RAMJAS COLLEGE, UNIVERSITY OF DELHI, INDIA

UNDER THE AEGIS OF IQAC

IN COLLABORATION WITH

ANWWI
EDUCATION FOR INNOVATIONS

ACADEMY OF NANOTECHNOLOGY AND WASTE WATER INNOVATIONS (ANWWI), JOHANNESBURG, SOUTH AFRICA

ORGANIZES AN ONLINE LECTURE ON

"Integrated Approach for Management of Cancer Hospital Aqueous Waste"

BY

Prof. Kashyap Kumar Dubey,
Dean, School of Biotechnology
JNU, New Delhi

ON GOOGLE MEET AT 4:00 PM ON JUNE 28, 2023

PATRONS

PROF MANOJ KHANNA, PRINCIPAL, RAMJAS COLLEGE
PROF HARDEEP KAUR, VICE – PRINCIPAL, RAMJAS COLLEGE
PROF SHIVANI BHARDWAJ MISHRA , DIRECTOR, ANWWI

PROF HAMENT RAJOUR, IQAC COORDINATOR, RAMJAS COLLEGE

DR AVNISH KR SISODIYA
COORINATOR, RAMJAS COLLEGE

PROF AJAY KR MISHRA
COORDINATOR, DURBAN UNIVERSITY OF TECHNOLOGY, SOUTH AFRICA

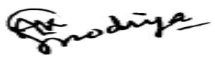
The lecture on ***"Integrated Approach for Management of Cancer Hospital Aqueous Waste"*** has been organized by Ramjas College, University of Delhi in collaboration with Academy of Nanotechnology and Waste Water Innovations, Johannesburg, South Africa.

The first lecture of this collaboration was delivered by Prof Kashyap Kumar Dubey, Dean, School of Biotechnology, Jawahar Lal Nehru University. The lecture witnessed the gracious presence of Prof Hardeep Kaur Ma'am, Vice – Principal, Ramjas College, Prof Hament Kumar Rajor, IQAC coordinator, Ramjas College and Prof Shivani Mishra, Director Academy of Nanotechnology and Waste Water Innovations, Johannesburg, South Africa.

In this lecture, the process of development and removal of antineoplastic compounds from aqueous waste was discussed. The development of low cost decentralised technology for onsite treatment of hospital aqueous water has also been the part of the discussion. The speaker mentioned about the consumption pattern of water by various pharmaceuticals around the world and various steps for analysis of waste water coming from different sources. He also talked about various regulations for segregation of biomedical waste. The negative impact of waste water coming from various sources on different water bodies was emphasised. Different challenges for the society to manage the waste water were discussed. The speaker discussed about various tools and techniques used in disposing off the aqueous waste coming from cancer hospitals.

Outcome: Nowadays specifically after covid the area of management of aqueous waste from hospitals has become of utmost importance. This lecture has been quite successful in imparting the knowledge to the participants about various skills and techniques for management the aqueous waste from hospitals

Skill enhanced: Different tools and techniques used in managing the aqueous waste from hospitals were learnt by the participants.



Dr Avnish Kumar Sisodiya
Coordinator,
Dept of Physics, Ramjas College

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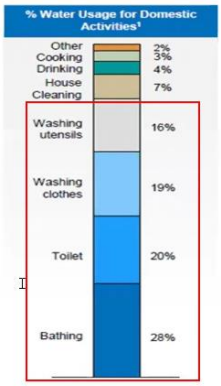
Dr. Kashyap Kumar Dubey is presenting

Water usage for domestic activities



Dr. Kashyap Kumar D...
103- aditya nath dwi...
Yachana Prajapati
Prof Shivani Bhardw...
Hament Kumar Rajor
Dr Abha Kathuria
27 others
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Dr. Kashyap Kumar Dubey is presenting

Consumption of water during COVID

Description	Before COVID - 19	After COVID - !9
Bathing & Hand wash	25	40
Toilet Flushing	20	20
Laundry Washing	20	30
Utensils Washing	5	5
Total	**70**	**95**

