showing the multisubjective variety of possible approaches that can be adopted in the concrete case, so that the judge can constantly maintain an interpretative perspective that is increasingly desubjectivized.

The human "touch" will be, continuously, of fundamental importance, to verify that the material loaded on the software is always correct, also through, for example, the processing and application of specific protocols that can avoid excessive simplifications capable of " flatten "the potential of the system or subjective deviations.

3. The state of the art of the Italian legal system: the ambitious project of the Scuola Superiore Sant'Anna in Pisa and the challenge of the Brescia Court of Appeal, the Brescia Court and the University of Brescia

Last May the Scuola Superiore Sant'Anna di Pisa¹⁰ was born, consisting of a predictive justice platform, aimed at developing a methodology for analyzing jurisprudential material, combining "machine learning" techniques and "big data" analysis.

¹⁰ V. MAGLIONE, *Artificial Intelligence, in Pisa the algorithm that "predicts" the sentences*, in *Il Sole 24 Ore*, 1 June 2021.

The project, which originated in 2019, thanks to the collaboration between the Lider Lab of the Dirpolis Institute (Law, Politics, Development) of the Scuola Superiore Sant'Anna and the Court of Genoa, which was followed by the signing, in the current year, of the Convention with the Court of Pisa for the development of protocols aimed at making jurisprudential material anonymous.¹¹

In conjunction with the launch of the Predictive Justice website, the Lider Lab of the Dirpolis Institute (Law, Politics, Development) of the Sant'Anna School of Advanced Studies also announced that it had renewed its website www.lider-lab.it, with research, training and third mission activities carried out in the six research areas (intellectual property, artificial intelligence governance and law, privacy, data law and governance, right to health, family relations law, civil liability and insurance), also through international projects. Ample space was then reserved for training for professionals with the offer of courses, seminars and webinars.

At the end of 2020, the predictive justice system in the field of labor and business law was also launched by the Court of Appeal of Brescia, the Court of Brescia and the University of Brescia. This was the first pilot project launched, following the signing of an agreement, on April 6, 2018, between the aforementioned subjects.¹²

The project aims to provide both the estimated duration of a dispute relating to a given matter and the different jurisprudential orientations for the benefit of both users and lawyers, in a fundamental perspective of guaranteeing legal certainty and the various relationships involved. of the various judicial offices, starting with the Court and the Court of Appeal of Brescia.

If it has been possible to publish a website, for now, limited to two legal subjects, it has been thanks to a long process divided into different phases of study, analysis and analysis, consisting of:

- identification of the subjects;

¹¹ For further information, see Sant'Anna Magazine News, *If data science puts itself at the service of law, justice becomes "predictive" with artificial intelligence. The Court of Pisa makes available the archive of the sentences to the jurists of the lider lab of the Dirpolis del Sant'Anna Institute*, 11 May 2021, published on www.santannapisa.it. On the project, Maria Giuliana Civinini, President of the Court of Pisa expressed herself, who stated: "*The conclusion of this agreement, delayed by the health emergency from Covid-19, marks an important moment for the development of the Scuola Superiore Sant'Anna of Pisa, for the perspectives of jurisprudential research and for our Court. The use of the decisions filed in the IT systems of our court was envisaged to test and implement a program of anonymization in view of the establishment of a jurisprudence archive of merit that can be navigated with semantic methods*". The President Civinini continued: "*The aim is to offer a double support and service to professionals, citizens and judges. Professionals and citizens will be able to have a better and more accessible knowledge of jurisprudence and the possibility of evaluating the potential solution of a particular case, while judges will be able to obtain a more in-depth knowledge, because it can be analyzed in an aggregate way, for reasons of decisions and for solutions, jurisprudence in sensitive matters such as those relating to the maintenance allowance in the event of separation and divorce or the settlement of damage to health. This will make it possible to adopt more informed decisions that guarantee and implement the principles of fairness, equality of treatment and correct consideration of the issues involved to the highest degree*". Giovanni Comandé, professor of comparative private law, who coordinated the creation of the website, noted: "*It is a question of automating and generalizing a methodology already developed and in use at the Observatory on personal injury in the field of compensation for damage. Introducing a semantically enriched access mechanism to jurisprudential data together with the explanation of legal reasoning will have a disruptive effect for magistrates, policy makers, academics. The repercussions in terms of reduction of disputes and the possibility of solutions agreed between the parties in dispute also become discounted*".

¹² For an in-depth analysis of the system, see the dedicated website www.giustiziapredictiva.unibs.it.

- creation of a dedicated database for each subject;
- circular flow of jurisprudential decisions taken at first and second level of judgment;
- creation of university working groups for each subject for the detailed examination of all the orientations taken in the various cases;
- extraction of data on the average duration of disputes, specifically for each subject;
- publication of the various data acquired, anonymously, on the website.

4. The European and US experience: the success stories of Holland and France vs. the controversial *Loomis* case in the *Wisconsin* Supreme Court

Regarding the European experience, it should be noted that Holland¹³ was the first civil law country to have reformed the judicial system, in order to make it smarter and more accessible to the user, since 2002.

The *Rechtwijzer* system, born from the joint activity of the University of Twente and Hiil (*Hague Institute for the Internationalization of the Law*), consists of a consultancy platform, operating internationally in the field of policies to promote the rule of law and based in The Hague.

Specifically, it is a telematic device that connects the mediator user and the legal assistant, digitally and dematerialized, providing various services, for example, mediation and monitoring of the enforcement phase.

In 2015, the system was expanded to cover property rights, condominium and personal service disputes.

Two years earlier, the Ministry of Security and Justice, in collaboration with the Council for Justice, had ordered the mandatory digital procedure for lawyers in both civil and commercial fields.

With reference, then, to the French one, this is undoubtedly the most flourishing experience in the current legal scenario, the results of which, deriving from the application of predictive justice, are presented as clear and multiple.

Just think, for example: (i) of the *Predictice*¹⁴ system, created in 2016, by a business group operating in the law and digital sector, used by the judiciary of the Courts of Appeal of *Rennes and Doua*¹⁵; (ii) the jurisprudential search engine, called *JuriPredis*¹⁶, founded in 2018 by *Frédéric Rouvière*, professor at the University of Aix-Marseille, specialist in civil law and theory of law and;

¹³ For a research on applied predictive justice in the Netherlands, see C. CASTELLI - D. PIANA, *Predictive justice. The quality of justice in two stages*, in *Questione Giustizia* web, 2018, 4.

¹⁴ For more information on the system, you can visit the dedicated website www.predictice.com.

¹⁵ T. OUSTET, *L'utilisation de l'outil Predictice déçoit la cour d'appel de Rennes*, *Dalloz-actualite*, 16 October 2017, on www.dalloz-actualite.fr.

¹⁶ For further information, see the dedicated website www.juripredis.com.

(iii) the *Case Law Analytics*¹⁷ tool that allows you to make an estimate of the amount of damages to which the party could be sentenced, in the context of public, commercial, financial, family and intellectual property law.

A sign of the acquisition of the predictive justice institute in France¹⁸ occurred, not only on the entrepreneurial level, but also on the state level, through decree no. 2020-356 of March 27, 2020¹⁹, adopted, moreover, during the health emergency due to the spread of the Covid-19 virus.

The "*DataJust*" system, authorized for two years, has the purpose of creating an algorithm that can automatically extract and exploit the personal data included in the decisions concerning the compensation of personal injuries, in order to improve the administration of justice and make citizens more informed about the convenience or otherwise of engaging in litigation, by representing an aid to the formulation of the *decisum*.

Looking, however, at the US experience, one cannot ignore the examination of the bitterly disputed sentence, issued by the Supreme Court of *Wisconsin* on July 13, 2016²⁰, in the face of the appeal made by *Mr. Eric L. Loomis*, against the sentence of six years of imprisonment, previously imposed by the *District Court of La Crosse*.²¹

In determining the sentence, the judges had referred to the findings drawn up by the "COMPAS" (*Correctional offender management profiling for alternative sanctions*) program, attributable to the property of the *Northpointe* company, according to which the man was a subject with a high risk of recidivism.

Without examining here, for reasons of exposition, the merits of the story, what is most interesting are the methods of operation of this program but, above all, the use made of its results, in the context of the case in question.

COMPAS is an evaluation tool, aimed at predicting the risk of recidivism and identifying the individual's needs in the context of employment, the availability of accommodation and drug abuse.

The algorithm proceeds to process the data obtained from the defendant's file and from the answers provided, during the interview, with the aforementioned.

Regarding the risk assessment, reference must be made to a graph of three bars representing on a scale from 1 to 10 the risk of preprosecutorial relapse, the risk of general relapse and the risk of violent

¹⁷ For further information, see the dedicated website www.caselawanalytics.com.

¹⁸ For an in-depth analysis of predictive justice applied in France, see A.F. CATERINO - D. FIORETTI, *Glossary of Forensic Linguistics*, Ururi, 2021, p. 63 ff.

¹⁹ For a full reading of the decree, see www.legifrance.gouv.fr.

²⁰ Reference is made to the State of *Wisconsin v. Eric L. Loomis*, 13 July 2016, the text of which can be consulted in its original language on www.giurisprudenzapenale.com.

²¹ For an in-depth analysis of the case discussed, see S. CARRER, *If the amicus curiae is an algorithm: the rumored Loomis case at the Supreme Court of Wisconsin*, in *Criminal Law Web*, 2019, 4, available on www.giurisprudenzapenale.com.

relapse, without the forecast, mind you, of an individual evaluation but only of an objective evaluation on the basis of the various information obtained.

In the case at hand, the COMPAS system certified a high level of risk in all areas of recidivism and the District Court, in the process of determining the sentence, also took into account the findings already indicated.

Loomis, complaining of the violation of his right to a fair trial, filed a petition for revision of the sentence imposed by the District Court which, however, provided for its rejection; rejection which was followed, again on the initiative of the condemned, by an appeal against this decision before the Court of Appeal which, in turn, referred the matter to the jurisdiction of the Supreme Court of *Wisconsin*.

The Supreme Court rejected *Loomis's* appeal, arguing that, despite the software used was sufficiently performing and functioning, the District Court had also referred, for the purpose of imposing the sentence, to other procedural findings, not having therefore verified any violation of the offender's right to a fair trial.

5. A necessary technological transformation of the functioning of the judicial system for the birth of a new figure of jurist?

Regardless of the possible approach that may be taken with respect to the issue of predictive justice, there is no doubt that the need for a transformation, on a technological level, of the organization and functioning of public institutions, both on the national and international scene.

As it has been possible to see, above all, in the last decade, the technologies have led to an appreciable innovation, in terms of the provision of the various legal services, in the management of judicial proceedings as well as in the long process of dematerialisation of the judicial content as well as in the digitization of requests and offers for the resolution of economic and commercial disputes.

The diffusion of technologies, albeit in massive form, should not, *sic et simpliciter*, demonized but rather tamed, in order to gain the greatest possible advantage and accompanied by adequate measures and policies to improve the efficiency of the justice sector.

In the ideal (and, perhaps, excessively utopian) scenario, this process should bring significant benefits also in terms of timing, costs and methods of handling disputes, with an increase in the quality of justice.

What certainly emerges from an introduction, albeit still timid in Italy, of the mechanisms of predictive justice lies in the need to give life to a new figure of jurist, who is no longer anchored to a traditional logical reasoning but who, above all, has also technological skills that can understand the

content of these innovations; all with a specific training path that should originate from university days.

For example, it would be useful to set up a parliamentary commission on artificial intelligence, in order to understand the real potential of technology in this area, also for an in-depth study of its risks, obviously, to be prevented²².

6. Predictive justice as a solution to the quality question of Italian justice

It does not appear to be a mystery how Italian justice is the subject of various criticisms and complaints, both by sector operators (first of all, judges and lawyers) and by end users, with regard to the failure to comply with the reasonable times referred to in art. 111 of the Constitution²³ and art. 6 of the ECHR.²⁴

However, the request does not seem to be easy to satisfy as the claim is to obtain the speedy issuing of decisions that are also of quality; This is an aspect on which the phenomenon of the so-called speedy trial focuses very little.

²² On this point, see M. PAOLUCCI, *Justice for young people. Predictive systems require new jurists*, in *Italy Today*, 13 July 2020, available on www.ristretti.org, where the Author refers to the English session of the third international congress on predictive justice virtually organized by the School of Advanced Law on 2-3 July 2020, in which the greatest exponents of the doctrinal panorama took part and Italian jurisprudence, including prof. Luigi Viola, who, at the opening of the congress, said: *"Mathematics and law were born together. It was the legal issues that provided the main impetus for the development of mathematics in ancient Egypt: the floods of the Nile, in fact, caused the destruction of the borders between acres of agricultural land. Consequently, when the waters receded, it was no longer possible to identify individual properties; geometry was born to resolve these legal conflicts"*, while Gianfranco D'Aiotti, professor of legal informatics at the universities of Pavia and Bocconi in Milan as well as president of the Court of Sondrio and author of the "ReMida" software which allows a mathematical determination of maintenance payments in cases of separation and divorce, observed: *"During the years of my presidency of the Sondrio court, I dealt with predictivity in separations and divorces by developing a mathematical model taken from concrete cases analyzed in their statistical frequency and this has led to a methodology applicable in many sectors characterized by discretion. This entails", the magistrate deduces, "a close relationship between the jurist who must analyze the procedures and mentally construct the algorithms and those who develop them: the analysts. They are the ones who go to study a sector they do not know, take the fundamental elements that they believe they understand, pass it on to programmers who develop and interpret in turn what the analyst told them and most of the time "the IT product. of the decision-making type that comes out of it is insufficient. This discrepancy between those who think and those who build the computer system by generating a sequence of errors is one of the serious problems of the legal world because there is no computational thinking, the method of measuring, evaluating and speaking between us operators of the law and who creates the computer systems so as to allow the jurist to dictate and control the algorithm"*.

²³ Art. 111 of the Constitution provides, in the first paragraph, as *"[t] he jurisdiction is implemented through the fair process governed by the law"* while, in the second paragraph, as *"[or] every process takes place in the cross-examination between the parties, in the condition of parity, before a third and impartial judge. The law ensures its reasonable duration"*.

²⁴ Art. 6 of the ECHR, first paragraph, first paragraph, establishes how *"[each] person has the right to have his case examined fairly, publicly and within a reasonable time by an independent and impartial tribunal, established by law, which is called to rule on disputes on his civil rights and duties or on the validity of any criminal accusation made against him"*.

Hence, the controversy over judicial errors²⁵ that have often been the object of exploitation by politics, to attack the judiciary, thus creating a climate of distrust towards the work of the judiciary.

It is clear that there should be greater awareness, accompanied by constant monitoring of the various jurisprudential orientations, precisely to guarantee a perpetual comparison between the data as well as greater attention to the qualitative profile of the decision-making power, equally to the quantitative one linked to the reasonable duration of the single procedure.

