

MID-ATLANTIC BIOSAFETY ASSOCIATION
37th ANNUAL BIOSAFETY SYMPOSIUM

**Biosafety Protocols in Cancer Research:
Best Practices and Applications**

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Molecular Biochemistry

June 19, 2025



Lewis Katz School of Medicine

Colorectal Cancer- A Global Health Concern

Colorectal cancer is the 4th most common cancer type and 2nd deadliest



It is estimated that 1 in 3 adults (50-75) are not getting screened as recommended

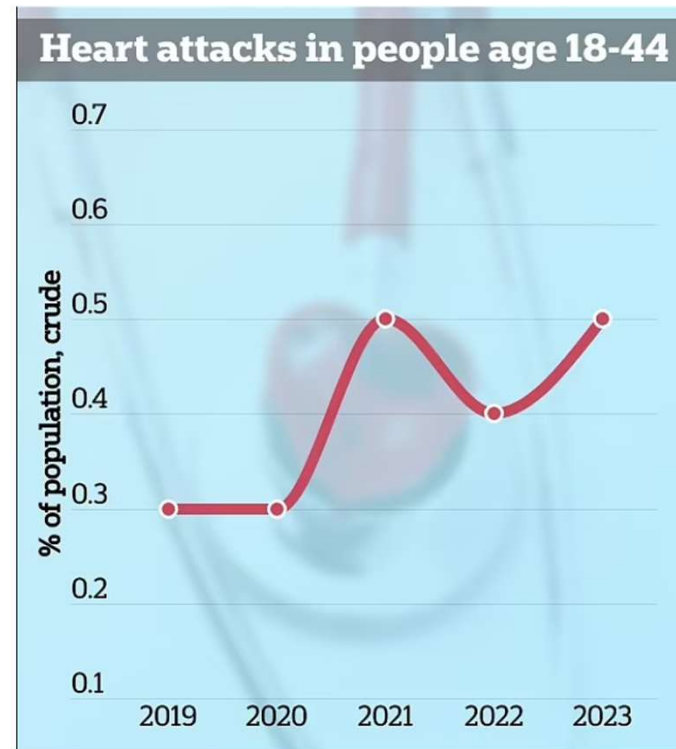
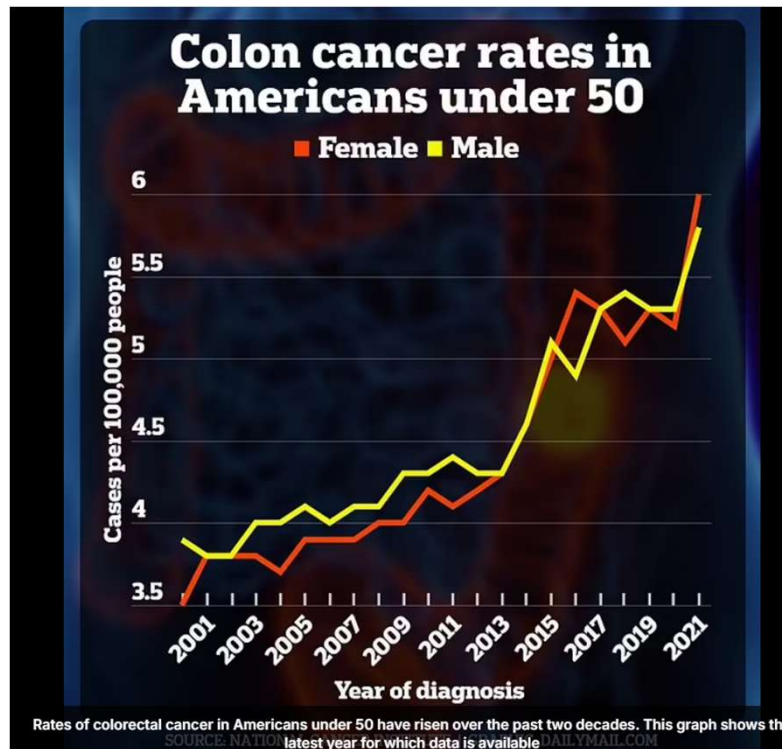
Of all cancer deaths in people under 50, colorectal is now
#1 in men
#2 in women



* Based on existing trends, incidence of colon and rectal cancer among individuals younger than 50 is expected to increase 90% (colon) and 124% (rectal), respectively by 2030

Colorectal Cancer is Increasing in Young Adults

*** No longer a cancer impacting the elderly**



* Based on existing trends, incidence of colon and rectal cancer among individuals younger than 50 is expected to increase 90% (colon) and 124% (rectal), respectively by 2030

Colorectal cancer death risk factors

■ Percent of Deaths, Global ■ Percent of deaths, North America

Alcohol



Diet high in processed meat



Diet high in red meat



Diet low in calcium



Diet low in fiber

Earlier this month, a study published in [Nature Communications](#) found an additional 300mg of calcium per day could cut colon cancer risk by 17 percent. That's roughly the same amount

1 large glass of milk



FAMILY HISTORY OF COLON CANCER

You're more likely to develop colon cancer if you have a blood relative who has had the disease.