- Average per capita water consumption increase by 35%

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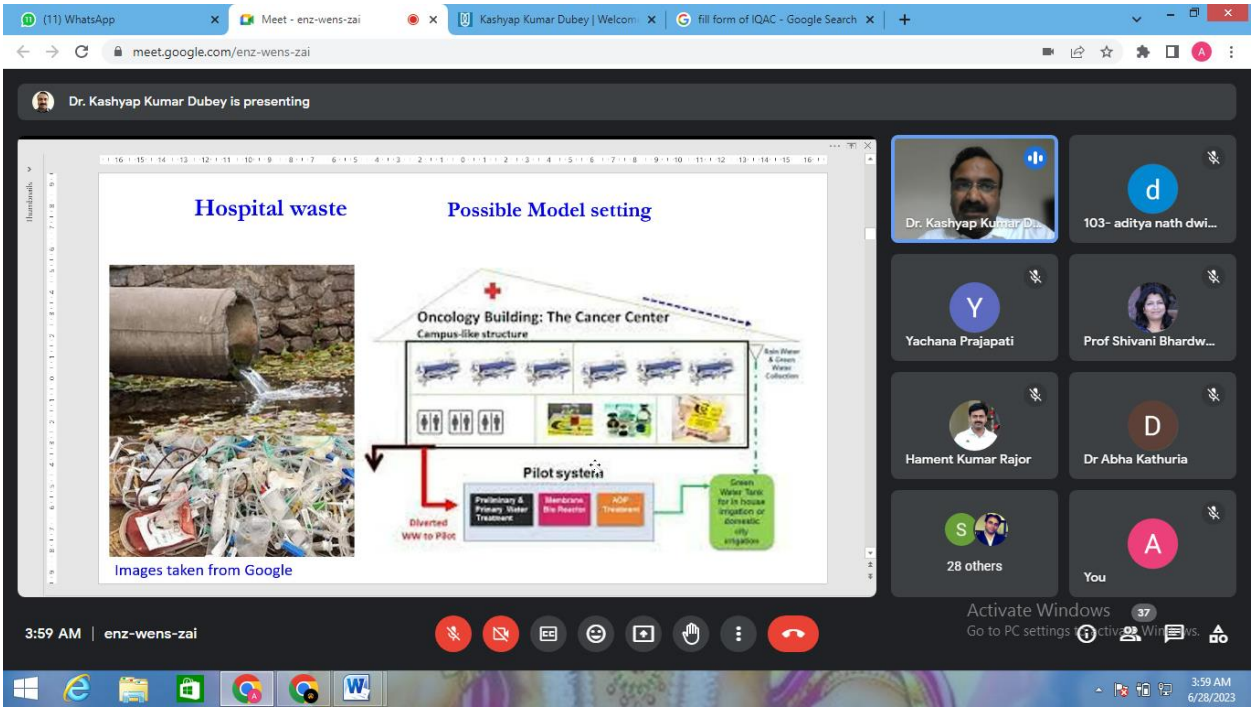
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Dr. Kashyap Kumar Dubey is presenting
Hospital waste
Possible Model setting
Oncology Building: The Cancer Center
Campus-like structure
Pilot system
Diverted WW to Pilot
Images taken from Google
Dr. Kashyap Kumar Du...
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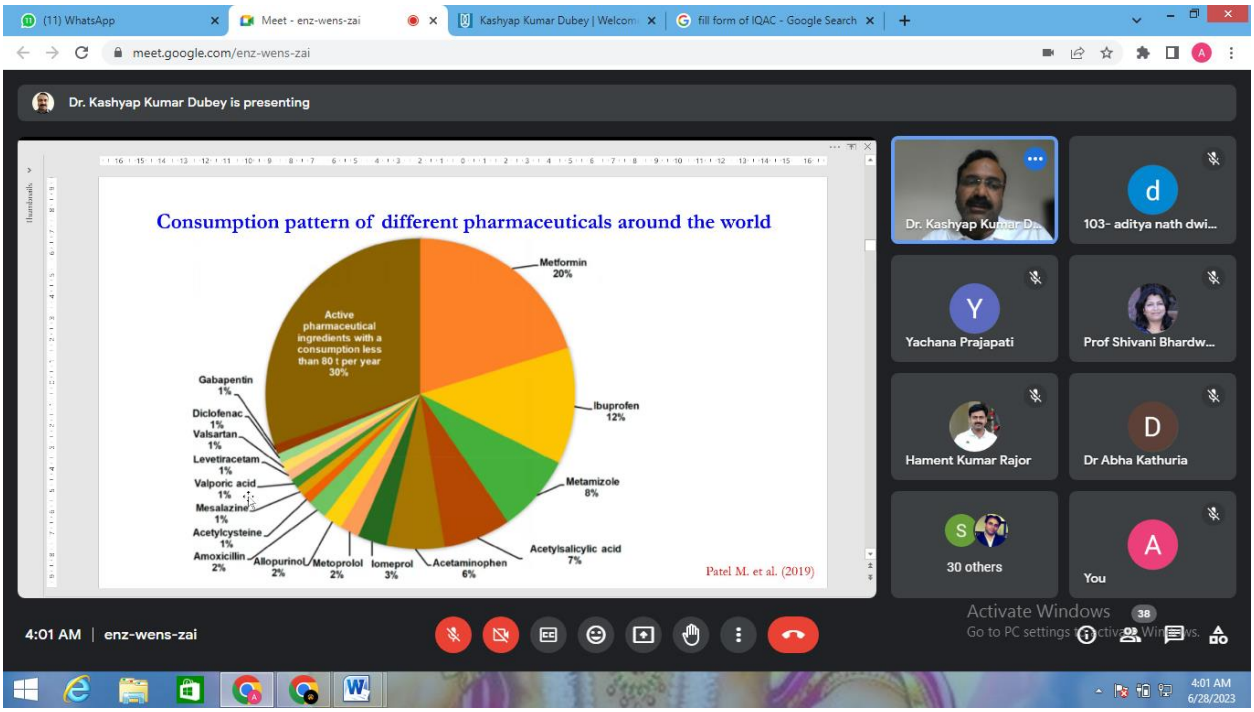
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Consumption pattern of different pharmaceuticals around the world
Active pharmaceutical ingredients with a consumption less than 80 t per year 30%
Metformin 20%
Ibuprofen 12%
Metamizole 8%
Acetylsalicylic acid 7%
Acetaminophen 6%
Iomeprol 3%
Metoprolol 2%
Allopurinol 2%
Amoxicillin 2%
Acetylcysteine 1%
Mesalazine 1%
Valporic acid 1%
Levetiracetam 1%
Valsartan 1%
Diclofenac 1%
Gabapentin 1%
Patel M. et al. (2019)
Dr. Kashyap Kumar Du...
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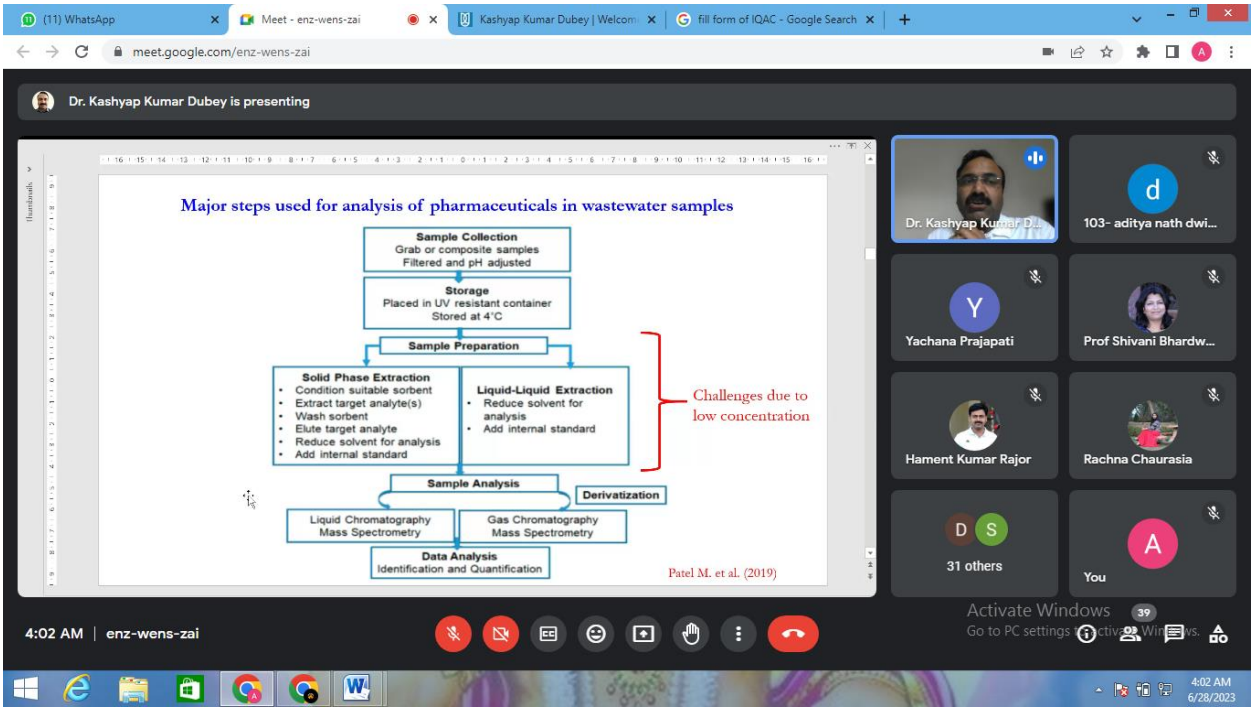
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Dr. Kashyap Kumar Dubey is presenting
Major steps used for analysis of pharmaceuticals in wastewater samples
Sample Collection
Grab or composite samples
Filtered and pH adjusted
Storage
Placed in UV resistant container
Stored at 4°C
Sample Preparation
Solid Phase Extraction
Condition suitable sorbent
Extract target analyte(s)
Wash sorbent
Elute target analyte
Reduce solvent for analysis
Add internal standard
Liquid-Liquid Extraction
Reduce solvent for analysis
Add internal standard
Challenges due to low concentration
Sample Analysis
Derivatization
Liquid Chromatography Mass Spectrometry
Gas Chromatography Mass Spectrometry
Data Analysis
Identification and Quantification
Patel M. et al. (2019)
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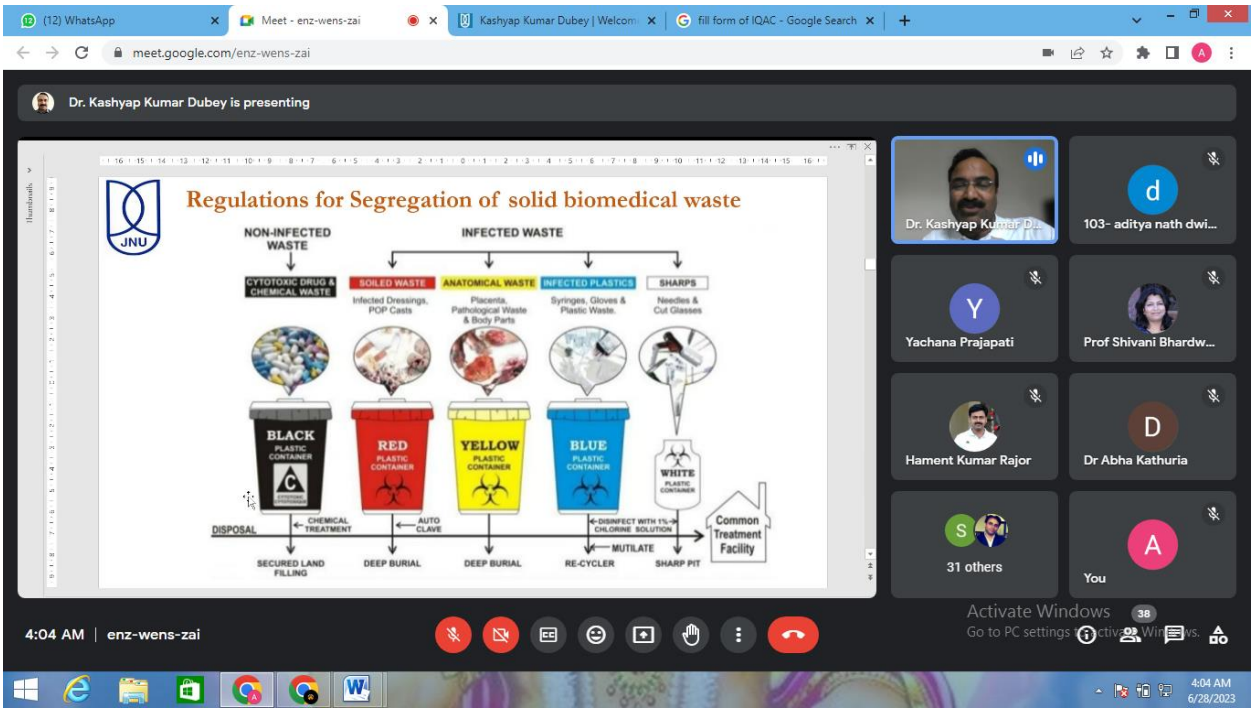
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Dr. Kashyap Kumar Dubey is presenting
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Regulations for Segregation of solid biomedical waste
NON-INFECTED WASTE
INFECTED WASTE
CYTOTOXIC DRUG & CHEMICAL WASTE
SOILED WASTE
Infected Dressings, POP Casts
ANATOMICAL WASTE
Placenta, Pathological Waste & Body Parts
INFECTED PLASTICS
Syringes, Gloves & Plastic Waste.
SHARPS
Needles & Cut Glasses
BLACK PLASTIC CONTAINER
RED PLASTIC CONTAINER
YELLOW PLASTIC CONTAINER
BLUE PLASTIC CONTAINER
WHITE PLASTIC CONTAINER
DISPOSAL
CHEMICAL TREATMENT
AUTO CLAVE
DISINFECT WITH 1% CHLORINE SOLUTION
MUTILATE
Common Treatment Facility
SECURED LAND FILLING
DEEP BURIAL
DEEP BURIAL
RE-CYCLER
SHARP PIT
Dr. Kashyap Kumar D...
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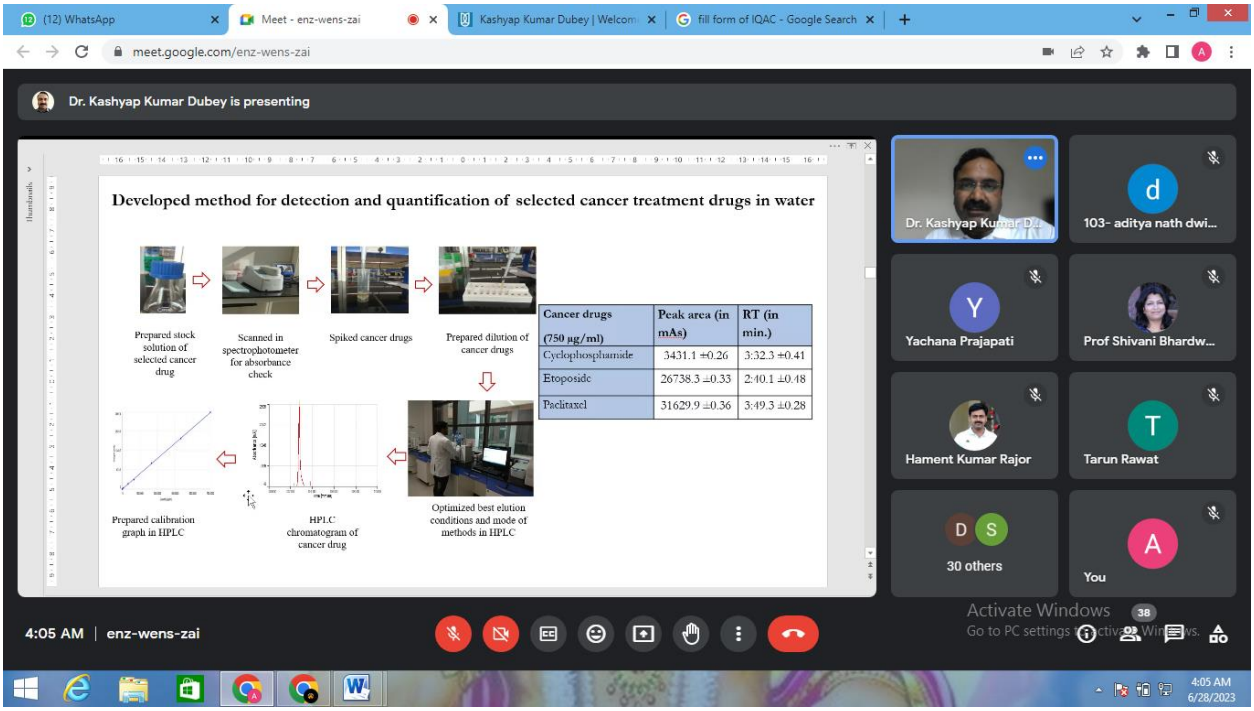
Dr. Kashyap Kumar Dubey is presenting
Developed method for detection and quantification of selected cancer treatment drugs in water