The predictability of jurisprudence could represent a tool for turning and resolving the problems already mentioned, ensuring legal certainty and stability.

The biggest criticism of this concept consists in having facsimile pronouncements, not very attentive to the specific case and formulated in an abstract way.

In reality, a concept of predictability should be accepted, not in a static sense, but on a proactive and dynamic level, on the basis of a constant communication flow, to allow a correct information exchange, not only of the decision device but of all the data, potentially relevant and also to be found in other cases, emerged for the purpose of elaborating the logical-judicial path by the judge.

In this regard, a reference to this need has already been expressed in art. 47-*quater* of the judicial system which, among the powers of the section president, provided for "*the exchange of information on jurisprudential experiences within the section*", thus generating continuous knowledge and, above all, a comparison that allows the various magistrates, moreover, to question their own guidelines, in order to always verify their congruity and suitability to the general rules of law, to make the subjects involved responsible in order to avoid any cases of bad justice or abuse of power.

In this sense, jurisprudential databases play an essential role.

In this regard, the Italian legal system has already begun to become active since the end of the 1960s. For example, the Electronic Documentation Center (Ced) of the Supreme Court of Cassation contains countless archives, where it is possible to search among legislative, doctrinal, jurisprudential and regulatory data or the *Italgire Find* system, containing the various maxims of legitimacy and several legal documents, the first installation of which in some judicial offices took place in 1973.

Lastly, art. 7 of the Ministerial Decree of 1 October 2015, containing "*Organizational measures necessary for the functioning of the office for the trial*"²⁶, had attributed, to the general directorate of

²⁵ Recently, the case of Marco Sorbara, former regional councilor of the Aosta Valley, acquitted of external competition after 909 days in custody, can be mentioned. For an in-depth analysis of the legal matter which resulted in a "simple" error, see S. MUSCO, *I was counting the steps from my cell and thinking about suicide. But I still believe in justice*, on www.ildubbio.news, August 13, 2021. On the subject, see also the illuminating contribution of S. ZURLO, *A thousand innocents a year persecuted by mistake. The shame of the South*, on www.ilgiornale.it, April 9, 2021, in which we read how Enrico Costa of Action "denounced" as "[n] and the three years of the Bonafede era there have been three thousand cases, but so far only 53 disciplinary actions have started and only 4 times has the sentence been sentenced, with the censure of the magistrate".

²⁶ For a full reading of the provision, see on www.giustizia.it.

information and automated systems, of the Ministry of Justice, the performance of the activities necessary for guarantee, from the end of 2016, the launch of the database of case law on the merits and the accessibility to its data on the national territory.²⁷

In any case, what made this assumption particularly questionable was the clarification, contained in the second paragraph of the aforementioned article, on the basis of which it would have been the task of the President of the Court of Appeal or of the Tribunal, to choose the criteria for the selection of measures to be included in the database; an attribution, this, cataloged as excessively discretionary, little in line with the needs of legal clarity, with the possibility for each court to adopt extremely different selection criteria.

The very topical issue was re-addressed in the resolution of October 31, 2017 of the Superior Council of the Judiciary, containing "*Guidelines aimed at identifying the methods for reconstituting a database of the relevant jurisprudence*"²⁸ and with the aim of restarting the archive of the decisions of merit within the *Italgiure* Web service, adopting very precise selection criteria, with respect to the decisions - not already maximized but in full form - to be included within, including, for example, decisions concerning newly introduced provisions or which represent the first application of rulings by the Council or by the Supreme Court; all always in compliance with the provisions on privacy.²⁹

In this scenario, once the transparency, awareness and circularity of the jurisprudence both of merit and legitimacy in its integral and not merely maximized form with relative information of the changing interpretative orientations by all legal operators (magistrates of first and second degree of judgment, for example) called to genuinely collaborate with each other, it will be possible to ensure correct predictive justice that moves on a terrain of proactivity, dynamism and evolution, like the law itself.

²⁷ Art. 7, entitled "*Database of case law of merit*", states, in the first paragraph, as "[the] general management of information and automated systems carries out all the activities necessary to ensure, starting from 31 December 2016, the database of case law on the merits and the usability of the data contained therein on a national basis. The general management referred to in paragraph 1 carries out all the activities necessary to allow the insertion of the classification metadata in the database referred to in paragraph 1 and to facilitate the retrieval of the judicial measures contained therein, also by enhancing the effectiveness of the research computer systems. . For the first twelve months following the date referred to in the previous period, the database operates in an experimental form "and the following, as" [i] the president of the court of appeal or of the court, or the subjects referred to in article 2, paragraph 3, establish, on an annual basis starting from the publication of this decree in accordance with article 11, the criteria for the selection of the measures to be included in the bank referred to in paragraph 1, making use of for the performance of these tasks of the activity of those who carry out an internship in accordance with article 73 of the decree-law of 21 June 2013, n. 69, converted, with modifications, by the law 9 August 2013, n. 98, or the professional training of graduates in accordance with article 37, paragraph 5, of the decree-law of 6 July 2012, n. 98, converted, with modifications, by law 15 July 2012, n. 111, as well as those who are part of the office for the trial pursuant to article 50, paragraph 1-bis, of the decree-law 24 June 2014 n. 90 converted, with amendments, by law 11 August 2014, n. 114 ".

²⁸ For a full reading of the resolution, see on www.csm.it.

²⁹ For an in-depth study on the concept of predictive justice, in comparison with the respect of constitutional principles, also in the field of privacy, V. MAFFEO, *Predictive justice and constitutional principles*, in *Legal Sciences, Cognitive Sciences and Artificial Intelligence*, published on www.i-lex.it, 2019, 12, pp. 278-282.

This project has no claim to conformism of the various decisions, much less to control the jurisprudence, but rather to avoid situations of abuse, abnormality and bad justice, guaranteeing good administration of the judicial circuit, for the benefit of all those involved, with reflected effects also of a positive nature on the quantitative and qualitative level of the entire decision-making process.

Furthermore, guaranteeing a stability of the law and, therefore, of the jurisprudence, it will not have its immutability but, on the contrary, will follow a greater sensitivity to the different interpretative changes, thanks to the help of special software and algorithms that will make this activity easier. for insiders.

7. Conclusions

On the basis of the findings already carried out, it could be affirmed that the term "predictive justice", with an apparent synthetic meaning, refers to a variety of options (by way of example, probability of the cost of a given dispute, deciphering of the majority decision-making orientation with respect to to a single matter and identification of the compensation range).

Through predictive justice (still in an embryonic and planning phase), it will not be possible to predict, in an abstract and precise way, the device of a sentence but to understand the interpretative-judicial direction with respect to a certain subject, not through a linear syllogism but through multiple processes of an analogical, deductive and inductive nature.

On the basis of the considerations already indicated, it is possible to affirm how the needs linked to the guarantee of legal certainty and equality of all citizens before the law, also in the light of cases of abuse, abnormality and bad justice, have allowed the thesis predictive justice and artificial intelligence to make more and more space in the Italian legal scenario.

The research of the so-called "Perfect decision" is leading to real experiments, in the context of the use of mathematical algorithms capable of predicting the judicial decision, with a clear inspiration to the prosecution of legal certainty, such as clarity, knowability and univocity of the provisions of the law which should be interpreted and applied by the different prosecuting judicial authorities in a coherent manner.

The challenge of making the results of the judgment calculable, thanks to an algorithm, a software and, therefore, a robotic machine, however, contrasts with some ethical and legal profiles.

Indeed, the algorithm will have to compare the case in question with the various data available; data, which must, however, be of certified origin, in terms of their originality and their integrity, must

also be analyzed in a transparent, fair and impartial manner, ensuring compliance with the regulatory provisions on privacy and sensitive data.³⁰

However, what we should ask ourselves is whether artificial intelligence, almost replacing the power of the judge, is able to issue decisions.

On the abstract level, one could answer in the affirmative but, on the human level, certainly not.

Let's think, for example, of the criminal law sector where, usually, the subjective or psychological element of the crime takes on an essential value, leaving out the exceptional cases that lead, by default, to its exclusion, for the purposes of the criminalization of the investigated subject. , precisely to avoid cases of strict liability.

Willful misconduct and guilt come to represent that emotional profile from which the judge cannot disregard for the formulation of his own decision.

In any case, however, also civil law and, more generally, all the other areas of law, present elements that can be subjected to a process of objectification but which must be interpreted and understood from the human point of view (for example , uncertainties in the way of speaking, pauses and so on).

It is undeniable how a more "mechanical" decision can bring significant benefits to the judicial circuit, with a reduction in dispute resolution times and with a lower waste of logistical-economic resources, reflecting, however, negatively on all those elements inherent in the individual case concrete that only the judge will be able to grasp humanly and which should always be taken into account for a decision that is fair and just, in order to avoid even facsimile decisions with a purely abstract content.

Rather than leaning more than a more traditional view of law or more towards an almost science fiction perspective, it should be understood how, in any case, the use and the different applications of artificial intelligence can give a new "manipulation" of the law. point of view that is of support for the operators of the field, not of substitution.

Another fact that is certainly essential, always with a view to predictive justice that can be placed alongside the current systems and mechanisms, not replacing them, is related to the choice and methods of data entry.

³⁰ In this regard, reference should be made to the *"Directive (EU) 2016/680 of the European Parliament and of the Council, of 27 April 2016, relating to the protection of individuals with regard to the processing of personal data by the competent authorities for the purpose of prevention, investigation, detection and prosecution of crimes or execution of criminal sanctions, as well as the free circulation of such data and which repeals the framework decision 2008/977 / JHA of the Council "*which provided for the prohibition of decisions based only on automated processing in the field criminal, recognizing, however, in other matters, the right of the interested party to request human intervention in cases of trials with an automated decision. For a full reading of the text of the Directive, see on www.eur-lex.europa.eu.

Indeed, it will be necessary not to refer only to legal maxims or only objective criteria but to concrete cases and abstracts, with an insertion of all jurisprudence, including the minority one, and not just the prevailing one.

The inclusion of a fair dose of predictability in the jurisprudential field certainly cannot be rejected negatively but, indeed, with due caution and ensuring adequate enhancement of all guidelines, including their evolutions.

In a nutshell, at least as far as the Italian legal system is concerned, the times cannot certainly be defined as ripe to be able to face, with the right amount of seriousness, the introduction of a predictive justice system, also in the light of the most complete lack of adequate logistical and, above all, economic resources in the justice sector, forced to face the continuous cuts and the inadequacy of the state coffers.

Any algorithm, software or, in general, any machine, will be able to replace human feeling, its perceptions and feelings which, although not falling within the exercise of judicial power, will in any case guide, implicitly, the completion of their functions.

The usefulness that, at the moment, could be found from these legal IT tools would be to be found in the aid to the profession of the lawyer, who could make potential clients desist from taking reckless causes or actions with a result, certainly , negative, seeking different out-of-court solutions for the resolution of their disputes, but also to the profession of the magistrate who can make use of this tool, in terms of a sort of guideline for the issuance of their own measures.

ABSTRACT: predictive justice, algorithmic justice and legal decision-making computer science. These are the issues of the moment that lead to the application of Artificial Intelligence to the Italian Justice for the formation of an abstractly perfect law, far from the current qualitative and quantitative problems that afflict the Italian judicial system. Taking an objective approach to law, as suggested by the perfect legal equation "discovered" by prof. Luigi Viola, the research will aim to investigate the positive effects but also the critical issues that would hinder an automatic computability of the law.

Nature-Based Solutions: The Holy Grail of Green Urbanism

Israa H. Mahmoud

Abstract—Cities are living systems. A holistic vision for urban sustainability looks at the city as an integration of energy, environment, mobility, urban design, new technologies, and most importantly “people and nature”. In this article, the aim is to shed the light on the role of Nature-based solutions (NBS) towards addressing climate change crisis and tackling a variety of socio-ecological challenges. Firstly, and most importantly, we review the role of NBS in shaping urban planning policies as a result of expansion and densification of cities. Secondly, we reflect on the co-benefits generated by NBS within the social and cultural regeneration of cities. Lastly, in this article we give examples from Nice, Boston, and Milan in order to showcase those cities spatial strategies to implement NBS through different scales. As a result, we reflect upon the residual impact on cities territorial planning which remains mainly environmental and less explored culturally and socially.

Keywords—Urban regeneration, nature-based solutions, green urbanism, socio-cultural regeneration.

I. INTRODUCTION

While many scientific contributions discuss the definitions and the theoretical frameworks of nature-based solutions [1-3,6,9,38]; however, hands on experiences and evidence-based methodological frameworks are still needed to improve our understanding to the wider range of economic, social and environmental benefits provided by NBS in cities, in order to promote their inclusion in urban planning policies and decision-making processes. The fundamental research question is about how the embeddedness of NBS in cities greening strategies tangibly affects urban morphologies and radically impacts on our approach to green urbanism and strategic planning. Currently, cities are making use of nature as a solution to many challenges, without radically and critically address the full potential of using urban greening as a design feature. Cities like Copenhagen and Paris deal with change in their historic urban plans to cope with pressuring climate challenges and risks [1]; nonetheless, cities such as Milan plan ambitiously to plant three million trees by 2030 [2]. Integrating nature and NBS seems happening more and more frequently in city plans and visions; however, a deep recognition of the role of green in shaping the overall imagery of cities and renovating the green as a quintessential element of design and planning seems lacking a deeper and conscious debate.

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II. NBS RELEVANCE IN URBAN PLANNING

A. Literature Review

The original definition of NBS derives from the International Union for Conservation of Nature (IUCN) 2013-2016 Programme as: “actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits” [3]. The European Commission [4] gives a broader definition of NBS, as “actions inspired by, supported by or copied from nature that aim to help societies address a variety of environmental, social and economic challenges in sustainable ways”. According to the European Commission scopes, NBS can transform environmental and societal challenges into innovation opportunities, by turning natural capital into a source for green growth and sustainable development for application in urban areas [5]-[8].