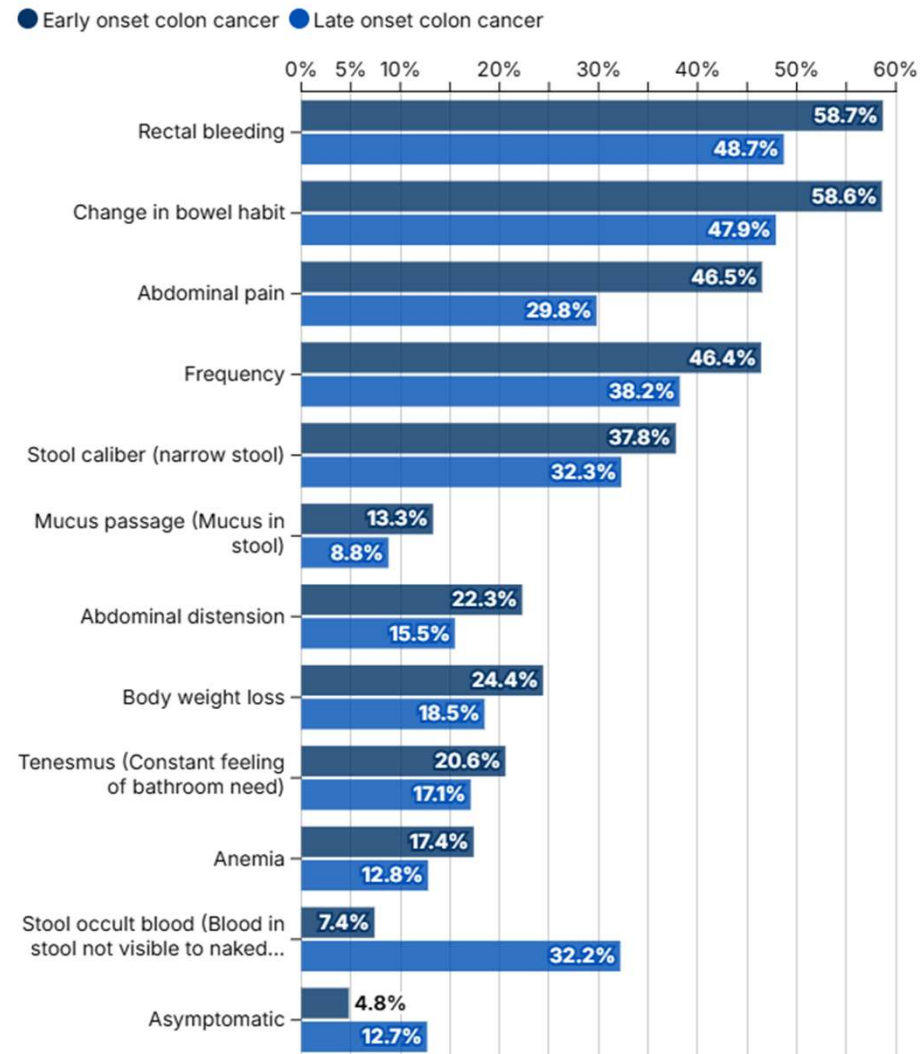
Colon cancer, as seen during colonoscopy