Prepared stock solution of selected cancer drug
Scanned in spectrophotometer for absorbance check
Spiked cancer drugs
Prepared dilution of cancer drugs
Cancer drugs (750 µg/ml)
Peak area (in mAs)
RT (in min.)
Cyclophosphamide
3431.1 ±0.26
3:32.3 ±0.41
Etoposide
26738.3 ±0.33
2:40.1 ±0.48
Paclitaxel
31629.9 ±0.36
3:49.3 ±0.28
Prepared calibration graph in HPLC
HPLC chromatogram of cancer drug
Optimized best elution conditions and mode of methods in HPLC
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Hament Kumar Rajor
Tarun Rawat
30 others
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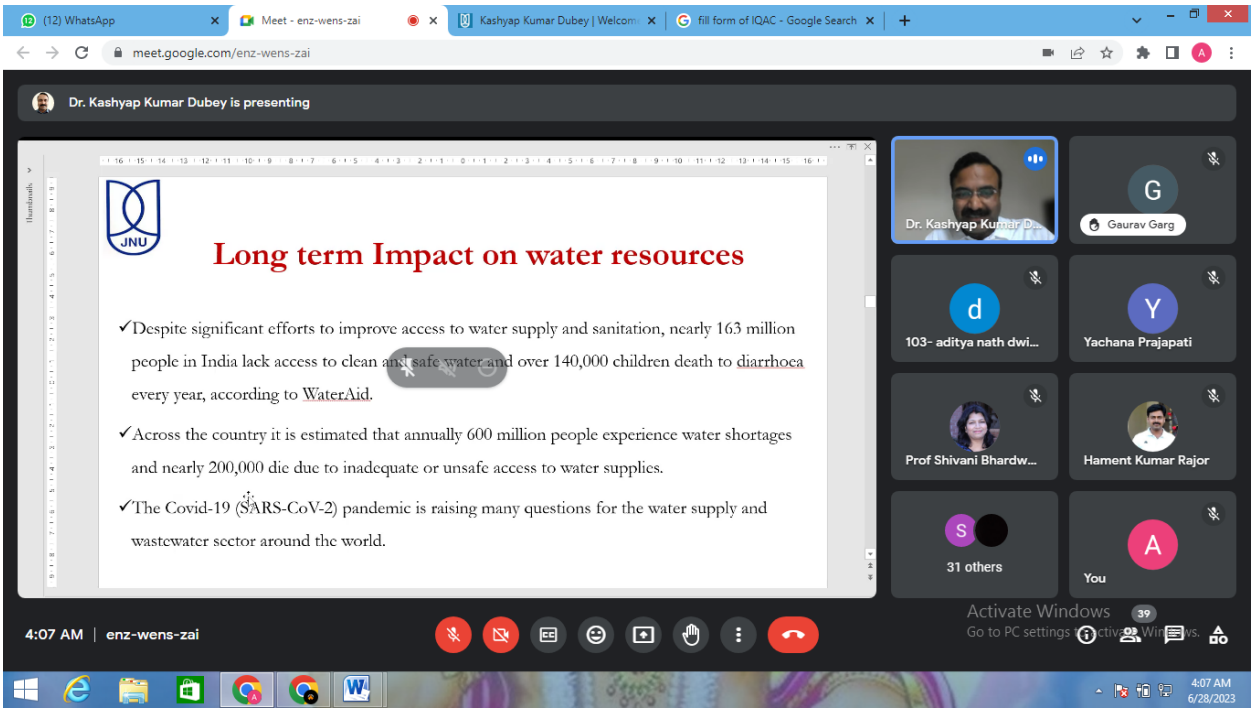
Dr. Kashyap Kumar Dubey is presenting
Long term Impact on water resources
✓Despite significant efforts to improve access to water supply and sanitation, nearly 163 million people in India lack access to clean and safe water and over 140,000 children death to diarrhoea every year, according to WaterAid.
✓Across the country it is estimated that annually 600 million people experience water shortages and nearly 200,000 die due to inadequate or unsafe access to water supplies.
✓The Covid-19 (SARS-CoV-2) pandemic is raising many questions for the water supply and wastewater sector around the world.
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Gaurav Garg
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Yachana Prajapati
Prof Shivani Bhardw...
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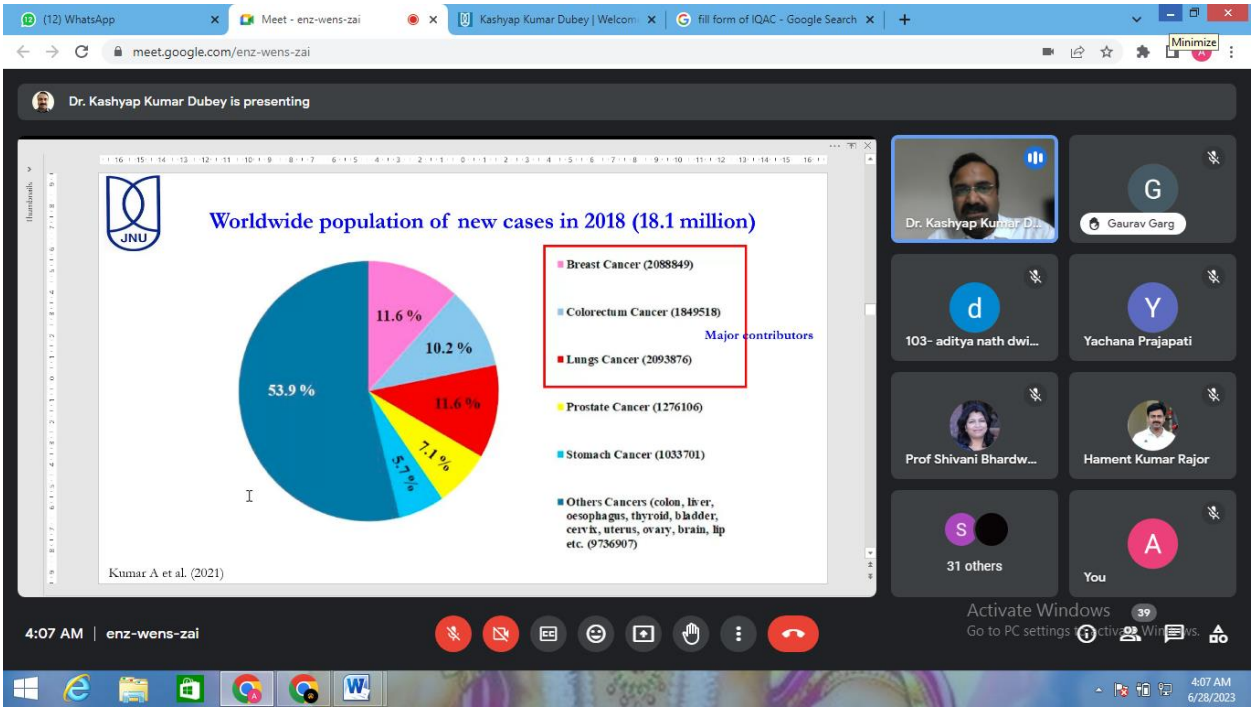
Dr. Kashyap Kumar Dubey is presenting
Worldwide population of new cases in 2018 (18.1 million)
JNU
11.6 %
10.2 %
11.6 %
7.1 %
5.7 %
53.9 %
Breast Cancer (2088849)
Colorectum Cancer (1849518)
Major contributors
Lungs Cancer (2093876)
Prostate Cancer (1276106)
Stomach Cancer (1033701)
Others Cancers (colon, liver, oesophagus, thyroid, bladder, cervix, uterus, ovary, brain, lip etc. (9736907)
Kumar A et al. (2021)
Dr. Kashyap Kumar D...
Gaurav Garg
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Prof Shivani Bhardw...
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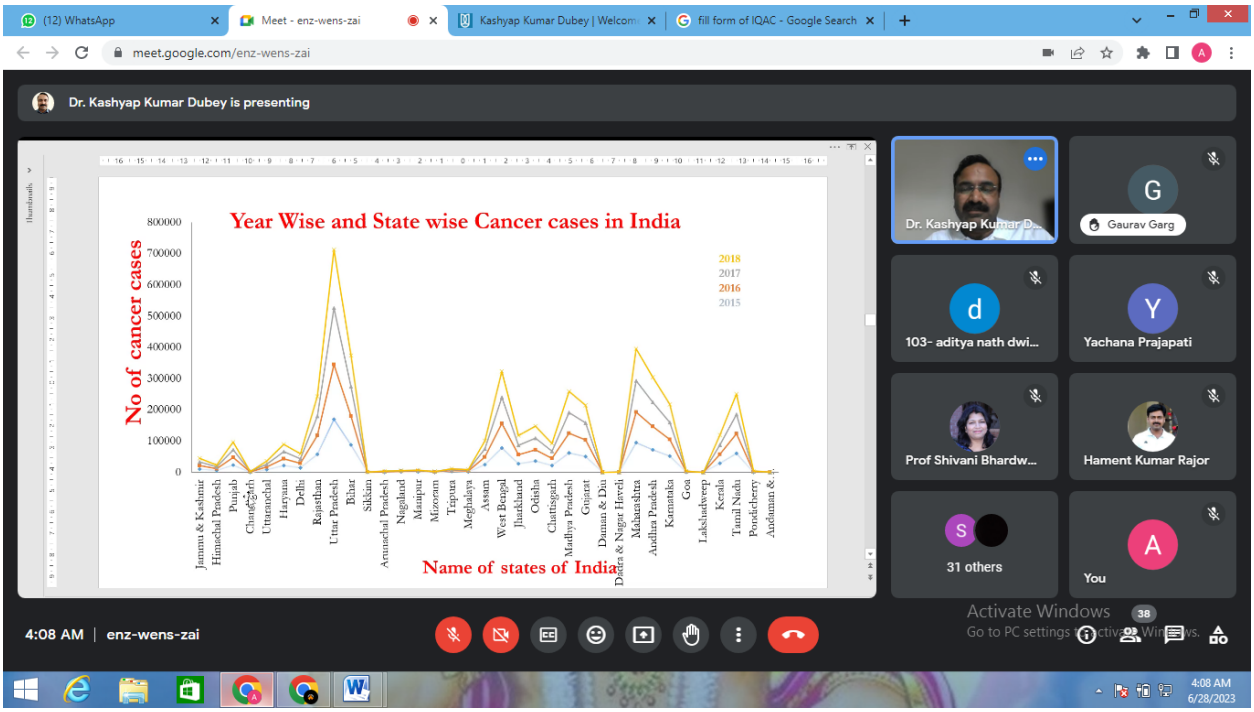
Dr. Kashyap Kumar Dubey is presenting
Year Wise and State wise Cancer cases in India
No of cancer cases
800000
700000
600000
500000
400000
300000
200000
100000
0
2018
2017
2016
2015
Jammu & Kashmir
Himachal Pradesh
Punjab
Chandigarh
Uttaranchal
Haryana
Delhi
Rajasthan
Uttar Pradesh
Bihar
Sikkim
Arunachal Pradesh
Nagaland
Manipur
Mizoram
Tripura
Meghalaya
Assam
West Bengal
Jharkhand
Odisha
Chattisgarh
Madhya Pradesh
Gujarat
Daman & Diu
Dadra & Nagar Haveli
Maharashtra
Andhra Pradesh
Karnataka
Goa
Lakshadweep
Kerala
Tamil Nadu
Pondicherry
Andaman & ...
Name of states of India
Dr. Kashyap Kumar D...
Gaurav Garg
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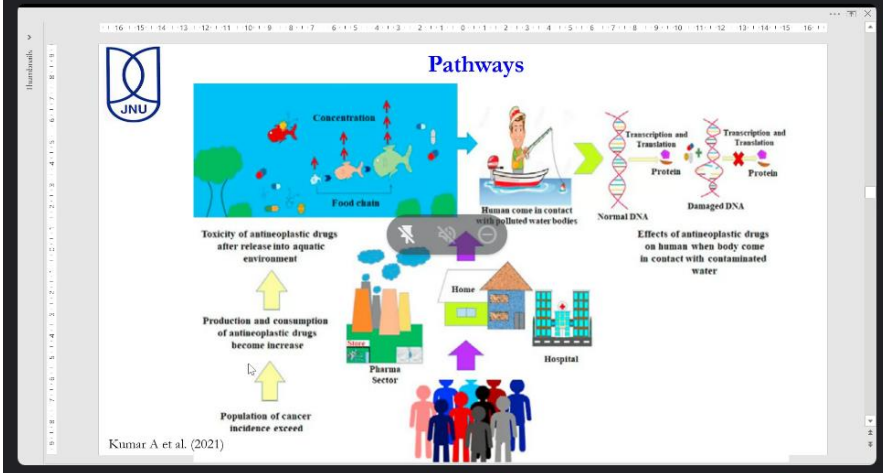
Dr. Kashyap Kumar Dubey is presenting