Top notch scientists have long discussed the importance of greening cities and the benefits of green infrastructure to reduce environmental pollution, mitigate climate change, enhance social cohesion and improve people well-being towards sustainable communities [9]. It is often believed that NBS simultaneously provide co-benefits for biodiversity and human health and well-being while fulfilling the functions of urban infrastructures using or mimicking natural processes. Raymond et al. [10], [11] assess a theoretical framework of NBS implementation in urban areas and their generated results as follows: 1) co-benefits for human health and well-being; 2) integrated environmental performance (e.g., the provision of ecosystem services); 3) trade-offs and synergies to biodiversity, health or economy; and 4) potential for citizen’s involvement in governance and monitoring. However, in urban contexts, the co-benefits of NBS are being increasingly recognized as a result of provisioning and improved availability of urban green spaces, such as parks, green corridors, etc. Even though not exhaustive of NBS types of interventions, literature often refers to “climate co-benefits” as result of intended positive side effects of a policy from climate change policies [12]-[14]. Such positive collateral benefits include also: improved quality of life, mental and physical health [15], and reinforced cultural identities, supporting a sense of belonging and place stewardships, etc. [6], [16]-[18]. Moreover, an overarching review of the literature highlights the importance of health benefits specifically generated by NBS, in particular see [19]-[21]. Taking this aspect of multi-functionality into account and considering the plethora of co-

benefits produced, NBS are often seen to represent more efficient and cost-effective solutions to climate change threats than conventional approaches, such as regular sewage or air conditioning systems, see [22]. Demonstrating these co-benefits, in that sense, could guarantee both stakeholder groups support, and funding opportunities to ensure a longer mainstreaming and acceptance of NBS across urban policy areas [23], [24]. Based on this understanding, decision-makers are encouraged to approach science-driven minds to plan, co-design and co-develop NBS [25], [26], towards making urban areas more sustainable and resilient [27].

B. NBS Role in Solving Challenges of Complex Cities'

NBS have proven outcoming positive impacts on cities environmental challenges without a doubt; nonetheless, the major challenge planners and designers have to face in NBS implementation refers to the land use regulations and the spatial allocation. Many cities and regions nowadays give-a-go towards more integrated urban solutions that work on multiple urban spatial scales, from nano to macro, such as green roofs and walls on buildings, green and eco-furniture in public spaces, as well as urban green corridors that also act as ecological habitats aiming to increase biodiversity.

With pressuring climate change challenges, many cities tend to use greenery and greening strategies to enhance existing infrastructure while offering side co-benefits to its citizens [28]. Hence, urban living labs (ULLs) are assumed to be the most convincing form of application for testing shared governance experiments, since nature and NBS are relevant to citizens' wellbeing due to the multiple co-benefits these later provide in terms of scales and costs. However, citizen engagement and empowerment in the procedural implementation of these strategies makes it longer and exhaustive to municipalities and decision makers to embark on. Mostly, in urban planning policies, the process of citizen empowerment is often figurative and ignored by local authorities. Spatial challenges and shared governance challenges are nowadays considered the war-line of citizen-centered urban planning. Nonetheless, many greening strategies require a lot of technical times to get executed, that process is lengthy, exhaustive, and mostly radically changing cities interfaces in a time of climate change uncertainty.

Literature argues on many spatial levels the need for a real operational pathway for NBS implementation - and other types of UGI - that overcomes the silos thinking in urban planning policies in order to cope with the emerging needs of cities and rapid urbanization [29], [30]. To put in place such a complexity of urban regeneration processes, the place-based implementation is most likely to take place in a physical ULL. The term is commonly used in urban planning to exploit dynamics of an innovative process to ideate, design and implement new products and services, in this case the service is the NBS deliverance. Nevertheless, in practice, very few experiences of shared governance in urban greening policies are considered successful in regeneration processes since it is hard to develop tailored policies, because of the following aspects:

- 1) Spatial challenges: hard to frame the different NBS that apply on different scales: NBS are very different amongst each other: The spatial implementation tends to be the most challenging since it varies from building scale interventions, public space interventions, water body systems, transport linear infrastructure, natural areas and ecological habitat interventions. These differences drive the need to be addressed with careful implementation techniques and capacity building to overcome the long-term maintenance timelines and responsibilities issues.
- 2) Governance challenges: breaking internal silos and prioritization in public discussion: While shared governance is an evident need in NBS lifetimes, the methods and procedural procurement in the public administration did not develop with the same rhythm. Internal silos still withhold a smooth implementation due to lack of communication and coordination strategy between different departments and a multi-scalar perspective of stakeholders' engagement. Nonetheless, most public administrations lack a more holistic approach to integrate NBS in urban policies by focusing on a comprehensive set of economic, social and environmental "win-win" co-benefits.
- 3) Temporal challenges of different projects and scales: Diversity in NBS types and scales brings in different timelines across ULLs scales of implementation. In one case of ULL implementation, there could be a variety of NBS in-place that need different timelines and skills for co-design and co-implementation.
- 4) Financial challenges: economic feasibility and resources to activate: While the willingness to pay for ecosystem services changed paradigmatically during the last years because of the pressing issues of climate change adaptation and resilience coping strategies; yet the NBS granular financial challenges are more of an adequacy of activation of resources and an economic feasibility during the implementation timeline. Public works and sponsorships follow different rules and timing making coordination very difficult.

III. SPATIAL SCALES AND METHODOLOGICAL ANALYSIS

Throughout the literature review, few questions were raised on the spatial challenges, governance challenges, and financial challenges related to NBS implementation practices. NBS are considered quite complex from a multifunctional point-of-view and require a multiplicity of stakeholders' collaboration during the realization of the intervention. The following section analyses the complexity and diversity of spatial scales challenges through NBS creation, implementation and long-term maintenance.

Firstly, NBS are not stand-alone systems; to be effectively implemented at urban scale in order to reverse ecosystem degradation trends; they need evidence-based standards, benchmarks and coordinated guidelines for practitioners to be developed, see also [31], [32]. Limited land space and time frameworks are widely reviewed restrictions of NBS, especially in dense urban areas such as cities inner centers. In

general, NBS require more land (and longer time) to provide expected co-benefits than conventional grey, blue and green infrastructures [33]. It is also important to highlight that NBS should not be considered an ‘either-or’ alternative to other grey solutions. In some larger metropolitan scales, “Hybrid solutions” that blends NBS with engineered systems may provide the optimal impact considering environmental challenges, spatial requirements and financial resources [7], [34].

Secondly, during the implementation of NBS, spatial dimension is also considered as a two-faced coin. The peculiarity of urban regeneration processes is the multiplicity of stakeholders in the same spatial proximity; that could be an advantage and a disadvantage at the same time. While stakeholder’s collaboration in a small spatial proximity is important to create a cluster that easily gets together, shares information and traffics knowledge exchange; it also creates competition and conflicts of interest. Another evident aspect of NBS in urban regeneration projects across cities is the green gentrification [35]. Like any other green strategies, if they are successful, they may exclude ultimately some residents and business from accessibility, and eventually exclude vulnerable populations. In this sense, urban green projects can set off rounds of gentrification, dramatically altering housing opportunities and lower income communities which are more acute for liveable and attractive cities [36].

NBS typologies and application scales can vary along the implementation and maintenance timeframe [37]. This perspective calls for a multiplicity of stakeholder groups to collaborate a long time to maximize the delivery of NBS in place, and to embark on adapting climate change by means of NBS while fulfilling stakeholders’ specific agendas. Examples from across European cities show cases that NBS spatial challenge is instrumental [38], see knowledge repositories such as [39], [40]

One Pilot project, KLIMATEK [41] categorizes NBS by scales of interventions (types) and by urban typologies diagnosis (climate threats and expected environmental co-benefits). Their work highlights the need to “easy replicate, coherent and clear methodology” to spatially map existing NBS and potential new deployments in order to address a variety of climate threats (such as: flood, sea level rise, droughts, and urban heat islands) while providing social and economic co-benefits as well. However, the NBS literature covers a wide array of interventions with a variety in scopes (from pervious pavements to urban forests), scales (from individual buildings, urban furniture to metropolitan forests and beyond), and range of functions (water detention, urban heat island mitigation to social inclusiveness and cohesion), see [42]-[46].

Summing up, the spatial scale challenges of NBS drastically change the resources needed to get implemented, the cost of maintenance on a longer term and the need to address a specific place-based challenge. While environmental challenges are the most pressing answer to NBS deployment, social and economic co-benefits should also be highly considered in possible urban regeneration processes that take

place in dense built-up areas with remarkable spatial vulnerability.

The following section of case studies exposes the examples of three spatial differences: micro, macro and meso scales. The idea is to reflect on how at all spatial scales, the use of the NBS does not cease at being a simple park or a green promenade but rather performs as a socio-cultural infrastructure for cities as well.

IV. CASE STUDIES

A. Micro Scale: A Neighborhood Park

Biblioteca degli Alberi (BAM), in the heart of Porta Garibaldi and Isola neighborhood of Milan, is more of a simple green neighborhood park. Its stiches the entrances of the neighborhood with the main street of Via Gioia, one of the oldest city’s traffic veins and Mind axes towards the city center.



Fig. 1 Example of seating areas and trees in the BAM park. Spring 2021



(a)

(b)

Fig. 2 The BAM Park during morning ((a) Municipality conference, Summer 2020) and night events ((b) a free musical concert, Spring 2021)

In [47], a critical reading for the role of BAM in the city urban design planning related to green infrastructure is

provided. Coima company, as the main landowner and maintenance provider for the park, sponsor social and cultural events in the BAM in order to maintain its sociability and livability. In winter, covered up terraces and areas work as possible social activities places. Nowadays, and due to COVID-19 social distancing regulations, all promoted social activities are held in open air only and with respect to sanitary regulations.

B. Macro Scale: A Green and Blue Corridor

Promenade du Paillon, Nice in France is one of the most relevant Meso scale examples of NBS. It is a green walkway throughout the city center with open air games for children, water elements and mist sprays for cooling, run-off collection and social entertainment to lower perceived temperature in summer. The Lush Park crosses the old city center towards the coastal passage is also considered a cultural hotspot for events. This example also has a socio-cultural aspect in it, the park also is a scene for summer festivals and open-air concerts. The promenade is also promoted as one of the must-go touristic spots in all city's recommendations.



Fig. 3 Google earth map for Promenade du Paillon location



Fig. 4 Water elements at Promenade du Paillon, Nice. Summer 2019



Fig. 5 Green elements at Promenade du Paillon, Nice. Summer 2019

C. Meso Scale: A Green way

Rose Kennedy Greenway of Boston, Massachusetts, USA is an example of how a different combination of green and blue infrastructures can blend into a strong socio-cultural urban regeneration process. The greenway crosses three different districts and has many parks allocated along the pathway, such as: Northend park, the Wharf District Park, the Dewey Park, and the Chinatown Park.



Fig. 6 The Mapped location of the Northend Park along the Green way in Boston, MA [50, based on 51]

The Greenway of Boston came a long way of urban regeneration process from a highway into a greenway in the 2000s [48]. The radical change started by replacing an elevated highway in 2004. That Highway have lengthy bludgeoned the downtown of Boston by a Greenway

containing a series of parks as seen in Fig. 6. Nowadays, the series of parks connecting the emerald necklace with the waterfront are also scene of cultural and social urban regeneration.



Fig. 7 The Wharf district park as seen from the middle of the greenway, Summer 2017

During good weather seasons, the park is flooded with tourists and locals that attend musical festivals, yoga classes and lounge in the Italian adjacent neighborhood and coffee shops. The cultural programming handled by the Rose Kennedy Greenway conservancy also includes a wide range of cinema festivals, open-air museums expositions, Christmas markets and touristic historical tours.



Fig. 8 The Northend Park along the Greenway in Boston. Summer 2018

V. DISCUSSIONS AND CONCLUSIONS

Green and Blue infrastructure and NBS should be systematically integrated into urban planning, including in public spaces, infrastructure, and the design of buildings and their surroundings. The most winning formula for cities willing to implement NBS successfully is a mix between green, blue, and socio-cultural elements.

From the cases studies presented in this article, it is evident that NBS territorial impact is environmentally explored to extremes, contrarily less evident from a socio-cultural perspective. In Milan, the BAM as situated in a rich and lately regenerated neighborhood brings a lot of touristic attraction to the area also to see the world famous “Bosco-Verticale” building. On the extremities of the BAM, economic activities generate income because of this cultural flow. In Boston, the greenway crosses a historical and contemporary pathway through the city bringing together different social classes, cultural events, and most importantly economic impacts. In Nice, the scale of the promenade does not allow much of the income generation to adjacent economic activities due to a vicinity to the waterfront that attracts much more touristic flows.

Clearly, NBS have a socio-cultural role on many meso and macro spatial scales, less clearly an economic urban generated impact at micro scale. From evidence-based research, many cities have developed strategic and urban planning mechanisms that favor nature embeddedness in future urban regeneration processes. However, social and cultural urban regeneration results as marginalized topics in comparison. Clear obligations in terms of binding policies at all spatial and political scales should emerge, especially after the latest development of climate crises in the last decades. NBS in this sense look like the “Holy grail” to sustainability and resilience

planning¹ as a provider for environmental, social and cultural co-benefits; nonetheless, the road to measure by scientific evidence the economic spillovers of NBS on the longer terms is still a bumpy and winding road to go.

DISCLAIMER

All images are author’s own unless cited.

ACKNOWLEDGMENT

This research is supported by Department of Architecture and urban studies of Politecnico di Milano (DASTU). All opinions are the author’s and not of the affiliation entity.

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¹ The term holy grail is borrowed from Michael Newman, Viewpoint article: Is resilience planning’s holy grail? [49]

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A Flexible Real-Time Eco-Drive Strategy for Electric Mini-Bus

Felice De Luca, Vincenzo Galdi, Piera Stella, Vito Calderaro, Adriano Campagna, Antonio Piccolo.

Abstract—Sustainable mobility has become one of the major issues of the recent years. The challenge in reducing polluting emissions as much as possible has led to the production and diffusion of vehicles with internal combustion engines that are less polluting and to the adoption of green energy vectors, such as vehicles powered by natural gas or LPG and, more recently, with hybrid and electric ones.

While on one hand the spread of electric vehicles for private use is becoming a reality, albeit rather slowly, not the same is happening for vehicles used for public transport, especially those that operate in the congested areas of the cities.

Even if the first electric buses are increasingly being offered on the market, it remains central the problem of autonomy for battery fed vehicles with high daily routes and little time available for recharging. In fact, at present, solid-state batteries are still too large in size, heavy and unable to guarantee the required autonomy. Therefore, in order to maximize the energy management on the vehicle, the optimization of driving profiles offer a faster and cheaper contribution to improve vehicle autonomy.

In this paper, following the authors' precedent works on electric vehicles in public transport and energy management strategies in electric mobility area, an eco-driving strategy for electric bus is presented and validated. Particularly, the characteristics of the prototype bus are described, and a general-purpose eco-drive methodology is briefly presented. The model is firstly simulated in MATLAB™ and then implemented on a mobile device installed on-board of a prototype bus developed by the authors in a previous research project. The solution implemented furnishes to the bus-driver suggestions on the guide style to adopt.

The result of the test in a real case will be shown to highlight the effectiveness of the solution proposed in terms of energy saving.

Keywords—Eco-drive, Electric bus, Energy management, Prototype.