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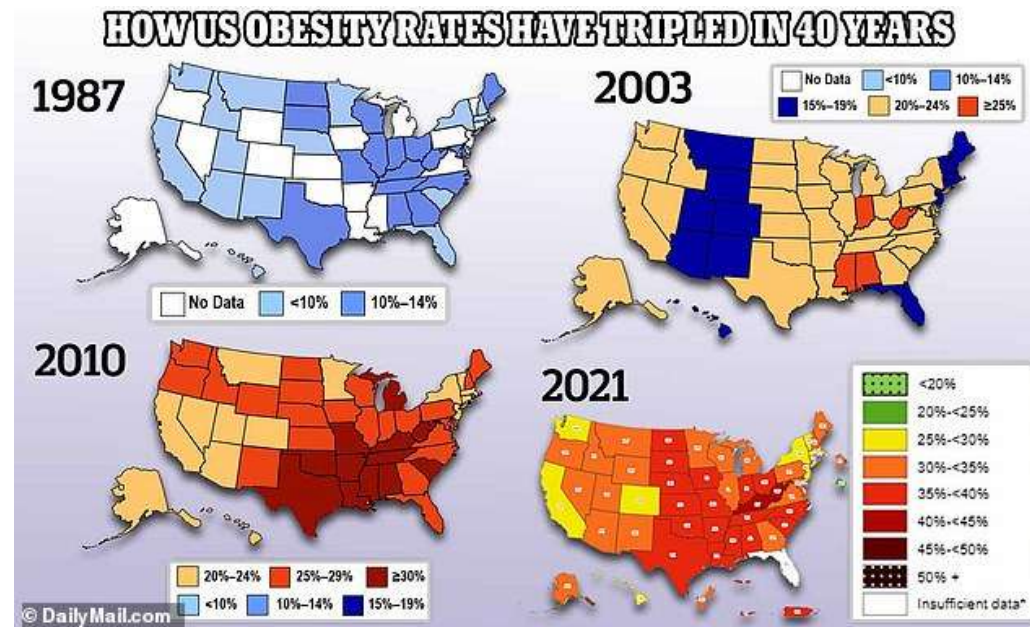
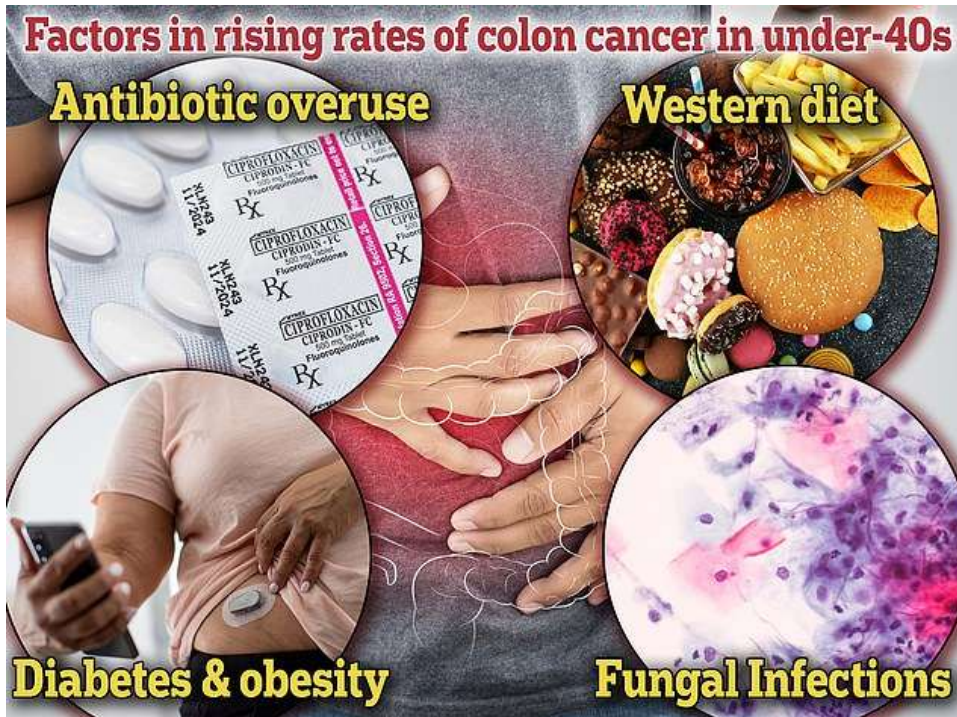
Warning Signs and Symptoms of Colorectal Cancer

	Bowel habits changes		Bowel doesn't empty completely
	Maroon colored or black stool		Abdomen fullness feeling
	Rectal bleeding		Fatigue
	Abdominal discomfort		Weight loss

Colon cancer symptoms that more common in young people



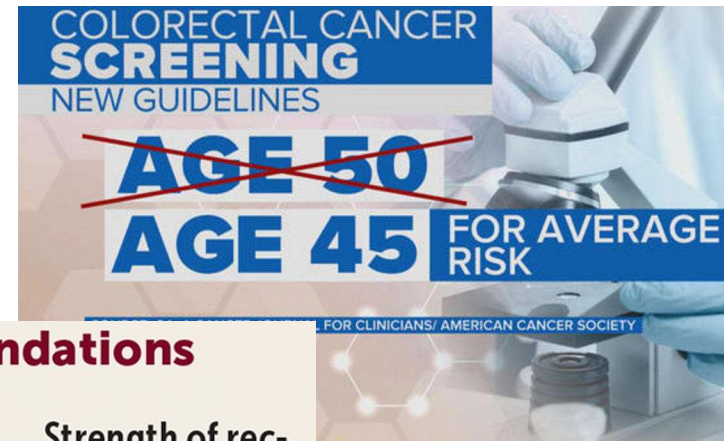
Why is there a surge in colorectal cancer among young adults?