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Dr. Kashyap Kumar Dubey is presenting

Occurrence Levels of cancer drugs (ng/L) in different country

Cytostatic	Hospital effluent	STP influent	STP effluent	Surface water	Sampling mode	Removal efficiency	Detection method	Country (reference)
CP	19–4486	< 6–143	< 6–17	–	24-h mixture (1 d); hourly (6 am–2 pm)	No	SPE, GC–MS (EI)	Germany (StegerHartmann et al., 1997)
	< 2–21 (8%); < 2 (0%)	< 2	< 2	–	24-h composite	n.a.	SPE, LC-TOF MS (ESI)	Norway (Thomas et al., 2007)
	–	–	< 125	< 100 (Pre-RO)	Duplicate composite	n.a.	SPE, LC–MS/MS (ESI)	Australia (Busetti et al., 2009)
	6–2000 (md. 100, 72%)	–	–	–	Grab samples (7 d)		SPE, UPLC–MS/MS (ESI)	China (Yin et al., 2010)
	–	< 2.1	< 2.3	< 1.7	24-h composite	n.a.	SPE, HPLC–MS/MS (ESI)	Spain (Martin et al., 2011)
	–	–	0.19–0.37	–	Spot samples		SPE, LC–MS/MS (ESI)	UK (Llewellyn et al., 2011)
	0.161 ± 0.026 (71%)	–	–	–	24-h flow/time-proportional	< 20% (pilot-MBR)	SPE, HPLC–MS/MS (ESI)	Switzerland (Kovalova et al., 2012)
	5730	< 3.1–13,100	< 3.1	–	24-h composite	n.a.	SPE, LC-Orbitrap-MS (ESI)	Spain (Gómez-Canela et al., 2012)

Dr. Kashyap Kumar D... | Gaurav Garg | 103- aditya nath dwi... | Yachana Prajapati | Prof Shivani Bhardw... | Hament Kumar Rajor | 31 others | You