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Understanding Farmers' Perceptions Towards Agrivoltaics Using Decision Tree Algorithms

Mayuri Roy Choudhury

Abstract— In recent times the concept of Agrivoltaics has gained popularity due to the dual use of land and the added value provided by photovoltaics in terms of renewable energy and crop production on farms. However, the transition towards Agrivoltaics has been slow, and our research tries to investigate the obstacles leading towards the slow progress of Agrivoltaics. We applied data science decision tree algorithms to quantify qualitative perceptions of farmers in the United States for Agrivoltaics. Till date, there has not been much research that mentions farmers' perceptions as most of the research focuses on the benefits of Agrivoltaics. Our study adds value by putting forward the voices of farmers, which play a crucial role towards the transition to Agrivoltaics in the future. Our results show a mixture of responses in favor of Agrivoltaics. Furthermore, it also portrays significant concerns of farmers, which is useful for decision-makers when it comes to formulating policies for Agrivoltaics.

Keywords—Agrivoltaics, Decision-Tree Algorithms, Farmers' Perception

The Application of Green Technology in Construction and How It Affects Cost Reduction During an Economic Crisis

Jason R. Rebamontan, Karl Danielle A. Cua, Samuel Reginald T. Lacuna

Abstract— Green Technology is one of the manifestations of sustainable change in the field of construction, it is an innovative construction method which entails or involves a higher protection for the environment. The pandemic (COVID-19) struck at the most unexpected time affecting the world's economy in many ways and for the Philippines, one of its affected areas is the construction industry. This paper describes the effects of using green technology during the construction and its effect in lowering th

Keywords— Green Technology, COVID-19, Economic Crisis, Construction Industry.

Synthesis, Structural and Spectroscopic Studies of NaSrVO₄ Doped with Nd³⁺.

Parul Sharma, Kamni Pathania

Abstract— This work presents a simplistic way to synthesize NaSr(1-x)VO₄:xNd³⁺ nanophosphors with $0.25 \leq x \leq 3.0$ mol% by using combustion synthesis route in which urea is used as an organic fuel. The structural, spectral and optical properties were examined using XRD, UV-Vis-NIR spectroscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Photoluminescence (PL) spectroscopy. Doping the host with Nd³⁺ ions results in increasing band gap with doping. Photoluminescence properties shows that under excitation at 808 nm, sample possess two prominent emissions peaks in the NIR region of the EM spectrum. This phosphor material may possibly be considered of as a new material to be used as a laser host material.

Keywords— Combustion Synthesis, PL Spectroscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, UV-Vis-NIR Spectroscopy, Vanadates.

India's Neighborhood Policy and the Northeast: Exploratory Study of the Nagas in the Indo-Myanmar Border

Sachoiba Inkah

Keywords— foreign policy, infrastructure development, insurgency, people to people connect.

Abstract— The Northeast region has not been a major factor in India's foreign policy calculation since independence. Instead, the region was ignored and marginalized even to the extent of using force and repressive Acts such as AFSPA (Armed Forces Special Powers Act) to suppress the voices of both states and non-state actors. The liberalization of the economy in the 90s in the wake of globalization gave India a new outlook and the Look East Policy (LEP) was a paradigm shift in India's engagement with the Southeast Asian nations as it seeks to explore the benefits of the ASEAN. The reorienting of India's foreign policy to 'Neighborhood First' is attributed to the present political dispensation, which is further widened to include 'Extended Neighborhood.' As a result, the Northeastern states have become key players in India's participation in regional groupings such as SAARC, BIMSTEC, and BCIM. The need for external balancing, diplomacy and development has reset India's foreign policy priorities as the Northeast states lie in the confluence of South Asia, Southeast and East Asia, and a stakeholder in Act East Policy. The paper will explore the role of Northeastern states in the framework of Indian foreign policy as it shares international boundaries with China, Bhutan, Bangladesh, and Myanmar and most importantly, study the case of Nagas who are spread across Manipur, Nagaland, and Arunachal Pradesh bordering Myanmar. The Indo-Myanmar border is an area of conflict and various illegal activities such as arms trafficking, illegal migrants, drug, and human trafficking are still being carried out and in order to address this issue, both India and Myanmar need to take into consideration the various communities living across the border. And conflict and insurgency should not be a yardstick to curtailed development of infrastructures such as roads, health facilities, transport, and communication in the contested region. The realities, perceptions, and contentions of the Northeastern states and the different communities living in the border areas need a wider discourse as the region the potential to drive India's diplomatic relations with its neighbors and extended neighborhood. The methods employed are analytical and more of a descriptive analysis on India's foreign policy framework with a focus on Nagas in Myanmar, drawing from both primary and secondary sources. Primary sources include official documents, data, and statistics released by various governmental agencies, parliamentary debates, political speeches, press releases, treaties and agreements, historical biographies and organizational policy papers, protocols and procedures of government conferences, regional organization study reports etc. The paper concludes that the recent proactive engagement between India and Myanmar on trade, defense, economic, and infrastructure development are positive signs cementing bilateral ties, but there is not much room for the people-to-people connect, especially for people living in the borderland. The Freedom of Movement Regime that is in place is limited and there is more scope for improvement as people in the borderland looks towards trade and commerce to not only uplift the border economy but also act as a catalyst for robust engagement between the two countries, albeit with more infrastructure such as road, healthcare, education, a tourist hotspot, trade centers, mobile connectivity, etc.

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Club House: A Minor Rebellion Against the Algorithmic Tyranny of the Majority

Vahid Asadzadeh, Amin Ataee

Abstract— Since the advent of social media, there has been a wave of optimism among researchers and civic activists about the influence of virtual networks on the democratization process, which has gradually waned. One of the lesser-known concerns is how to increase the possibility of hearing the voices of different minorities. According to the theory of media logic, the media, using their technological capabilities, act as a structure through which events and ideas are interpreted. Social media, through the use of the learning machine and the use of algorithms, has formed a kind of structure in which the voices of minorities and less popular topics are lost among the commotion of the trends. In fact, the recommended systems and algorithms used in social media are designed to help promote trends and make popular content more popular, and content that belongs to minorities is constantly marginalized.

As social networks gradually play a more active role in politics, the possibility of freely participating in the reproduction and reinterpretation of structures in general and political structures in particular (as Laclau and Mouffe had in mind) can be considered as criteria to democracy in action. The point is that the media logic of virtual networks is shaped by the rule and even the tyranny of the majority and this logic does not make it possible to design a self-foundation and self-revolutionary model of democracy. In other words, today's social networks, though seemingly full of variety But they are governed by the logic of homogeneity, and they do not have the possibility of multiplicity as is the case in immanent radical democracies (influenced by Gilles Deleuze).

However, with the emergence and increasing popularity of Club House as a new social media, there seems to be a shift in the social media space, and that is the diminishing role of algorithms and systems reconditioners as content delivery interfaces. This has led to the fact that in the Club House, the voices of minorities are better heard and the diversity of political tendencies manifests itself better.

The purpose of this article is to show, first, how social networks serve the elimination of minorities in general, and second, to argue that the media logic of social networks must adapt to new interpretations of democracy that give more space to minorities and human rights. Finally, this article will show how the Club House serves the new interpretations of democracy at least in a minimal way.

To achieve the mentioned goals, in this article by a descriptive-analytical method, first the relation between media logic and postmodern democracy will be inquired. The political economy popularity in social media and its conflict with democracy will be discussed. Finally, it will be explored how the Club House provides a new horizon for the concepts embodied in radical democracy; a horizon that more effectively serves the rights of minorities and human rights in general.

Keywords— Algorithmic tyranny, Club House, Minority rights, Radical democracy, Social media.

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Migration and Policy Dedication in Ethiopia: A Study of Migration of Hadiya People

Solomon Tagesse

Abstract— This study has been conducted on “Migration and Policy Dedication in Ethiopia: A Study of Migration of Hadiya People,” which was aimed at scrutinizing the reason for Hadiya people’s migration from Ethiopia to the Republic of South Africa. Basically, a qualitative research approach has been employed to address the justified problem and to achieve the objectives stated accordingly. The purposive and snowball sampling techniques were employed to identify the study sites and respondents for the study. Field observations, interviews, focus group discussions and recording of data were used as instruments to collect data. It has been observed that lack of jobs and peer pressure, lack of interest to learn and work, scarcity and low wages were push factors; whereas job opportunity and better income; the existence of families, relatives and friends pull factors. Communication, transportation, the existence of brokers, etc., were also found to be intermediary factors. Based on the findings, recommendations and policy suggestions have been made in specific areas of the study.

Keywords— migration, reason, migrant, households.

Conceptualizing IoT Based Framework for Enhancing Environmental Accounting by ERP Systems

Amin Ebrahimi Ghadi, Morteza Moalagh

Abstract— This research is carried out to find how a perfect combination of IoT architecture (Internet of Things) and ERP system can strengthen environmental accounting to incorporate both economic and environmental information. IoT (e.g., sensors, software, and other technologies) can be used in the company's value chain from raw material extraction through materials processing, manufacturing products, distribution, use, repair, maintenance, and disposal or recycling products (Cradle to Grave model). The desired ERP software then will have the capability to track both midpoint and endpoint environmental impacts on a green supply chain system for the whole life cycle of a product. All these enable environmental accounting to calculate, and real-time analyze the operation environmental impacts, control costs, prepare for environmental legislation and enhance the decision-making process. In this study, we have developed a model on how to use IoT devices in life cycle assessment (LCA) to gather emissions, energy consumption, hazards, and wastes information to be processed in different modules of ERP systems in an integrated way for using in environmental accounting to achieve sustainability.

Keywords— ERP, environmental accounting, green supply chain, IOT, life cycle assessment, sustainability.

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Impact of Economic and Financial Factors on Tax Revenue as Percentage of GDP: Evidence from Pakistan

Abdul Mannan

Abstract— Taxes are important for economies to provide civic facilities, build up infrastructure, fortify defence, and ensure equivalence growth. Funds are imperative to meet governments' goals and there are number of economic and financial variables which influence these funds and policy of internal revenue generation of a country. There is scarcity of research studying impact of economic and financial factors on tax revenue and none of them has been conducted on Pakistan's taxation system. This study has studied the impact of economic and financial factors on tax revenue in the case of Pakistan for the period ranging from 1980 to 2019. The study uses ARDL Bound Testing having mixed level of stationarity. The study finds that financial variables impact tax revenue positively whereas per capita income related negatively. According outcomes of the study, Financial variables as bank capital to total asset ratio, bank non performing loans, and bank risk premium on lending relate positively and economic variables as broad money and foreign development assistance relates positively except per capita income which gives results otherwise. The study finds major portion of indirect taxation causes negative tax and national income relationship and it suggests that stable financial institutions, equivalence growth, strengthening of money market and progressive tax system could help economy generate more rewarding revenue generation activity. Developing countries heavily rely on indirect taxation with incident on poor and creating disparity and regressive taxation, which hampers economic growth; therefore, it is suggested efficient taxation with more portion of direct taxation by the study.

Keywords— Tax Revenue, Economic Factors, Financial Factors, Economy of Developing countries, Fiscal Deficit.

Subdued Electrodermal Response to Empathic Induction Task in IPV Perpetrators

Javier Comes-Fayos, Isabel R. Moreno, Sara Bressanutti, Marisol Lila, Ángel Romero-Martínez y Luis Moya-Albiol

Abstract— Empathy is a cognitive-affective capacity whose deterioration is associated with aggressive behaviour. Deficient affective processing is one of the predominant risk factors in men convicted of intimate partner violence (IPV perpetrators), since it makes their capacity to empathize very difficult. The objective of this study is to compare the response of electrodermal activity (EDA), as an indicator of emotionality, to an empathic induction task, between IPV perpetrators and men without a history of violence. The sample was composed of 51 men who attended the CONTEXTO program, with penalties for gender violence under two years, and 47 men with no history of violence. Empathic induction was achieved through the visualization of 4 negative emotional-eliciting videos taken from an emotional induction battery of videos validated for the Spanish population. The participants were asked to actively empathize with the video characters (previously pointed out). The psychophysiological recording of the EDA was accomplished by the "Vrije Universiteit Ambulatory Monitoring System (VU-AMS)." An analysis of repeated measurements was carried out with 10 intra-subject measurements (time) and "group" (IPV perpetrators and non-violent perpetrators) as the inter-subject factor. First, there were no significant differences between groups in the baseline AED levels. Yet, a significant interaction between the "time" and "group" was found with IPV perpetrators exhibiting lower EDA response than controls after the empathic induction task. These findings provide evidence of a subdued EDA response after an empathic induction task in IPV perpetrators with respect to men without a history of violence. Therefore, the lower psychophysiological activation would be indicative of difficulties in the emotional processing and response, functions that are necessary for the empathic function. Consequently, the importance of addressing possible empathic difficulties in IPV perpetrator psycho-educational programs is reinforced, putting special emphasis on the affective dimension that could hinder the empathic function.

Keywords—electrodermal activity, emotional induction, empathy, intimate partner violence.

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Difficulties in the Emotional Processing of IPV Perpetrators

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Abstract— Given the great impact produced by gender-based violence, its comprehensive approach seems essential. Consequently, research has focused on risk factors for violent behaviour, linking various psychosocial variables, as well as cognitive and neuropsychological deficits with the aggressors. However, studies on affective processing are scarce, so the present study investigates possible emotional alterations in men convicted of gender violence. The participants were 51 aggressors, who attended the CONTEXTO program with sentences of less than 2 years, and 47 men with no history of violence. The sample did not differ in age, socioeconomic level, education or alcohol and other substances consumption. Anger, alexithymia and facial recognition of other people's emotions were assessed through the State-Trait Anger Expression Inventory (STAXI-2), the Toronto Alexithymia Scale (TAS-20) and Reading the mind in the eyes (REM), respectively. Men convicted of gender-based violence showed higher scores on the anger trait and temperament dimensions, as well as on the anger expression index. They also scored higher on alexithymia and in the identification and emotional expression subscales. In addition, they showed greater difficulties in the facial recognition of emotions by having a lower score in the REM. These results seem to show difficulties in different affective areas in men condemned for gender violence. The deficits are reflected in greater difficulty in identifying and expressing emotions, in processing anger and in recognizing the emotions of others. All these difficulties have been related to the use of violent behavior. Consequently, it is essential and necessary to include emotional regulation in intervention programs for men who have been convicted of gender-based violence.

Keywords—Alexithymia, Anger, Emotional Processing, Emotional Recognition, Empathy, Intimate Partner Violence.