<https://www.dailymail.co.uk/health/article-12195757/Researchers-point-red-meat-sugar-culprits-disease-spike-people-50.html>

<https://www.dailymail.co.uk/health/article-12166107/What-causing-mystery-uptick-colon-cancer-40s.html>

As of 2021



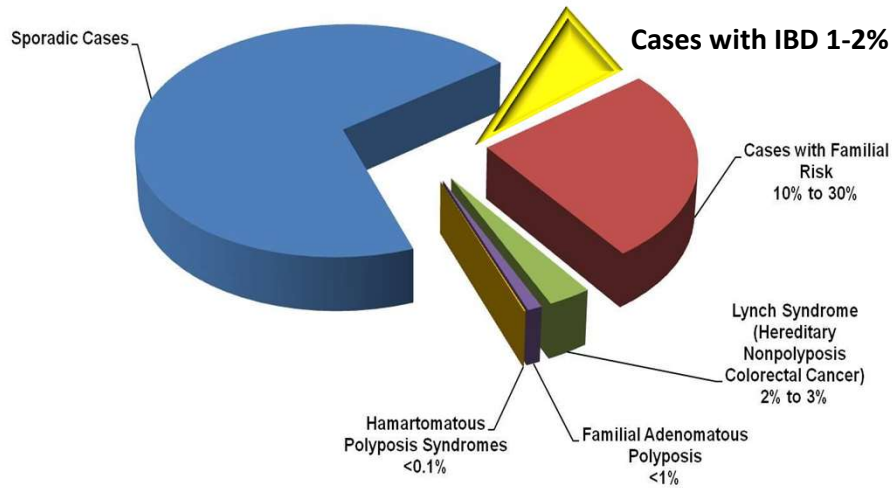
Colorectal Cancer Screening Recommendations

Risk level	Action	Age	Strength of recommendation
Average risk	Start screening	45 years	Conditional
	Screen	50 to 75 years	Strong
	Stop screening	> 75 years	Conditional
One or more first-degree relatives with colon cancer or advanced polyps	Start screening	40 years or 10 years before age of youngest relative at time of diagnosis	Conditional

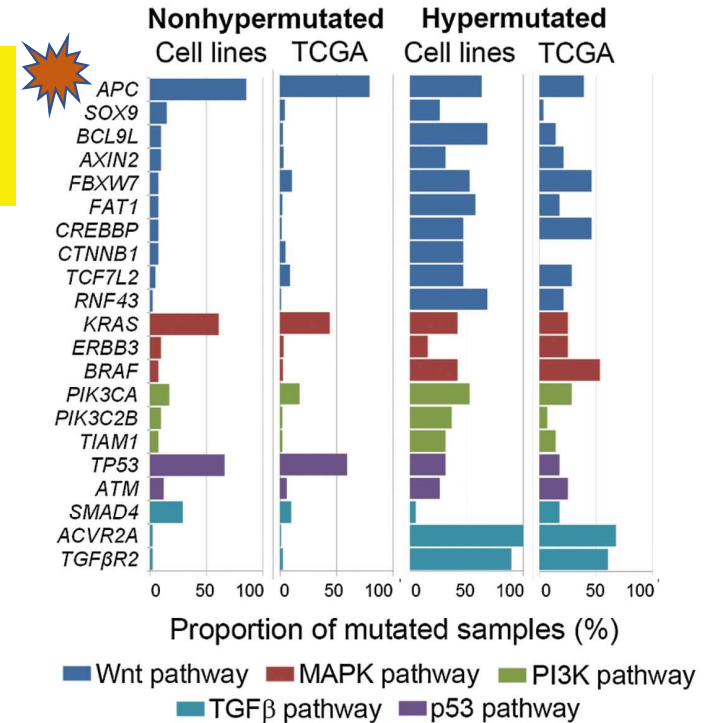
**American College of Gastroenterology
US Preventive Task Force**