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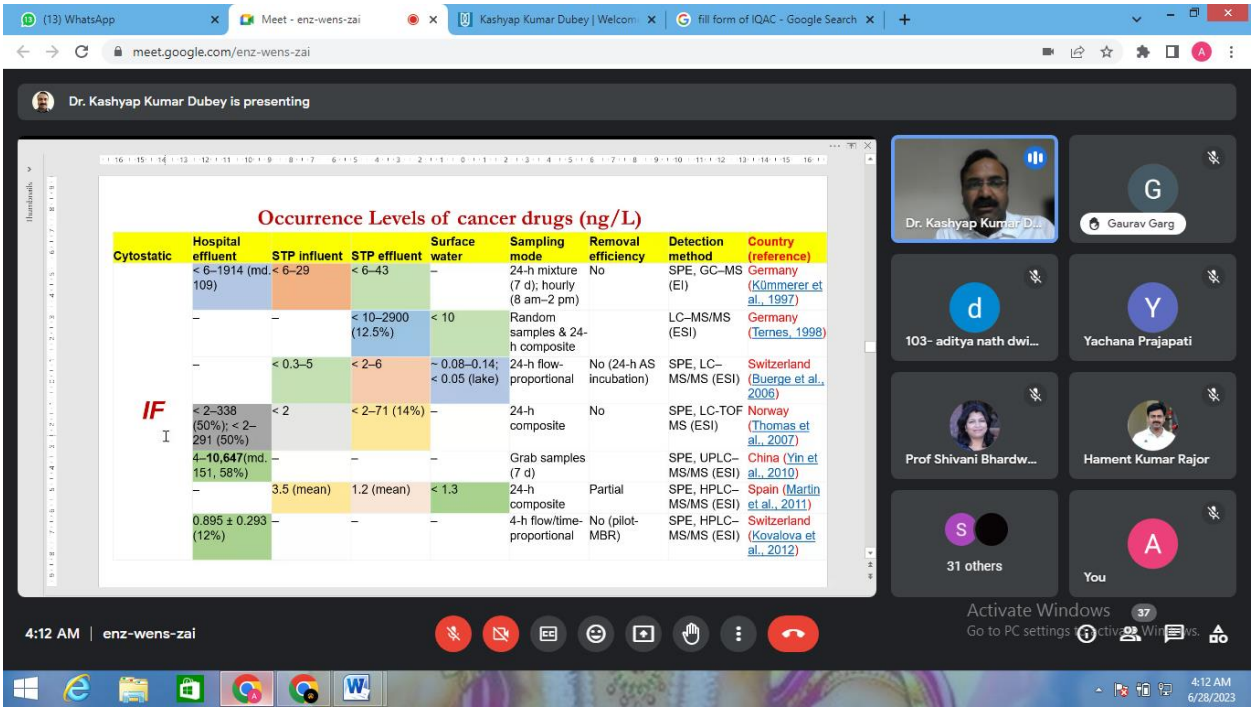
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Occurrence Levels of cancer drugs (ng/L)
Cytostatic | Hospital effluent | STP influent | STP effluent | Surface water | Sampling mode | Removal efficiency | Detection method | Country (reference)
IF
< 6–1914 (md. 109) | < 6–29 | < 6–43 | – | 24-h mixture (7 d); hourly (8 am–2 pm) | No | SPE, GC–MS (EI) | Germany (Kümmerer et al., 1997)
– | – | < 10–2900 (12.5%) | < 10 | Random samples & 24-h composite | | LC–MS/MS (ESI) | Germany (Ternes, 1998)
– | < 0.3–5 | < 2–6 | ~ 0.08–0.14; < 0.05 (lake) | 24-h flow-proportional | No (24-h AS incubation) | SPE, LC–MS/MS (ESI) | Switzerland (Buerge et al., 2006)
< 2–338 (50%); < 2–291 (50%) | < 2 | < 2–71 (14%) | – | 24-h composite | No | SPE, LC-TOF MS (ESI) | Norway (Thomas et al., 2007)
4–10,647(md. 151, 58%) | – | – | – | Grab samples (7 d) | | SPE, UPLC–MS/MS (ESI) | China (Yin et al., 2010)
– | 3.5 (mean) | 1.2 (mean) | < 1.3 | 24-h composite | Partial | SPE, HPLC–MS/MS (ESI) | Spain (Martin et al., 2011)
0.895 ± 0.293 (12%) | – | – | – | 4-h flow/time-proportional | No (pilot-MBR) | SPE, HPLC–MS/MS (ESI) | Switzerland (Kovalova et al., 2012)
Dr. Kashyap Kumar D...
Gaurav Garg
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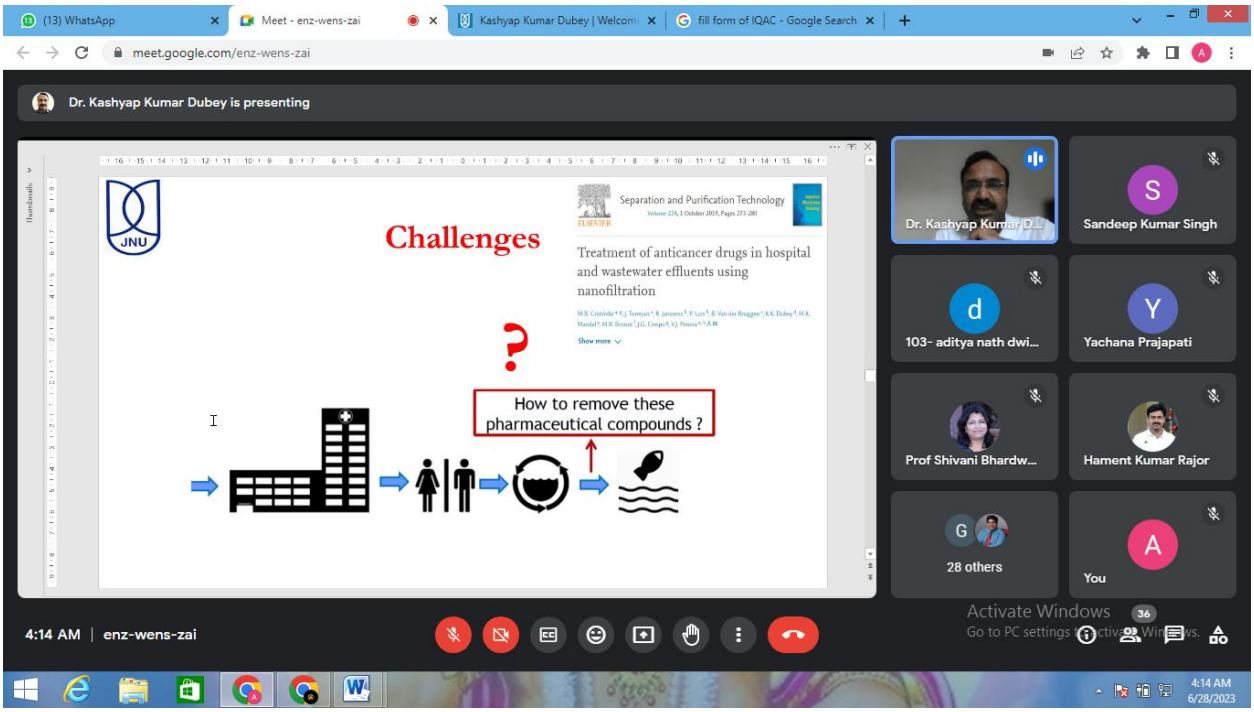
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Challenges
Separation and Purification Technology
Treatment of anticancer drugs in hospital and wastewater effluents using nanofiltration
?
How to remove these pharmaceutical compounds ?
Dr. Kashyap Kumar D...
Sandeep Kumar Singh
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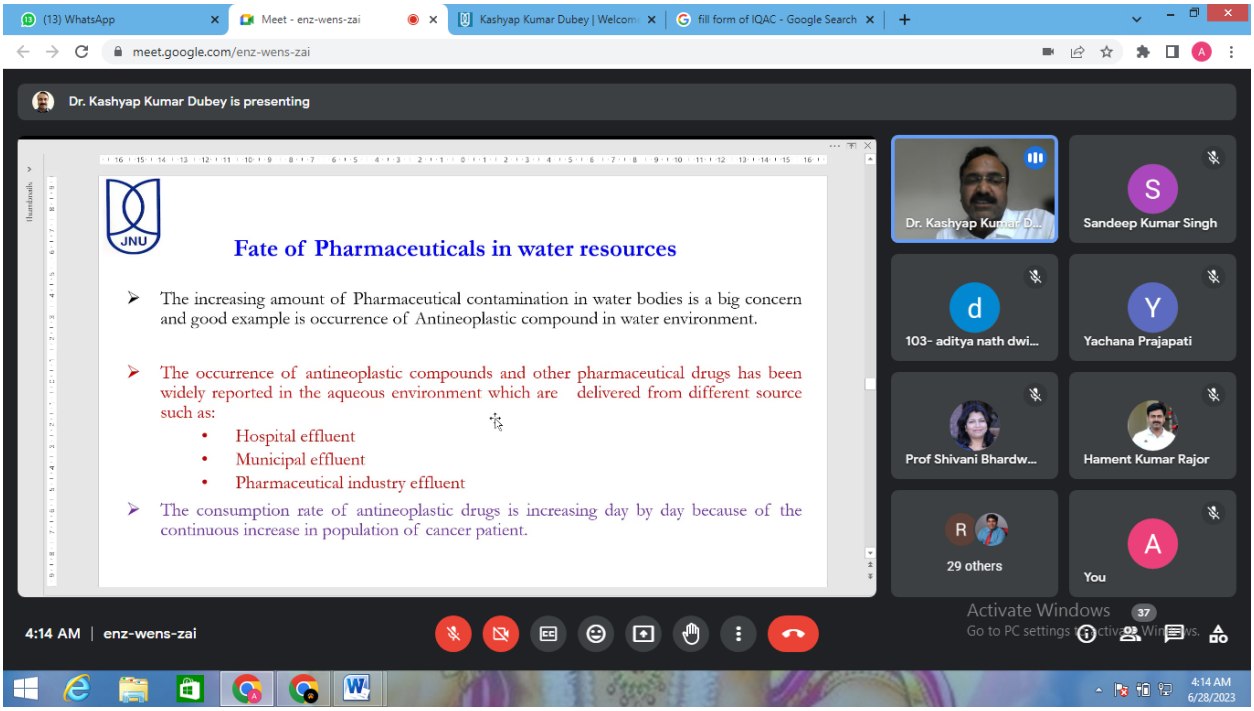
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Dr. Kashyap Kumar Dubey is presenting
Fate of Pharmaceuticals in water resources
The increasing amount of Pharmaceutical contamination in water bodies is a big concern and good example is occurrence of Antineoplastic compound in water environment.
The occurrence of antineoplastic compounds and other pharmaceutical drugs has been widely reported in the aqueous environment which are delivered from different source such as:
Hospital effluent
Municipal effluent
Pharmaceutical industry effluent
The consumption rate of antineoplastic drugs is increasing day by day because of the continuous increase in population of cancer patient.
Dr. Kashyap Kumar D...
Sandeep Kumar Singh
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Prof Shivani Bhardw...
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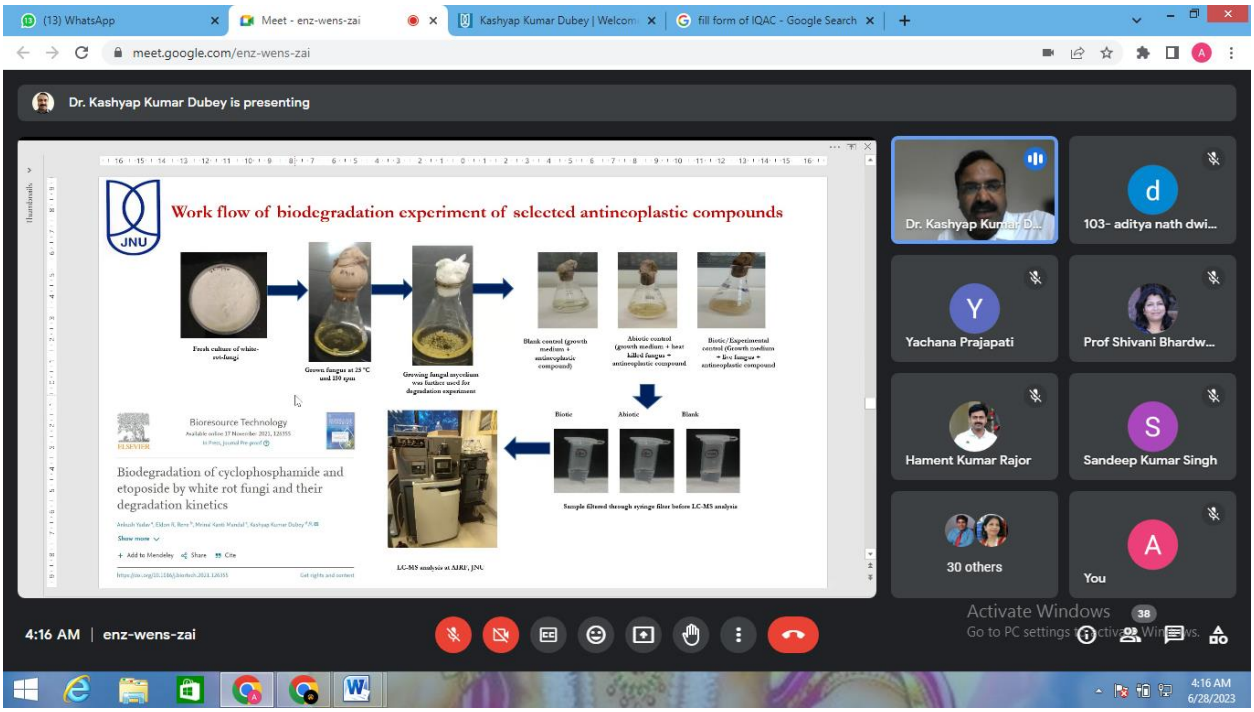
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Dr. Kashyap Kumar Dubey is presenting