Examination of Porcine Gastric Biomechanics in the Antrum Region

Sif J. Friis, Mette Poulsen, Torben Strøm Hansen, Peter Herskind, Jens V. Nygaard

Abstract— Gastric biomechanics governs a large range of scientific and engineering fields, from gastric health issues to interaction mechanisms between external devices and the tissue. Determination of mechanical properties of the stomach is, thus, crucial, both for understanding gastric pathologies as well as for the development of medical concepts and device designs. Although the field of gastric biomechanics is emerging, advances within medical devices interacting with the gastric tissue could greatly benefit from an increased understanding of tissue anisotropy and heterogeneity. Thus, in this study, uniaxial tensile tests of gastric tissue were executed in order to study biomechanical properties within the same individual as well as across individuals. With biomechanical tests in the strain domain, tissue from the antrum region of six porcine stomachs was tested using eight samples from each stomach ($n = 48$). The samples were cut so that they followed dominant fiber orientations. Accordingly, from each stomach, four samples were longitudinally oriented, and four samples were circumferentially oriented. A step-wise stress relaxation test with five incremental steps up to 25 % strain with 200 s rest periods for each step was performed, followed by a 25 % strain ramp test with three different strain rates. Theoretical analysis of the data provided stress-strain/time curves as well as 20 material parameters (e.g., stiffness coefficients, dissipative energy densities, and relaxation time coefficients) used for statistical comparisons between samples from the same stomach as well as in between stomachs. Results showed that, for the 20 material parameters, heterogeneity across individuals, when extracting samples from the same area, was in the same order of variation as the samples within the same stomach. For samples from the same stomach, the mean deviation percentage for all 20 parameters was 21 % and 18 % for longitudinal and circumferential orientations, compared to 25 % and 19 %, respectively, for samples across individuals. This observation was also supported by a nonparametric one-way ANOVA analysis, where results showed that the 20 material parameters from each of the six stomachs came from the same distribution with a level of statistical significance of $P > 0.05$. Direction-dependency was also examined, and it was found that the maximum stress for longitudinal samples was significantly higher than for circumferential samples. However, there were no significant differences in the 20 material parameters, with the exception of the equilibrium stiffness coefficient ($P = 0.0039$) and two other stiffness coefficients found from the relaxation tests ($P = 0.0065$, 0.0374). Nor did the stomach tissue show any significant differences between the three strain-rates used in the ramp test. Heterogeneity within the same region has not been examined earlier, yet, the importance of the sampling area has been demonstrated in this study. All material parameters found are essential to understand the passive mechanics of the stomach and may be used for mathematical and computational modeling. Additionally, an extension of the protocol used may be relevant for compiling a comparative study between the human stomach and the pig stomach.

Keywords—antrum region, gastric biomechanics, loading-unloading, stress relaxation, uniaxial tensile testing.

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Improving Glycemic Control in Pediatric Patients with Type 1 Diabetes Mellitus

Amanda Baine

Abstract— Introduction: In pediatric patients with type 1 diabetes mellitus (DM), does continuous glucose monitoring (CGM), when compared to conventional self-monitoring of blood glucose levels, improve glycemic control? Children with type 1 DM have the worst glycemic control across the lifespan due to their rapidly growing bodies. Diabetes is the most significant chronic metabolic illness, accounting for blindness, kidney failure, and nontraumatic amputations (Floyd, 2012). These risks are increased with poor glycemic control. CGM has the potential to promote better diabetic management and optimal glycemic control in pediatric patients. Methods: This study is a research study of CGM effectiveness versus conventional self-monitoring of blood glucose levels and the effects on glycemic control in pediatric patients with type 1 DM. An analysis of previous studies was conducted to determine if there is a direct correlation between improved glycemic control when CGM is used in pediatric patients. This study reviewed literature presented by the Journal of Clinical Research in Pediatric Endocrinology, the Journal of Diabetes Science and Technology, JAMA Network, and BMC Endocrine Disorders. Findings: Findings of a study by JAMA Network showed that among adolescents and young adults with type 1 diabetes, CGM resulted in a small but statistically significant improvement in glycemic control over 26 weeks (Laffel, 2020). A more in-depth look at this study and the findings can be seen below. The Journal of Diabetes Science and Technology found that the use of CGM is associated with improvement in metabolic control in type 1 DM, with significant short- and long-term reductions in hemoglobin A1C and reduction in the duration of periods of hypoglycemia and hyperglycemia self-monitoring (Floyd, 2012). Implications: CGM can be an empowering and motivational tool that enables participants to fine-tune and optimize their blood glucose control (Lawton, et al., 2018). This could prove to be a particularly useful tool in a vulnerable population, such as pediatric patients. Conclusion: Studies have consistently found that CGM is useful in improving glycemic control in pediatric patients. Improving glycemic control helps in reducing hyperglycemic events that could lead to hospitalization. This also helps in reducing problems in adulthood, such as kidney failure.

Keywords— blood glucose monitoring, endocrinology, pediatrics, type 1 diabetes..

Management of Geriatric Bipolar Disorder: A Case Series and Review of Current Evidence-Based Treatment Guidelines

Rana Jawish, David Atkinson

Abstract— Description: Geriatric bipolar disorder is associated with high utilization of health care services, persisting disability, cognitive impairment, increased mortality, and increased risk of suicide. However, evidence to guide clinical management of this disorder is limited, often based on studies of non-geriatric patients. This session will present a case series of older veterans with geriatric bipolar disorder engaged in longitudinal mental health care at the Minneapolis Veterans Affairs Medical Center. We will then review the most current literature on evidence-based treatment guidelines for geriatric bipolar disorder. Finally, through a critical examination of real-world clinical practice challenges and the current state of the evidence, discuss future steps needed in geriatric bipolar disorder research.

Abstract:

Bipolar disorder is a severe, relapsing mental illness with recurrent episodes of altered mood that interfere with cognition and functioning. Although the prevalence of bipolar disorder decreases with age, the absolute number of older adults with bipolar disorder is expected to increase with the aging population. Bipolar disorder is a frequent reason for psychiatric hospitalization in later life, with prevalence rates in psychiatric inpatient treatment settings ranging from 4.7%–18.5%. There are several challenges in the management of the geriatric bipolar disorder. First, due to physiologic changes, comorbid medical conditions, and polypharmacy, older adults are at higher risk for adverse effects of medications used to treat bipolar disorder. Second, the disorder itself often impairs insight and treatment adherence. Additionally, response to medication is often incomplete, and later-life bipolar disorder is associated with persisting disability, cognitive impairment, increased mortality, and increased risk of suicide. Finally, limited data are available on medications and psychotherapies for older patients with bipolar disorder. Many of the current treatment approaches to bipolar disorder in later life are based on clinical trials in younger populations, extrapolated to the geriatric population. During this session, presenters will: 1) Describe current pharmacologic practice patterns and real-world challenges in clinical practice for older adults with bipolar disorder through a summary of a clinical case series of 50 older veterans diagnosed with bipolar disorder and engaged in longitudinal outpatient mental health care at the Minneapolis Veterans Affairs medical center; 2) Review the most current literature on evidence-based treatment guidelines for geriatric bipolar disorder; 3) Identify limitations in existing guidelines, through comparison of real-world practice with current research evidence; 4) Propose future steps in geriatric bipolar disorder research that will help fill the existing gaps between the current evidence and clinical practice.

Learning objectives

1. Recognize the key features of bipolar disorder in older adults and how the clinical aspects of later-life bipolar disorder differ from that of non-geriatric patients.
2. Identify which medications have shown efficacy in treating bipolar disorder in older adults, understanding their potential side

effects and limitations given later-life physiologic changes and common medical comorbidities.

Keywords— Geriatric Bipolar disorder , Mood Disorder , Cognitive Impairment , Lithium.

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Maternal Experience During the Establishment of Feeding among Infants Who Have Feeding Issues, at Selected Neonatal and Pediatric Units in Gampaha District, Sri Lanka

Lakna Mignon Fernando

Abstract—

Background – In neonatal care, treatments received by infants born prematurely, low birth weight, hypoxia...etc. are at risk of feeding difficulties. In pediatric care, also there are specific children who have feeding difficulties because eating is a complicated learned behavior which happens for the duration of infancy (around birth to one year). When the infant is in the neonatal unit, there is a lack of interaction between infant and the mother. Maternal experience about the feeding care is important to speech and language therapists and they are specialized for the feeding and swallowing evaluation and intervention.

Objectives - The main objective of this study was to identify maternal experiences during the establishment of feeding among infants who have feeding issues, at selected neonatal and pediatric units in Gampaha district. The specific objectives are to discover maternal experiences of professional support, feeding methods and techniques and family support during the establishment of feeding among infants who have feeding issues.

Method – A descriptive cross sectional study was carried out with a sample size of fifty participants. Pre- tested interviewer-administered questionnaire used to collect data. The study setting was neonatal and pediatric units of the selected government hospitals where mothers of infants with feeding difficulties. The data was analyzed using SPSS 23.0 statistical software

Results – results suggested that majority of the participants had good support from the professionals including doctors (50%, n=25), nursing staff (48%, n=24) and Speech and language therapists (46%,n=23). Most of the participants had fair experience about the feeding method and techniques. The results found that there is poor experience (34%,n=17) and knowledge(26%,n=13) about the feeding method and techniques before coming the NICU or PICU. Other than that majority of the participants had fair experiences during the hospitalization.

Conclusion –Maternal experience is important to establishing among infants who have difficulties because mother is the main person who interacts and feeds the infants in the NICU or PICU and at home. According to results, some of the participants had poor knowledge and experiences about feeding methods and techniques. Therefore, it is essential to more aware the mothers about knowledge and training of the feeding methods and techniques and provide the best support as health care professionals.

Keywords— Maternal experiences,infants with feeding issues,neonatal unit,pediatric unit.

Electromyographic Analysis of Trunk Muscle Activity of Healthy Individuals While Catching a Ball on Three Different Seating Surfaces

Hanan H. Al Qahtani, Karen Jones

Abstract—Catching a ball during sitting is a functional exercise commonly used in rehabilitation to enhance trunk muscle activity. To progress this exercise, physiotherapists incorporate a Swiss ball or change seat height. However, no study has assessed the effect of different seating surfaces on trunk muscle activity while catching a ball.

Objective: To investigate the effect of catching a ball during sitting on a Swiss ball, a low seat and a high seat on trunk muscle activity.

Method: A repeated-measures, counterbalanced design was used. A total of 26 healthy participants (15 female and 11 male) performed three repetitions of catching a ball on each seating surface. Using surface electromyography (sEMG), the activity of the bilateral transversus abdominis/internal oblique (TrA/IO), rectus abdominis (RA), erector spinae (ES) and lumbar multifidus (MF) was recorded. Trunk muscle activity was normalised using maximum voluntary isometric contraction and analysed. Statistical significance was set at $p \leq .05$.

Results: No significant differences were observed in the activity of RA, TrA/IO, ES or MF between a low seat and a Swiss ball. However, the activity of the right and left ES on a low seat was significantly greater than on a high seat ($p = .017$ and $p = .017$, respectively). Conversely, the activity of the right and left RA on a high seat was significantly greater than on a low seat ($p = .007$ and $p = .004$, respectively).

Conclusion: This study suggests that replacing a low seat with a Swiss ball while catching a ball is insufficient to increase trunk muscle activity, whereas changing the seat height could induce different trunk muscle activity. However, research conducted on patients is needed before translating these results into clinical settings.

Keywords— Catching, Electromyography, Seating, Trunk.

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Modern Contraceptive Use Among Female Refugee Adolescents in Northern Uganda: Prevalence and Associated Factors

Ritah Bakesiima, Amanda Cleeve, Elin Larsson, James K. Tumwine, Kristina Gemzell-Danielsson, Rose Chalo Nabirye, Jolly Beyeza-Kashesya

Abstract— Background: Adolescent pregnancies are persistently high among refugees. The pregnancies have been attributed to low contraceptive use in this population. The aim of this study was to determine the prevalence of and factors associated with modern contraceptive use among female refugee adolescents in Northern Uganda.

Methods: This was a cross sectional study employing both descriptive and analytical techniques. The study was carried out in Palabek refugee settlement in Northern Uganda from May to July 2019. A total of 839 consenting refugee adolescents who were sexually active or in-union were consecutively enrolled. Interviewer administered questionnaires were used for data collection.

Results: The modern contraceptive prevalence rate was 8.7% (95% CI: 7.0 to 10.8). The injectable was the most commonly used modern contraceptive method (42.5%), and most of the participants had used the contraceptives for six months or less (59.7%). Reasons for not using modern contraceptives included fear of side effects (39.3%), partner prohibition (16.4%), and the desire to become pregnant (7.0%). The factors significantly associated with modern contraceptive use were being married (OR=0.11, 95% CI: 0.04 to 0.35, $p<0.001$), cohabiting (OR=0.43, 95% CI: 0.20 to 0.93, $p=0.032$) and having an older partner (OR=0.93, 95% CI: 0.86 to 0.99, $p=0.046$).

Conclusion: Modern contraceptive use among female refugee adolescents was very low, and few reported a desire to become pregnant, leaving them vulnerable to unplanned pregnancies. Least likely to use modern contraceptives were participants who were married/cohabiting and those having older partners implying a gender power imbalance in fertility decision making. There is urgent need for innovations to address the gender and power imbalances within relationships, which would shape decision-making and increase modern contraceptive use among refugee adolescents.

Keywords— Modern contraceptives, Contraception, Refugees, Adolescents, Teenage pregnancies.

Title: Evaluation and Association of Thyroid Function Tests with Liver Function Parameters LDL and LDH Level Before and After I131 Therapy

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Abstract

Background and objectives: The pathogenesis of liver function abnormalities and cardiac dysfunction in hyperthyroid patients after I¹³¹ treatment is still unclear. The aim of this study was to determine the effects of radioiodine I¹³¹ on liver function parameters, lactate dehydrogenase(LDH) and low-density lipoproteins(LDL) before and after I¹³¹ therapy in hyperthyroidism patients.