Work flow of biodegradation experiment of selected antineoplastic compounds
Fresh culture of white-rot-fungi
Grown fungus at 25 °C and 120 rpm
Growing fungal mycelium was further used for degradation experiment
Blank control (growth medium + antineoplastic compound)
Abiotic control (growth medium: + heat killed fungus + antineoplastic compound
Biotic/Experimental control (Growth medium + live fungus + antineoplastic compound
Biotic
Abiotic
Blank
Sample filtered through syringe filter before LC-MS analysis
LC-MS analysis at ARIF, JNU
Bioresource Technology
Biodegradation of cyclophosphamide and etoposide by white rot fungi and their degradation kinetics
Dr. Kashyap Kumar D...
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Prof Shivani Bhardw...
Hament Kumar Rajor
Sandeep Kumar Singh
30 others
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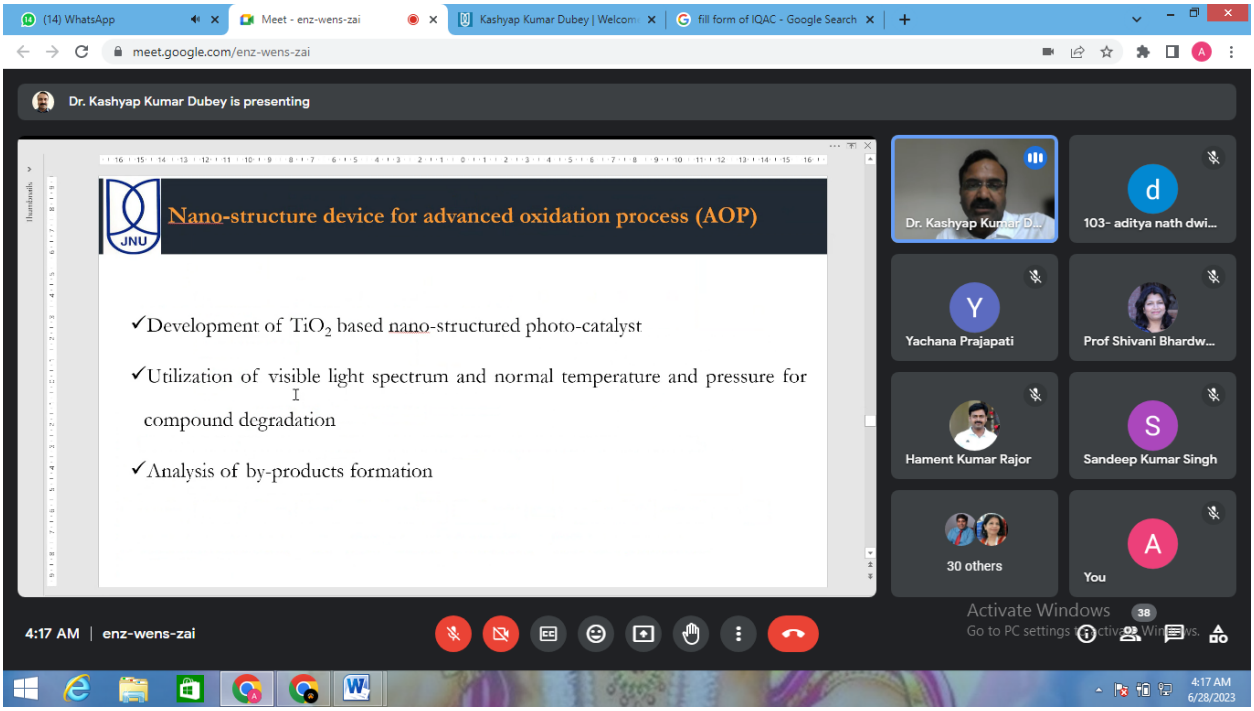
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Dr. Kashyap Kumar Dubey is presenting
Nano-structure device for advanced oxidation process (AOP)
✓Development of TiO_2 based nano-structured photo-catalyst
✓Utilization of visible light spectrum and normal temperature and pressure for compound degradation
✓Analysis of by-products formation
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Yachana Prajapati
Prof Shivani Bhardw...
Hament Kumar Rajor
Sandeep Kumar Singh
30 others
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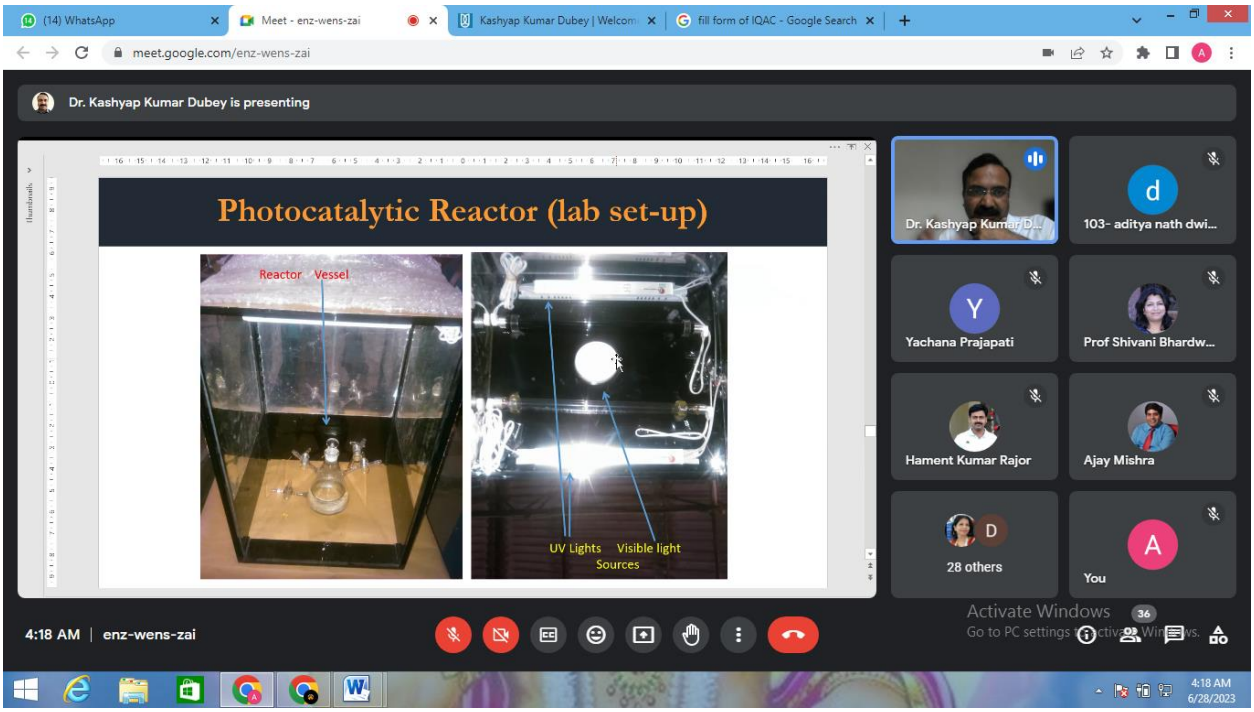
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Photocatalytic Reactor (lab set-up)
Reactor Vessel
UV Lights
Visible light Sources
Dr. Kashyap Kumar D...
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Prof Shivani Bhardw...
Hament Kumar Rajor
Ajay Mishra
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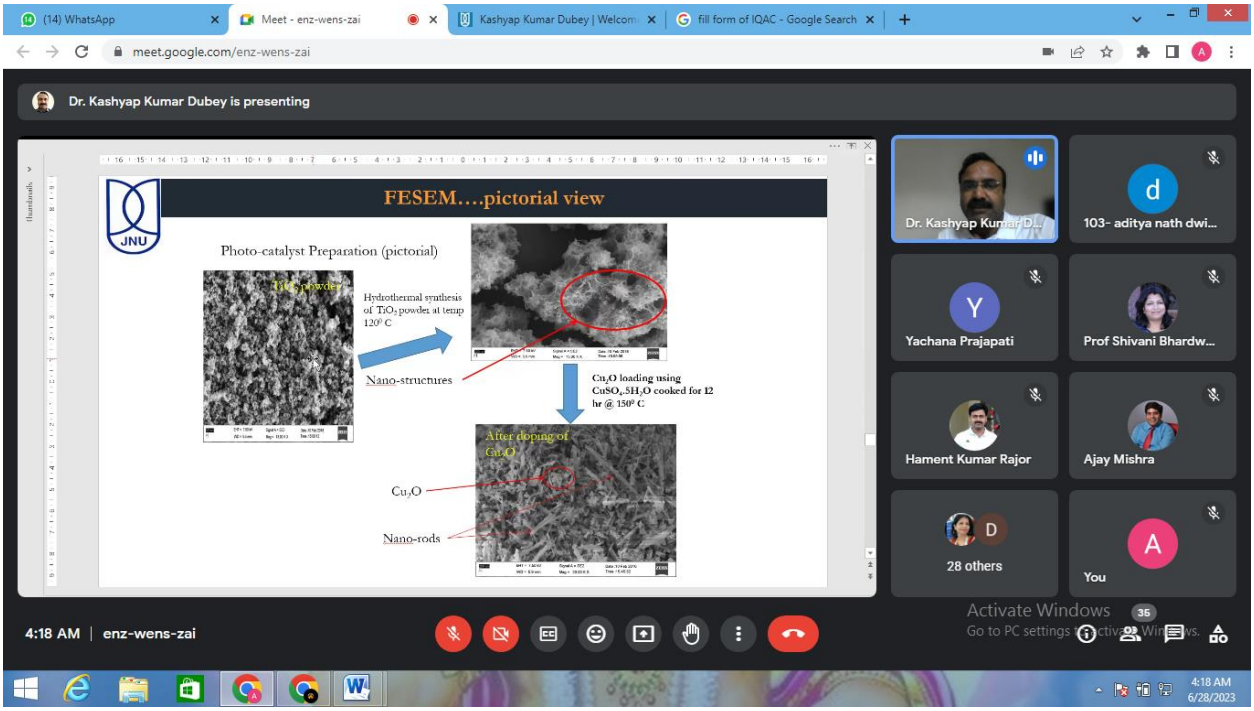
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FESEM….pictorial view
JNU
Photo-catalyst Preparation (pictorial)
TiO2 powder
Hydrothermal synthesis of TiO2 powder at temp 120° C
Nano-structures
Cu2O loading using CuSO4.5H2O cooked for 12 hr @ 150° C
After doping of Cu2O
Cu2O
Nano-rods
Dr. Kashyap Kumar D...
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Yachana Prajapati
Prof Shivani Bhardw...
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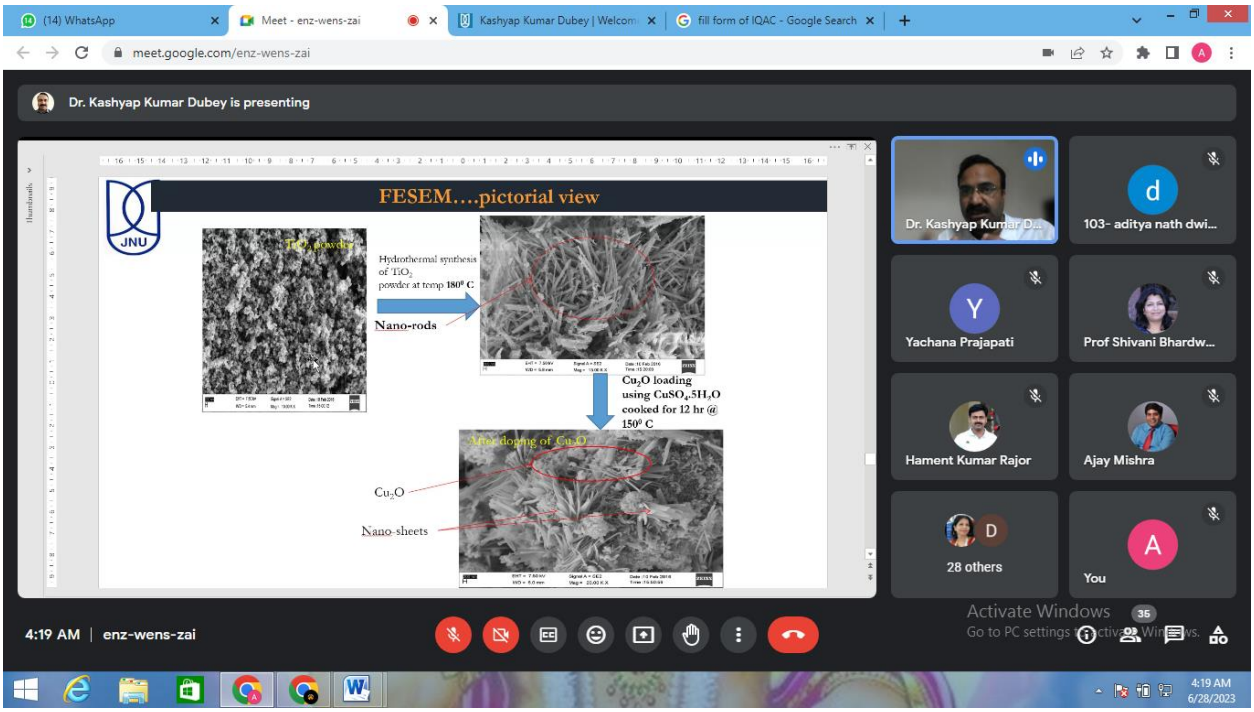
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Dr. Kashyap Kumar Dubey is presenting
FESEM….pictorial view
JNU
TiO2 powder
Hydrothermal synthesis of TiO2 powder at temp 180° C
Nano-rods
Cu2O loading using CuSO4.5H2O cooked for 12 hr @ 150° C
After doping of Cu2O
Cu2O
Nano-sheets
Dr. Kashyap Kumar D...
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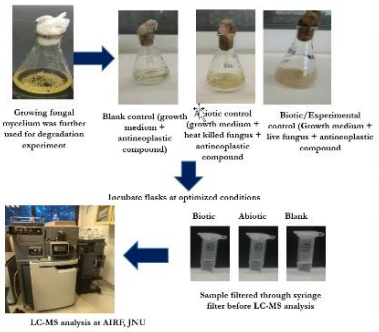
Dr. Kashyap Kumar Dubey is presenting

Optimized biodegradation using selected white rot fungi



Total removal efficiency of white rot fungi

White-rot-fungi	Cancer drugs	Total removal rate (%)	Biosorption rate (%)	Biodegradation rate (%)
Ganoderma lucidum	Cyclophosphamide	75.56	3.99	71.57
	Etoposide	99.69	0.75	98.94
	Paclitaxel	21.84	1.67	20.17
Trametes versicolor	Cyclophosphamide	1.47	0.43	1.04
	Etoposide	98.75	18.93	79.82
	Paclitaxel	8.43	2.36	6.07
Phanerochaete chrysosporium	Cyclophosphamide	23.77	23.77	No removal
	Etoposide	98.1	21.25	76.85
	Paclitaxel	6.33	1.42	4.91

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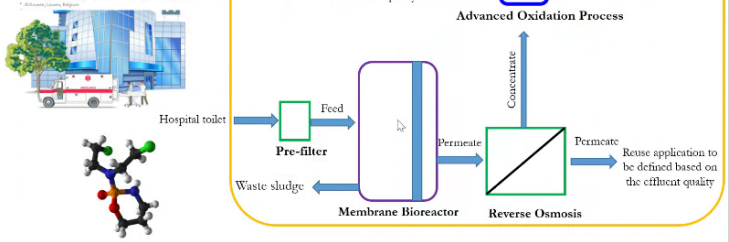
Dr. Kashyap Kumar Dubey is presenting

Journal of Hazardous Materials

Predicted concentrations of anticancer drugs in the aquatic environment: What should we monitor and where should we treat?