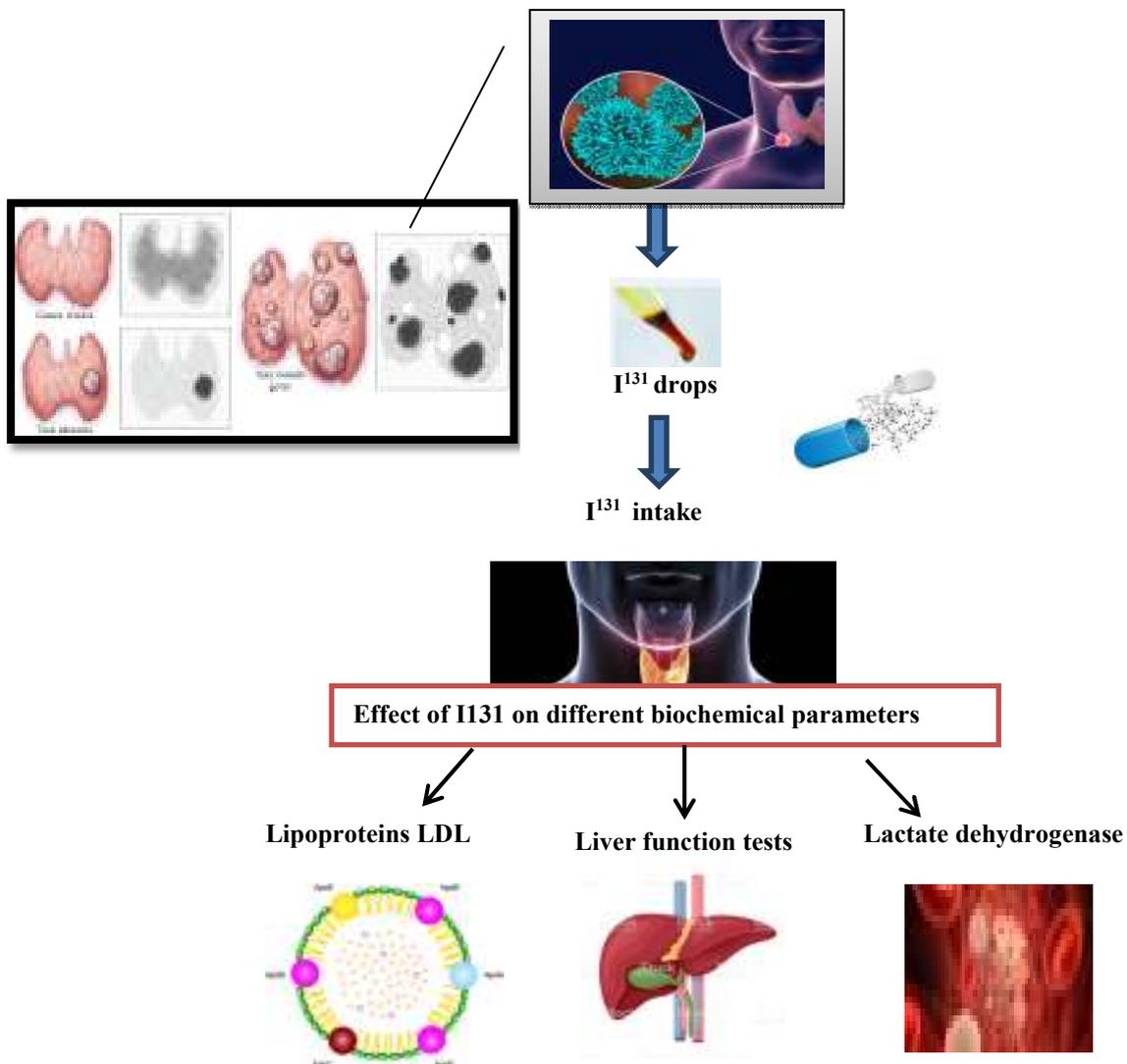
Material & Methods: Total 52 patients of hyperthyroidism recommended for I131 were involved in this study with age ranging from 12–65 years (mean age=38.6±14.8 & BMI=11.5±3.7). The significance of the differences between the results of 1st, 2nd and 3rd time serum analysis was assessed by unpaired student's t-test. Associations between the parameters were assessed by Spearman correlation analysis.

Results: Significant variations were observed for thyroid profile free FT3(p=0.04), FT4(p=0.01), TSH(p=0.005) during the follow-up treatment. Before taking I131 (serum analyzed at 1st time), negative correlation of FT3 with AST (r=-0.458, p=0.032) and LDL (r=-0.454, p=0.039) were observed. During 2nd time (after stopping carbimazole) no correlation were assessed. Two months after administration of I131 drops, significant negative association of FT3 (r=-0.62, p=0.04) and FT4(r=-0.61, p=0.02) with ALB were observed. FT3(r=-0.82, p=0.00) & FT4 (r=-0.71, p=0.00) also showed negative correlation with LDL after I131 therapy. Whereas TSH showed significant positive association with ALB (r=0.61, p=0.01) and LDL (r=0.70, p=0.00) respectively.

Conclusion: Current findings suggested that the association of TFTs with biochemical parameters in patients with goiter recommended for iodine therapy is an important diagnostic and therapeutic tool. The significant changes increased in transaminases, low-density lipoprotein level after taking I131 drops are the alarming signs for heart and liver function abnormalities and warrant physicians attention on urgent basis.

Keywords: Hyperthyroidism, Carbimazole, Radioiodine I¹³¹, liver functions, low-density lipoprotein

Graphical Abstract



Parameters	Level
Low-density lipoproteins	↑↑
Albumin	↑↑
Alkaline phosphates	↓↓
Aminotransferases	↑↑
Lactate dehydrogenase	↑↑

Background

In hyperthyroid state endocrine gland become more aggressive and trigger thyroid gland to release excess amount of thyroid hormones, which is distinguish by regular or elevated uptake of radioiodine by thyroid gland, this situation also known as true hyperthyroidism or thyrotoxicosis with hyperthyroidism[1]. Thyroid hormones play imperative role in development, reproduction and neuronal growth and also involved in the regulation of energy-metabolisms which affect the function of all body organs, tissues and cells[2]. In iodine sufficient areas Graves' disease accounts 70 to 80% of patients associated with hyperthyroidism whereas, in iodine deficient areas it accounts ~50% of patients with hyperthyroidism and other half attributable to nodular thyroid disorder[3]. Thyroid goiter disorders can be categorized into toxic, non-toxic, local or non-endemic and diffuse or nodular goiter. Because of endocrine disorders 500-600 million peoples are affected with nodular goiter around the world [4][5]. Most prevalent 90% of cases of hyperthyroidism are associated with multi-nodular goiter, diffuse toxic goiter, and toxic adenomas [6, 7]. The higher prevalence rate of goiter has been documented in females (94.7%) and less prevalent in males (5.26%) [8]. The extent of hyperthyroidism is lower as compared to hypothyroidism in Pakistan and their prevalence rate was 5.1% and 5.8% respectively [9, 10].

Graves' disease affects numerous organs such as gastrointestinal cardiovascular and hepatic systems [11]. The liver is the key organ where thyroid hormones metabolism takes place [12]. Hepatic dysfunction is common in patients with Graves' disease [13]. Hyperthyroidism induced liver function abnormalities or liver failure may occur due to excess release of thyroid hormones or autoimmune injuries. Previous studies showed that the elevated level of free thyroid hormone had a deleterious effect on hepatic cells[14, 15]. The liver is the main organ plays an important role in metabolizing thyroid hormones and regulates their systemic effects[16, 17]. Hyperthyroidism may also be responsible for cholestatic jaundice due to decreased bilirubin and bile excretion[18].

Liver dysfunctions are common in patients with thyrotoxicosis including hepatocellular injuries, increased level of liver enzymes AST and ALT, cholestasis, and also increased level of alkaline phosphatase (ALP), GGT and bilirubin. The risk of coexisting autoimmune hepatitis has also been considered in hyperthyroidism associated patients[19].

Thyroid dysfunctions have intense effect on lipoprotein metabolism[20]. Hyperthyroidism may also increase the heart rate and contractility along with bone turnover, osteopenia, osteoporosis, and fractures, hyperactivity, anxiety, excessive sweating, weight loss, palpitations, muscle weakness, reduced fat mass, tachycardia, stare, eyelid lag, irritability, and menstrual irregularity[21]. Thyroid hormones directly regulate lipoprotein consumption by decreasing low-density cholesterol via the activation of LDL gene receptors[22]. Thyroid hormones also involved in the stimulation of cholesteryl ester transfer proteins (CETP) that convert the HDL into VLDL and triglycerides [23]. Transitory alterations in thyroid hormones disturb both efflux and influx of lipid metabolism and may also disturb the cholesterol homeostasis[24]. Thyroid function abnormalities may have great impact on lipids metabolism as well as various cardiovascular risk factors.

Radioiodine (RIA) therapy considered as common treatment of hyperthyroidism. Radioiodine treatment may periodically be administered in patients with subclinical hyperthyroidism[26]. Radioiodine iodine therapy recommended as safe, simple and effective treatment and relatively inexpensive method as compared to other therapeutic practices [27]. Anti-thyroid drugs: Carbimazole, Methimazole and propylthiouracil considered as primary treatment of thyrotoxicosis (goiter disease) or use for preparing the patients for definitive therapy with surgery or radioiodine treatment [28].

Radioiodine I131 treatment may cause worsen liver damage due to the massive release of stored thyroid hormones into the bloodstream, which may also lead to temporary exacerbation of thyrotoxicosis [29]. The purpose of the present study was to evaluate the association of thyroid function tests (TFTs) with liver function tests (LFTs), LDH and LDL before and after radioiodine I131 therapy in hyperthyroid patients. Therefore, this study evaluated the potential effect of RAI therapy on liver function, LDL and LDH with emphasis on BMI, sex, age, smoking, accumulated dose and type of goiter (DG, DTG, MNG, TNG, nodule in right lobe, cold nodule in right lobe isothymus, nodule in left lobe and left lobe benign thyroid tissue).

MATERIAL & METHODS:

Study Subjects:

This is a longitudinal hospital based cohort study in which 52 patients were involved associated with Goiter disease (hyperthyroidism). They were living in the region of southern Punjab of Pakistan and recruiting to Outpatient Clinics of Multan Institute of Nuclear Medicine and Radiotherapy (MINAR), Nishtar Hospital Multan during the period of 10 months from September 2019 to June 2020.

Inclusion criteria:

All the clinically tested thyroid function tests (TFTs) patients of hyperthyroidism with age ranging from 12-65 years were selected for taking first time radioiodine I131 therapy. Sample size (n=52) was determined by serum samples collected 3 times from the same patient: 1st time when patient came for taking time of Iodine I131 (taking Carbimazole), 2nd time before taking Iodine I131 drops (after 15 days off of Carbimazole) and 3rd time after 2 months of taking iodine 131.

Exclusion criteria:

Any known case of hypothyroidism and euthyroidism on treatment, supplementation with vitamin D or patients that took medications which affected thyroid functions, liver functions and lipid metabolism such as, Statins, diabetic medicines, oral contraceptives, estrogen, glucocorticoids were excluded from the study after taking proper medical history.

Anthropometric Measurements

Subjects accomplished a planned form concerning demographic characteristics at the primary visit. All procedures performed in this study involving human participants were in accordance with the ethical standards of the Institutional Ethics Committee of MINAR' and Informed consent was obtained from all individual participants included in the study. The height and weight of the subjects were measured twice and then average calculated by employing a digital scale. Body mass index (BMI) was calculated by using the subsequent formula: weight in kilogram divided by the sq. in height in meters (kg/m²). All data including age, gender, BMI, marital status, Smoking, Goiter duration, Amount of I131 dose, thyroid

scan and region were recorded on a standard form. Different types of goiter: diffused goiter, diffused toxic goiter, multinodular goiter, toxic nodular goiter, nodule in right lobe, cold nodule in right lobe isothymus, nodule in left lobe and left lobe benign thyroid tissues were defined by thyroid scan.

Laboratory Measurement:

Blood samples were drawn in fasting. Samples were taken into K2-EDTA and BD gel vacutainer for TFTs analysis and plain red top vials with no additives used for biochemical parameters analysis[30]. Thyroid function tests FT3, FT4 and TSH (reference range; TSH: 0.2-5.5miU/L, FT4: 10-24.5pmol/L, FT3: 3.1-6.8pmol/L) were measured with an electrochemiluminescence immunoassay (Hitachi Modular E411; Roche Diagnostics, Mannheim, Germany) and by radioimmunoassay (RIA) kits provided by Immunotech, Beckman coulter, Czech Republic. Liver function parameters (ALB, ALP, ALT, AST & Total Bilirubin), LDL and LDH were measured by Chemistry Analyzer (P500 Diatron).

Statistical Analysis:

Statistical analysis was performed with SPSS version 26 (SPSS Inc., Chicago, IL, USA). The level of significance of 3 different time points; 1st 2nd and 3rd time (hormonal and biochemical parameters of a same individual) were assessed by unpaired independent Student's t-test after checking for normality by the Shapiro-wilk test [31]. As non-normal distribution was found for TFT's, Albumin, LFTs, LDL and LDH results were assessed by Wilcoxon ranked pairs test. The level of statistical significance was set at $P < .05$. Finally, the relationship of TFT's with Albumin, LFTs, LDL and LDH were assessed by Spearman correlation analysis. All graphs are plotted by graphpad prism 8 software.

RESULTS

The patients included in this study were belonging to diverse areas of Punjab nearby Multan, Pakistan. The incidence of hyperthyroidism was diverse in different regions and the highest prevalence of hyperthyroidism was observed in Multan with 22(42%) frequency followed by Borewala 8(15%), Tonsashareef 7(13%), Khanewal 6(12%), Deraghazi Khan 5(10%), Tatapur and 4(8%) as show in Fig 1.

Total fifty-two (52) patients of hyperthyroidism diagnosed with diffused goiter (DG) 9(17.3%), diffused toxic goiter (DTG) 13(25%), multinodular (MNG) 20(38.4%), Toxic Nodular Goiter (TNG) 3(5.7%), Nodule in right lobe 2(3.8%), Nodule in left lobe 3(5.7%), cold Nodule in right lobe isothymus 1(1.9%) and left lobe benign thyroid tissue 11(1.9%) with age ranging from 12-65 years (Fig2). The patients were diagnosed on the basis of Tc-99m pertechnetate thyroid scan (Fig 3). The mean age of patients was 38.6 ± 14.8 years with BMI 11.5 ± 3.7 . In which 42 (80%) females and 10 (20%) males associated with different types of hyperthyroidism. The amount of dosage I131 (5mci-29mci) and duration of goiter ranges from 2 months to 15years. Patients demographic data represented in Table 1.

The comprehensive results of free T3, free T4, and TSH before and after I131 therapy was shown in Fig 4. The significance of the differences between the results of 3 time points (1st, 2nd, 3rd time) serum analysis were recorded by unpaired independent student-t test. When we compared the 1st time results with 2nd time results significant difference were observed in ALB ($p=0.000$), ALP ($p=0.003$), ALT ($p=0.002$), AST ($p=0.002$), Bilirubin Total ($p=0.002$), LDH ($p=0.020$) and LDL ($p=0.001$). And when we compared 2nd time results with 3rd time results significant differences were recorded in ALP ($p=0.000$) and LDH ($p=0.031$). And by the comparison of 1st time results with 3rd time results significant differences were recorded in FT3 ($p=0.04$), FT4 ($p=0.010$), TSH ($p=0.005$), ALB ($p=0.000$), ALP ($p=0.007$), ALT ($p=0.001$), AST ($p=0.000$), and LDL ($p=0.000$) after completion of patient's visits during treatment (before and after taking I131 therapy) (Table 2).

Before I¹³¹ therapy, significant negative association of FT3 with AST ($r=-0.458$, $p=0.032$) and LDL ($r=-0.454$, $p=0.039$) was observed in hyperthyroid condition (Fig 5) by using Spearman correlation analysis. Whereas, there was no correlation found in FT4 and TSH with biochemical parameters.

After the I¹³¹ treatment of radioiodine significant correlation of TFTs with ALB and LDL was observed as shown in Fig 6. In this scenario significant negative association of FT3 with ALB ($r=-0.62$, $p=0.04$) and LDL ($r=-0.820$, $p=0.00$) was observed. FT4 also showed negative association with ALB ($r=-0.621$, $p=0.041$) and LDL ($r=-0.71$, $p=0.00$). Meanwhile TSH showed positive correlation with ALB ($r=0.610$, $p=0.016$) and highly strong positive correlation with LDL ($r=0.707$, $p=0.003$) by using spearman correlation analysis after I131 therapy (Table 3).

Discussion:

Radioiodine radiations had a great effect on hepatocellular enzymes and growth factors and also cause the mutations in DNA or RNA at the molecular level [32]. Our results proves that FT3 negatively correlates with LDL in a hyperthyroid state, similar with *Ferdos A. Alterihy, et al. (2012)* [34] study which showed that the level of low-density lipoprotein (LDL) decreased in hyperthyroid patients than those of control group. Another study proved that hyperthyroidism causes a reduction in serum cholesterol concentrations. Hyperthyroidism is inversely related to low-density lipoprotein as FT3 or FT4 level increases LDL level decreases due to increased hepatic uptake because of greater affinity for the LDL receptor and regulatory triglycerides protein [35]. Excess amount of T3 causes hepatic dysfunction by inducing apoptosis via activation of a mitochondrial-dependent pathway [14], another study also indicates that the serum-free T3:T4 ratio negatively correlates with the severity of the liver disease and has prognostic value [33].

After I¹³¹ therapy significant increase in TSH level and decrease in FT3 and FT4 level were observed in patients, converting the status of disease from hyperthyroidism to hypothyroidism or euthyroidism as *Shakhreet, B., et al. (2015)* proved in his study [36]. A similar study also proved that strongly significant changes were observed for TFT's (FT3=0.012, T4 =0.017, and TSH=0.001) during the follow-up treatment (before and after taking iodine I131)[37]. Current results showed that ALP level significantly decreases after taking I131 therapy. Similar to *Alavi, et al. [38]* but their results are not significant. Our results confirmed that ALP level decreases and ALT level increases after taking iodine I131 therapy as *Papachristos et al.* proved in his study [39]. The prognosis of hepatic dysfunction is closely correlated with the consequences of hyperthyroid Graves' disease after iodine I131 therapy [40]. Our results suggest that ALT and AST levels continuously increases during the follow up treatment. Conversely, *Alavi, et al.*[38] mentioned that ALT and AST levels decrease after radioiodine therapy in hyperthyroidism. However, they evaluated the results after 72hrs of iodine I131 intake whereas we have evaluated the biochemical parameters after 2 months of I131 therapy. Previous studies showed that hepatic enzymes or liver function parameters altered after I131 therapy which demonstrated that RAI therapy affects the liver functions as *Renfei Wang, et al. (2017)* also proved that hepatic dysfunctions closely associated with outcomes of iodine I131 treatment in patients with thyrotoxicosis [40].

An interesting observation was a continuous increase in albumin level after Iodine-131 oral administration. After taking I131 therapy elevation in albumin level may lead to kidney problem as

Rubaida mehmood et al. (2019) mentioned that the increased in creatinine and chloride after administration of I131 therapy of patients leading to kidney problems[37]. However they evaluate the results of serum electrolytes and creatinine before and after iodine I131 administration. Our study also confirmed that FT3 and FT4 negatively correlate with albumin after I131 treatment. As previous study proved that FT3 positively correlates with Albumin in untreated hyperthyroid patients[41]. Another study also shown that albuminuria positively correlates with FT4 in chronic kidney disease[42] as well as our study also showed that FT4 positively associated with Albumin but this association becomes negative after iodine 131 therapy, however, the previous studies are not available that confirmed the direct effect of I131 therapy on Albumin level.

This study confirmed that low-density lipoprotein (LDL) levels increase after the treatment of iodine I131, as *F. Azizi, et al.*[43] proved that LDL-cholesterol concentrations were increases in radioiodine I131 treated patients as compared to anti-thyroid drugs treated patients. A study also has been reported that total cholesterol and LDL levels constantly decreases in hyperthyroidism state and increased in hypothyroidism condition [25]. Another remarkable observation was a negative association of FT3 with LDL after Iodine I131 treatment, as *Muls, et al. (1982)*[44] proved that lipoproteins (HDL & HDL) level significantly increased with the decrease of FT3 and FT4 and increased in TSH level after treatment as compared to untreated hyperthyroid patients. *F. Costantini et al. (1998)* also indicates that decreased level of thyroid hormones not only increases the quantity of low-density lipid particles, but also stimulates LDL oxidability[45]. The lipid metabolism dysfunction may results in the development of atherosclerotic coronary artery diseases(CAD) in patients associated with overt hypothyroidism [46][47]. In addition hypothyroidism may also affect cardiovascular (CVD) risk factors as well as increasing the risk of coronary artery diseases. However our finding suggests that radioiodine 131 may adversely affect the lipid metabolism and contributing to increasing the risk of cardiovascular and coronary artery diseases.

This study also evidences that TSH positively associates with albumin and low-density lipoprotein in I¹³¹ treated patients. This study shows that LDL level increases with the increase of TSH level similar with previous studies which showed that a steady increase in total cholesterol, low-density lipoprotein (LDL) and triglycerides and a gradual decrease in high-density lipoprotein cholesterol (HDL-C) level have been observed with elevating TSH level[48, 49]. Thyroid function abnormalities have a great

influence on lipids as well as various cardiovascular risk factors. The increase in low-density lipoprotein (LDL) in serum after administration of Iodine131 therapy is an alarming situation for coronary artery diseases or heart disorders. However, future studies are needed to determine the potential adverse effects of Iodine131 therapy on lipid metabolism and serum albumin level. This study has limitation due to smaller number of sample size and this study also not evaluate the molecular basis of disease prognosis.

Conclusion

This study suggested that the association of thyroid functions with liver function parameters LDH and LDL level in patients recommended for iodine therapy gives a new idea of diagnostic and therapeutic tool. This study indicates that radioiodine 131 may have adverse effect on hepatocellular enzymes and had a great impact on lipid metabolism. The increase in liver enzymes and LDL levels after administration of I131 therapy is an alarming situation for liver and heart disorders. As well as increase in albumin level may cause kidney problems. However, future studies are needed to confirm our results.

Abbreviations:

TFTs: Thyroid function tests; FT3:Free triiodothyronine; FT4: Free thyroxine; TSH: Thyroid stimulating hormone; LFTs: Liver function tests; LDL: Low density lipoprotein; LDH: Lactate dehydrogenase enzyme; ALT: Alanine aminotransferase;ALB: Albumin; AST: Aspartate transaminase; ALP:Alkaline phosphate, TiB: Total Bilirubin; BMI:Body mass index.

Declarations

ACKNOWLEDGEMENTS:

The authors acknowledge with thanks to MINAR Cancer Hospital (Multan, Pakistan) in order to conduct study in the hospital and provide instrumental assistance for performing Biochemical tests.

AUTHOR'S CONTRIBUTION:

SR performed the Biochemical tests, analyze and interpret the data and written the manuscript. SH performed the statistical analysis of the data. RM did the supervision of the research. AI contributed in

writing manuscript. I also acknowledged that all authors have contributed significantly, and agreed with the content of the manuscript.

FUNDING:

None

AVAILABILITY OF DATA AND MATERIALS:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE:

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional ethics committee of MINAR Cancer Hospital Multan, Pakistan (Pakistan Atomic Energy Commission, Ref.No.M-3(13)/2018). Informed consent was obtained from all individual participants included in the study.

CONSENT FOR PUBLICATION:

An informed consent was obtained from the participants involved in the study.

COMPETING INTEREST:

Authors declare no conflict of interest, financial or otherwise.

HUMAN AND ANIMAL RIGHTS:

The reported experiments involving human participants were performed in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

SIGNIFICANCE OF WORK:

This study had significant impact on drug safety which helps the physicians in follow-up treatment. The association of thyroid function tests (TFTs) with liver function tests (LFTs), LDH and LDL before and after radioiodine I131 therapy in hyperthyroid patients help the physicians to overcome the post treatment effects by taking precautionary measurements to prevent heart and liver functions abnormalities

AUTHORS CONTRIBUTION:

SR performed the Biochemical tests, analyze and interpret the data and written the manuscript. SH performed the statistical analysis of the data. RM did the supervision of the research. AI contributed in writing manuscript. I also acknowledged that all authors have contributed significantly, and agreed with the content of the manuscript.

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Figures

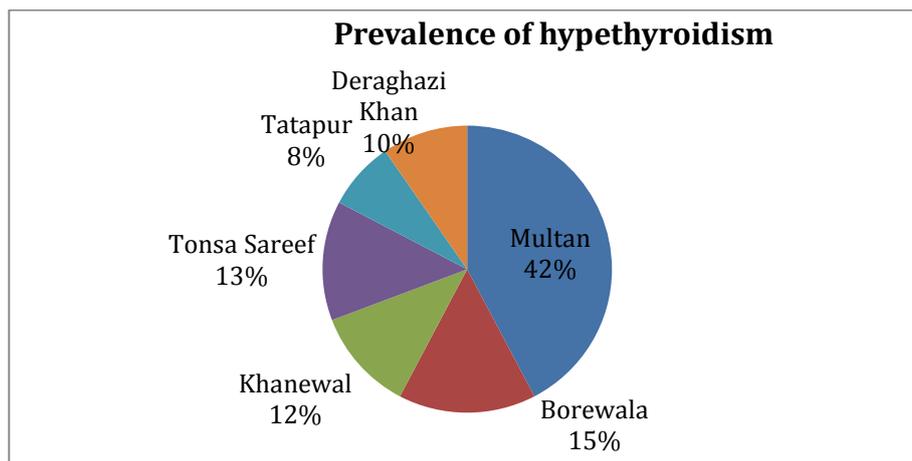


Figure 1: Prevalence of hyperthyroidism in southern Punjab, Pakistan

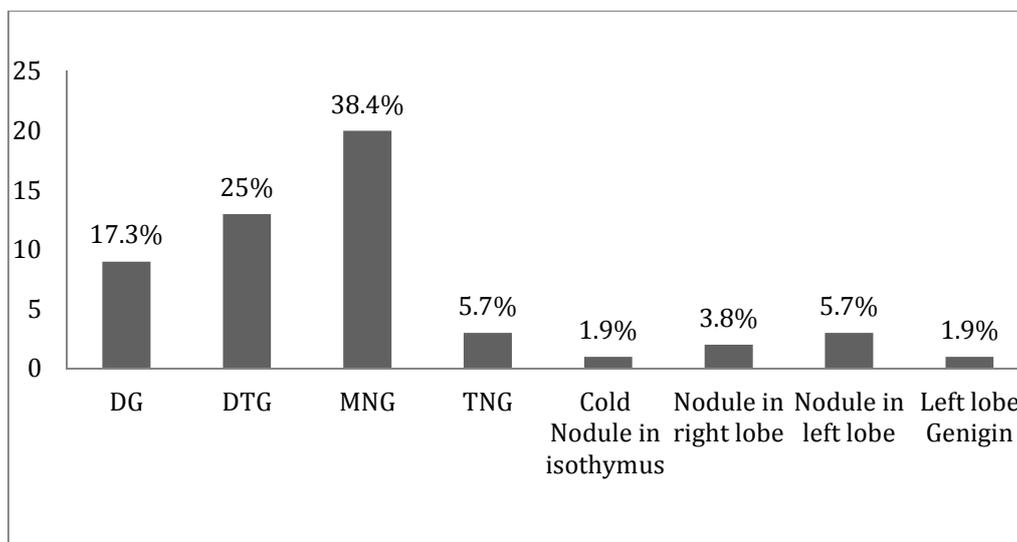


Figure 2: Distribution of different types of goiters on the basis of thyroid scan