Treatment scheme



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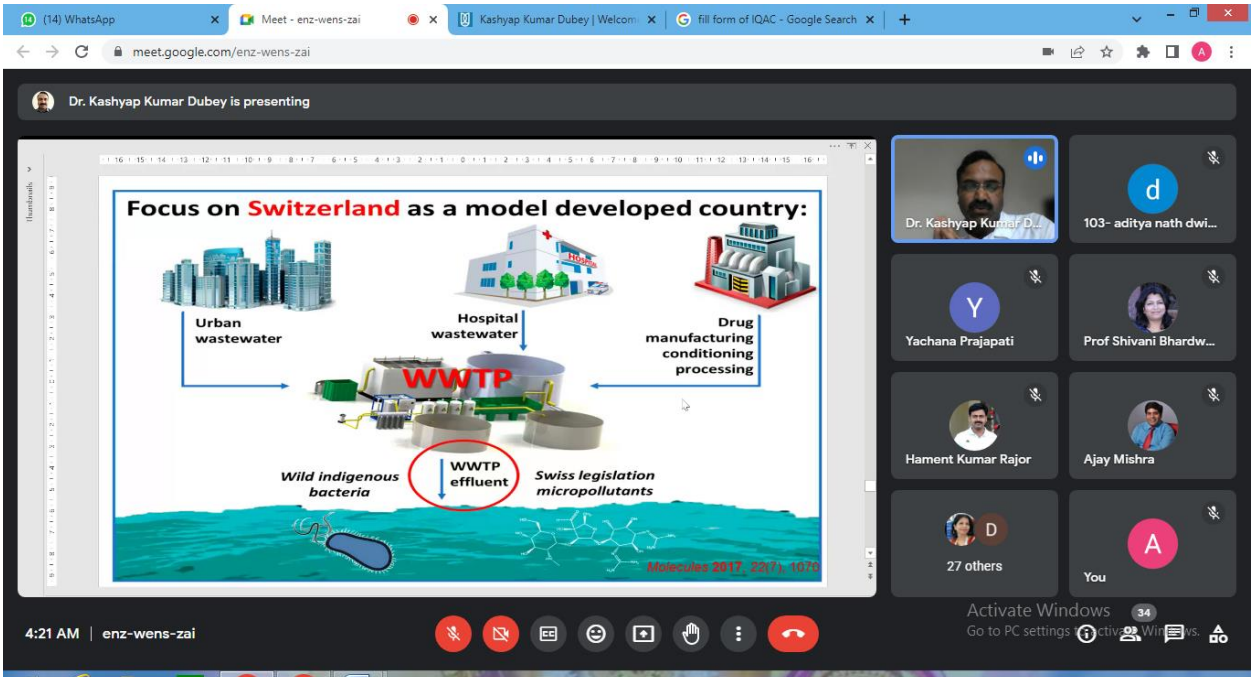
Dr. Kashyap Kumar Dubey is presenting
Focus on Switzerland as a model developed country:
Urban wastewater
Hospital wastewater
Drug manufacturing conditioning processing
WWTP
Wild indigenous bacteria
WWTP effluent
Swiss legislation micropollutants
Molecules 2017, 22(7), 1070
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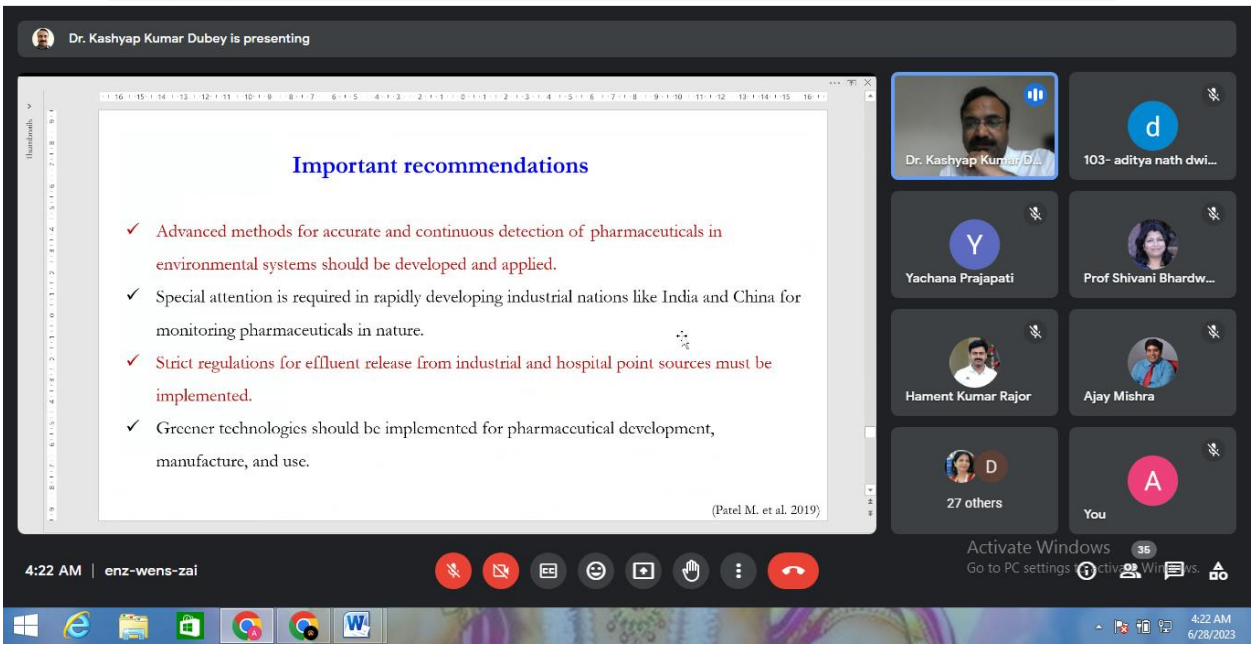
Dr. Kashyap Kumar Dubey is presenting
Important recommendations
✓ Advanced methods for accurate and continuous detection of pharmaceuticals in environmental systems should be developed and applied.
✓ Special attention is required in rapidly developing industrial nations like India and China for monitoring pharmaceuticals in nature.
✓ Strict regulations for effluent release from industrial and hospital point sources must be implemented.
✓ Greener technologies should be implemented for pharmaceutical development, manufacture, and use.
(Patel M. et al. 2019)
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Yachana Prajapati
Prof Shivani Bhardw...
Hament Kumar Rajor
Ajay Mishra
27 others
You
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Department-	Select
Zoology	Faculty Member
Physics	Faculty Member
Physics	Faculty Member
Physics	Faculty Member
B.s.c(honours)physics	Student
Physics	Faculty Member
B.sc physics hons.	Student
Physics	Student
Sri Venkateswara College	Student
Physics	Student
Physics	Faculty Member
Physics	Faculty Member
Physics department	Student
Academy of Nanotechnology and	Faculty Member
Physics	Faculty Member
Physical Education and sports sc	Faculty Member
Physics	Student
Physics	Student
Physics	Faculty Member
Applied Physics	Student
Physics	Faculty Member
Physics	Faculty Member
Physics	Student
Physics	Faculty Member
Physics	Student
Physics	Student
Botany	Faculty Member
SPS	Student
Physics	Student
School of Physical Sciences	Student
Environmental science	Faculty Member
Biochemistry	Faculty Member
Environmental Science	Faculty Member
Pharmaceutics	Student
Applied Physics	Faculty Member
Zoology	Student
Chemistry	Faculty Member
Physics	Student
Chemistry	Faculty Member
Bsc. Life science	Student
Department of Zoology	Student
Central Planning Department	Faculty Member
Botany	Faculty Member

Physics	Faculty Member
Electronics	Faculty Member
Physics	Faculty Member
Botany	Faculty Member

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CERTIFICATE

of Participation

This certificate is proudly presented to **Anjali Thakur**, Department of Physics, Ramjas College, for participating in the online lecture on *"Integrated Approach for Management of Cancer Hospital Aqueous Waste"* delivered by Prof. Kashyap Kumar Dubey, Dean, Faculty of Biotechnology, JNU, India on June 28, 2023.

Prof. Manoj Khanna
Principal, Ramjas College

Prof. Hament Rajor
IQAC Coordinator, Ramjas College

Prof. Shivani Bhardwaj Mishra
Director, ANWWI

Dr Avnish Kr Sisodiya
Coordinator, Ramjas College

Prof. Ajay Kr Mishra
Coordinator, Durban University of Technology

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