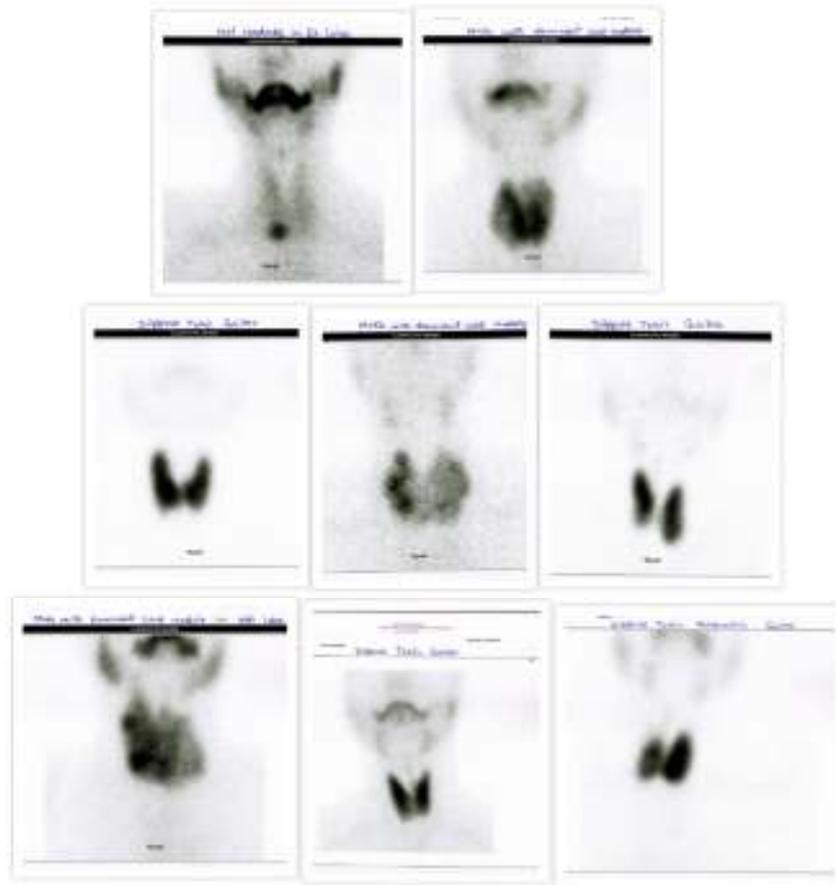


Figure 3: Goiter diagnosed by Tc-99m pertechnetate scans

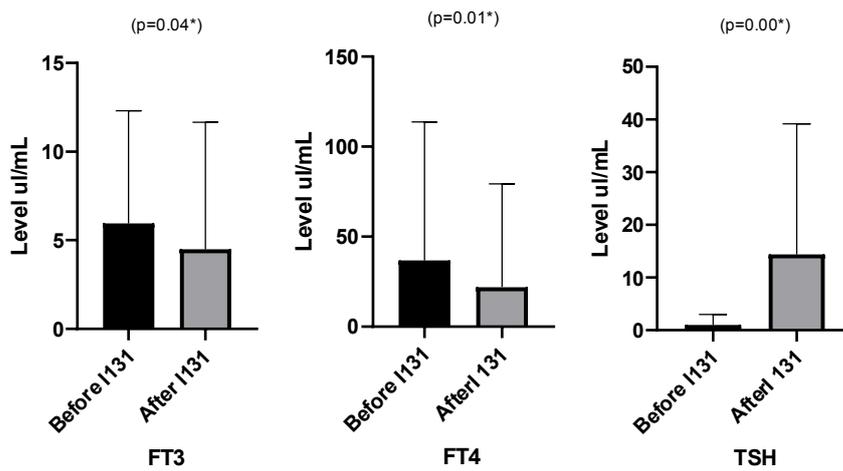


Figure 4: Comprehensive results of free TFTs before and after I131

Correlation graphs before I131

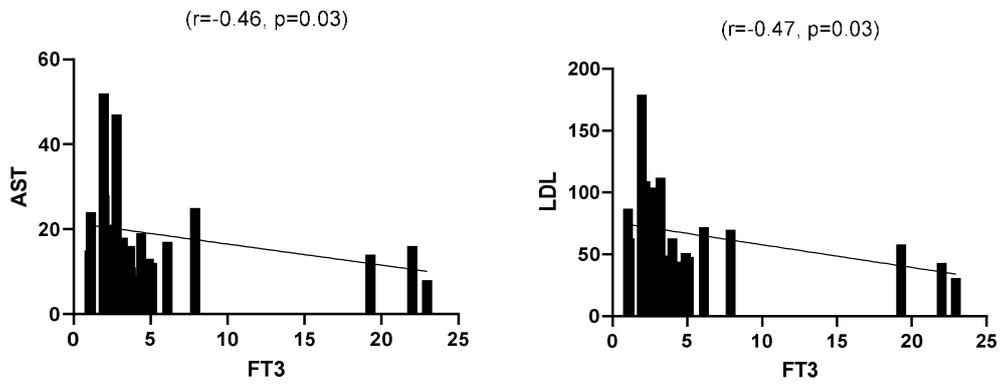


Figure 5: Correlation of FT3 with AST and LDL before I131 therapy

Correlation graphs after I131

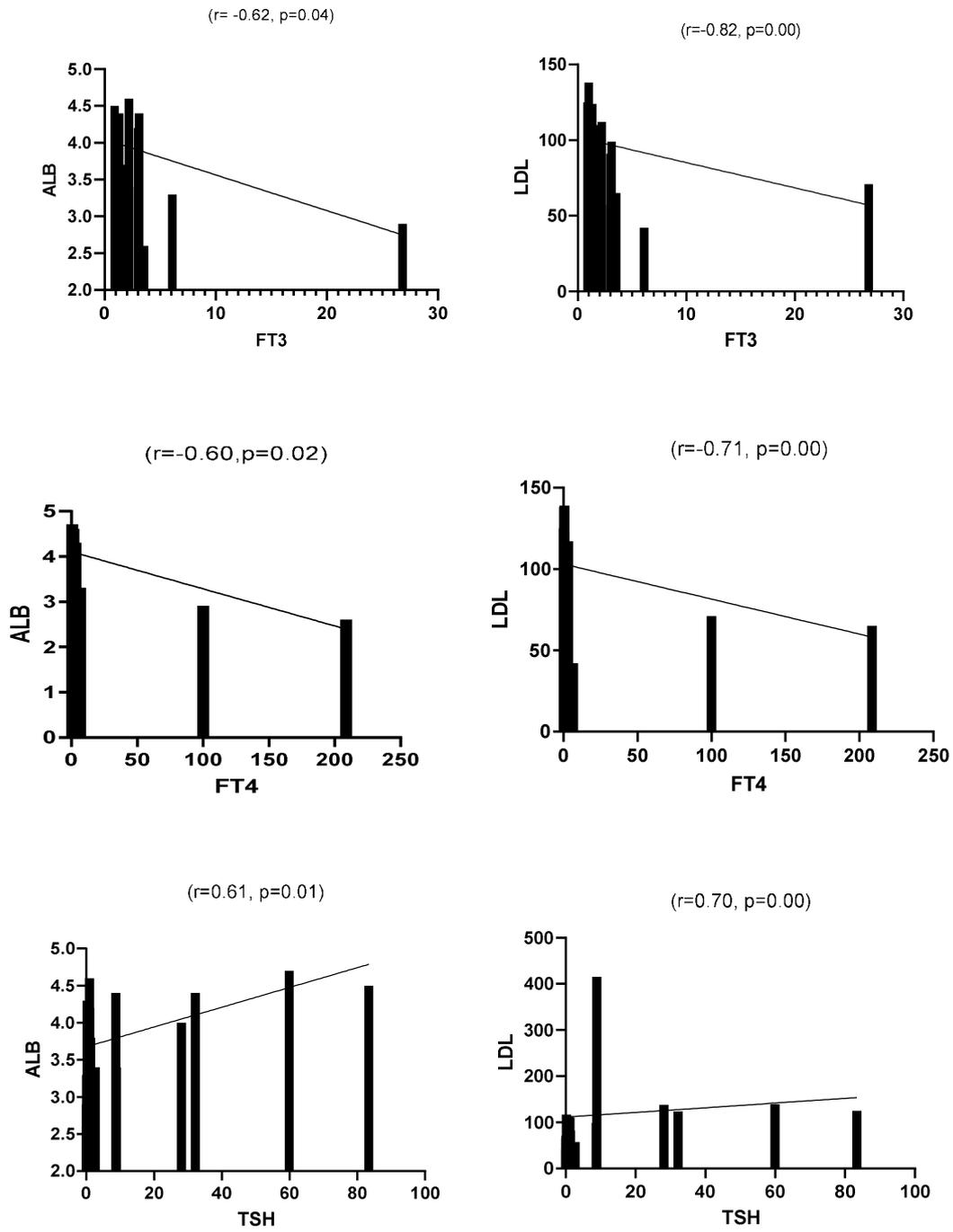


Figure 6: Correlation of TFTs with ALB and LDL after I131

Tables

Table 1: Demographic Data of patients

Total Number of Patients (n = 52)	
Female	42 (80%)
Male	10 (20%)
Age	12 – 65 years
Goitre duration	02months---15years
BMI (Mean±SD)	11.5±3.7
Dose(Mean±SD)	5mci--29mci
Smokers	17(32.6%)
Diffused Goitre	9(17.3%)
Diffused Toxic Goitre	13(25%)
Multinodular Goitre	20(38.4%)
Toxic Nodular Goitre	3(5.7%)
Cold Nodule in right lobe isothymus	1(1.9%)
Nodule in right lobe	2(3.8%)
Nodule in left lobe	3(5.7%)
Left lobe Genigin thyroid tissue	1(1.9%)

Table 2: Comprehensive Results of TFT'S, LFTs, LDH & LDL

Parameters	1 st Time mean±std	2 nd Time mean±std	3 rd Time mean±std	P-Value Summery (1 st Vs 2 nd Time)	P-Value Summery (2 nd Vs 3 rd Time)	P-Value Summery (1 st Vs 3 rd Time)
FT3	5.9 ±6.3 ^b	-	4.4 ±7.1 ^b	-	-	0.04*
FT4	36.8 ±76.6 ^b	-	21.8 ± 57.5 ^b	-	-	0.01*
TSH	1.0 ± 2.0 ^b	-	14.4 ± 24.7 ^b	-	-	0.00*
ALB	2.6 ± 0.9 ^a	3.9 ± 0.8 ^b	3.8 ± 0.6 ^a	0.00*	0.88	0.00*
ALP	81.6 ±60.4 ^a	148.5 ± 96.0 ^a	44.4 ± 48.6 ^b	0.00*	0.00*	0.00*
ALT	12.9 ± 7.4 ^a	23.2 ±16.9 ^b	42.0±82.5 ^b	0.00*	0.57	0.00*
AST	18.4 ±11.1 ^b	29.4±13.4 ^b	42.9 ± 42.4 ^a	0.00*	0.20	0.00*
Bilirubin.T	0.2 ± 0.3 ^b	3.11 ±11.9 ^b	0.2 ± 0.1 ^b	0.00*	0.00	0.38
LDH	324.3±402.0 ^b	318.7±107.1 ^a	568.9 ± 482.8 ^a	0.02*	0.03*	0.91
LDL	59.8 ± 33.7 ^a	95.7 ±38.9 ^a	119.1 ± 87.1 ^a	0.00*	0.31	0.00*

^anormal distribution, ^bnon-normaldistribution *P-value represents significance from unpaired non-parametric test sum statistical analysis) Significance level: <0.05

Table 3: Correlation of TFTs with Biochemical parameters (before & after I131 therapy)

Parameters	ALB r-value (p-value)	ALP r-value (p-value)	ALT r-value (p-value)	AST r-value (p-value)	Bilirubin.T r-value (p-value)	LDH r-value (p-value)	LDL r-value (p-value)
FT3	-0.18 (0.42)	0.21 (0.32)	-0.32 (0.14)	-0.52 *(0.03)	0.25 (0.26)	-0.13 (0.56)	-0.47 *(0.03)
FT4	0.07 (0.70)	0.04 (0.80)	-0.03 (0.85)	0.03 (0.84)	0.02 (0.91)	-0.06 (0.74)	0.09 (0.63)
TSH	0.08 (0.64)	-0.23 (0.20)	0.24 (0.19)	0.31 (0.09)	-0.21 (0.25)	0.05 (0.77)	0.12 (0.52)
After I131 therapy (3rd time)							
FT3	-0.62 *(0.04)	0.08 (0.80)	0.00 (1.00)	0.07 (0.83)	0.45 (0.19)	0.05 (0.87)	-0.82 ** (0.00))
FT4	-0.609 *(0.02)	0.11 (0.69)	-0.05 (0.85)	-0.15 (0.60)	0.26 (0.38)	-0.05 (0.86)	-0.71 ** (0.00))
TSH	0.610 *(0.01)	0.01 (0.95)	0.05 (0.84)	0.16 (0.55)	-0.20 (0.47)	-0.03 (0.88)	0.70 ** (0.00))

Basic Guidelines of Bacteriophages Isolation and Characterization

Safia Samir

Abstract— The world is on the border of a post-antibiotic period. A century ago, bacteriophage therapy was the choice for treating bacterial infections before the advent of antibiotics. Even though bacteriophages continue to lack drug approval in Western medicine, researchers and medical doctors started to look forward of phage therapy. Bacteriophages are viruses that depend on bacterial cells' metabolism to multiply. It is a promising alternative to the use of antibiotics, and an excellent antibacterial option for combating multidrug resistance in bacteria. Moreover, not every phage is suitable for phage therapy. In particular, prophages should not be used because they can lysogenize host cells instead of lysing them. To offer adequate therapeutic options for many patients suffering from various infectious diseases, a wide selection of different phages is needed. While there is no evidence of direct toxicity induced by phage particles, it is crucial to study mammalian cell–phage interaction. This requires phage preparations to be free of bacterial cells, toxins and other compounds to avoid skewing host responses. Negative staining of purified viruses and electron microscopy remains the gold standard in the identification of bacteriophages. Interestingly, genomics has greatly changed our understanding of phage biology. Bacteriophages genome sequencing is essential to obtain a more complete understanding of their biology, and to obtain confirmation of their lifestyle. Bacteriophage full genetic material sequencing enables better understanding phage encoded proteins and biomolecules (especially phage lytic enzymes) involved in the process of bacterial cell lysis and death. Mass spectrometry is used for identification of phage structural proteins. The use of lytic phages as biocontrol agents signifies the need of most appropriate and standard methods to insure application safety.

Keywords— Bacteriophage isolation , electron microscopy, genome sequencing, mass spectrometry.

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Bacteriophage Therapy is an Emerging Novel Solution of Antimicrobial Resistance

Sanjay Shukla, A. Nayak, R.K. Sharma, A.P. Singh, R.V. Singh, K. Jadav, S.P. Tiwari

Abstract— Excessive use of antibiotics is a major problem in the treatment of wounds and other chronic infections and antibiotic treatment is frequently non-curative, thus alternative treatment is necessary. Phage therapy is considered one of the most promising approaches to treat multi-drug resistant bacterial pathogens. Infections caused by *Staphylococcus aureus* are very efficiently controlled with phage cocktails, containing a different individual phages lysate infecting a majority of known pathogenic *S. aureus* strains. The aim of present study was to evaluate the efficacy of a purified phage cocktail for prophylactic as well as therapeutic application in mouse model and in large animals with chronic septic infection of wounds. A total of 150 sewage samples were collected from various livestock farms. These samples were subjected for the isolation of bacteriophage by double agar layer method. A total of 27 sewage samples showed plaque formation by producing lytic activity against *S. aureus* in double agar overlay method out of 150 sewage samples. In TEM recovered isolates of bacteriophages showed hexagonal structure with tail fiber. In the bacteriophage (ØVS) had an icosahedral symmetry with the head size 52.20 nm in diameter and long tail of 109 nm. Head and tail were held together by connector and can be classified as a member of the Myoviridae family under the order of Caudovirales. Recovered bacteriophage had shown the antibacterial activity against the *S. aureus* in vitro. Cocktail (ØVS1, ØVS5, ØVS9 and ØVS 27) of phage lysate were tested to know in vivo antibacterial activity as well as the safety profile. Result of mice experiment indicated that the bacteriophage lysate were very safe, did not show any appearance of abscess formation which indicates its safety in living system. The mice were also prophylactically protected against *S. aureus* when administered with cocktail of bacteriophage lysate just before the administration of *S. aureus* which indicates that they are good prophylactic agent. The *S. aureus* inoculated mice were completely recovered by bacteriophage administration with 100% recovery which was very good as compare to conventional therapy. In present study ten chronic cases of wound were treated with phage lysate and follow up of these cases was done regularly up to ten days (at 0, 5 and 10 d). Result indicated that the six cases out of ten showed complete recovery of wounds within 10 d. The efficacy of bacteriophage therapy was found to be 60% which was very good as compared to the conventional antibiotic therapy in chronic septic wounds infections. Thus, the application of lytic phage in single dose proved to be innovative and effective therapy for treatment of septic chronic wounds.

Keywords— phage therapy, *S. aureus*, antimicrobial resistance, lytic phage, bacteriophage.