Colorectal Cancer

Colon Cancer Cases Arising in Various Family Risk Settings



85% of cases have mutations in the APC gene



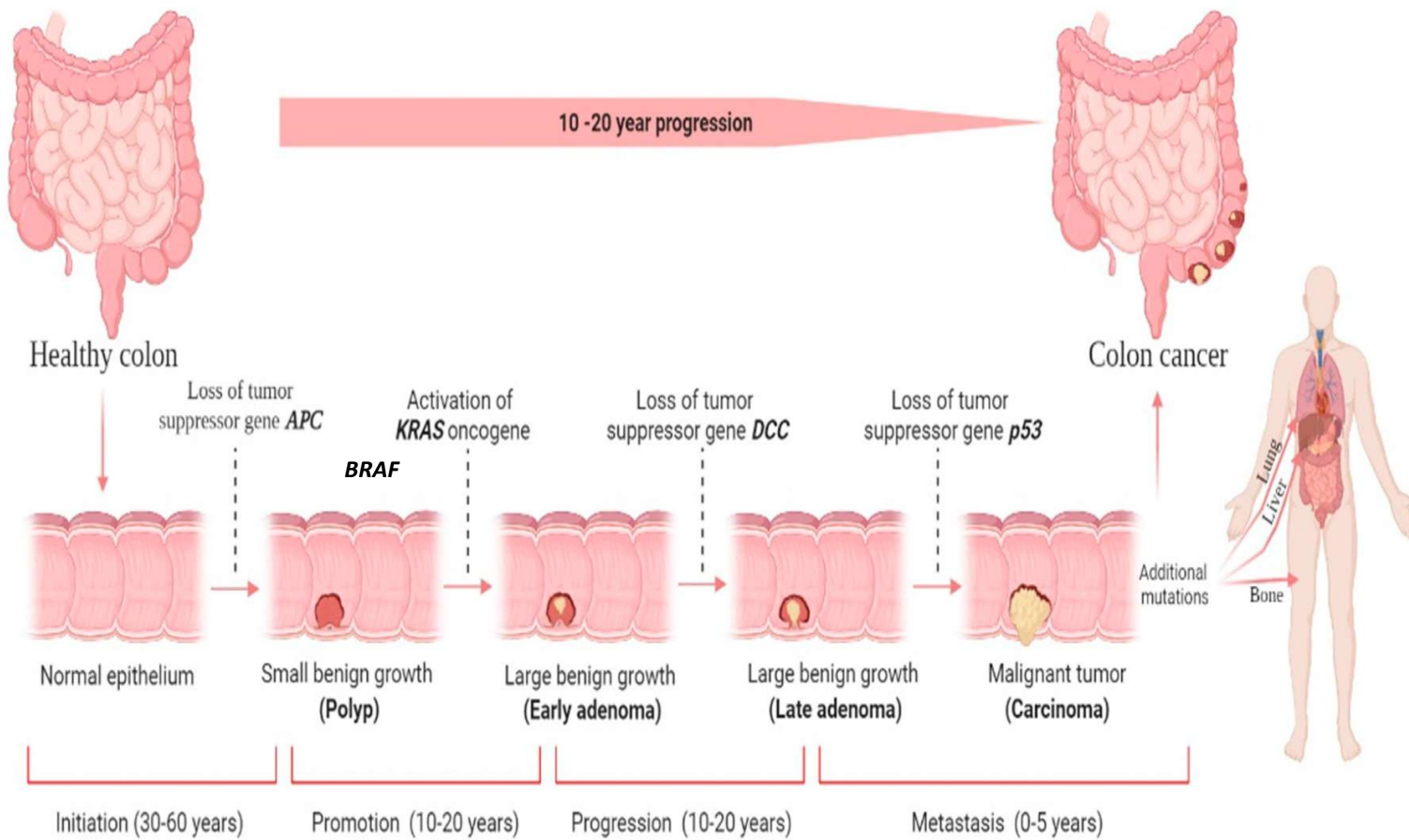
IBD: Inflammatory bowel disease: Ulcerative Colitis and Crohn's Disease

Colorectal Cancer Cell Lines Are Representative Models of the Main Molecular Subtypes of Primary Cancer

Dmitri Mouradov, Clare Sloggett, Robert N. Jorissen, Christopher G. Love, Shan LI, Antony W. Burgess, Diego Arango, Robert L. Strausberg, Daniel Buchanan, Samuel Wormald, Liam O'Connor, Jennifer L. Wilding, David Bicknell, Ian P.M. Tomlinson, Walter F. Bodmer, John M. Maradason, and Oliver M. Sieber

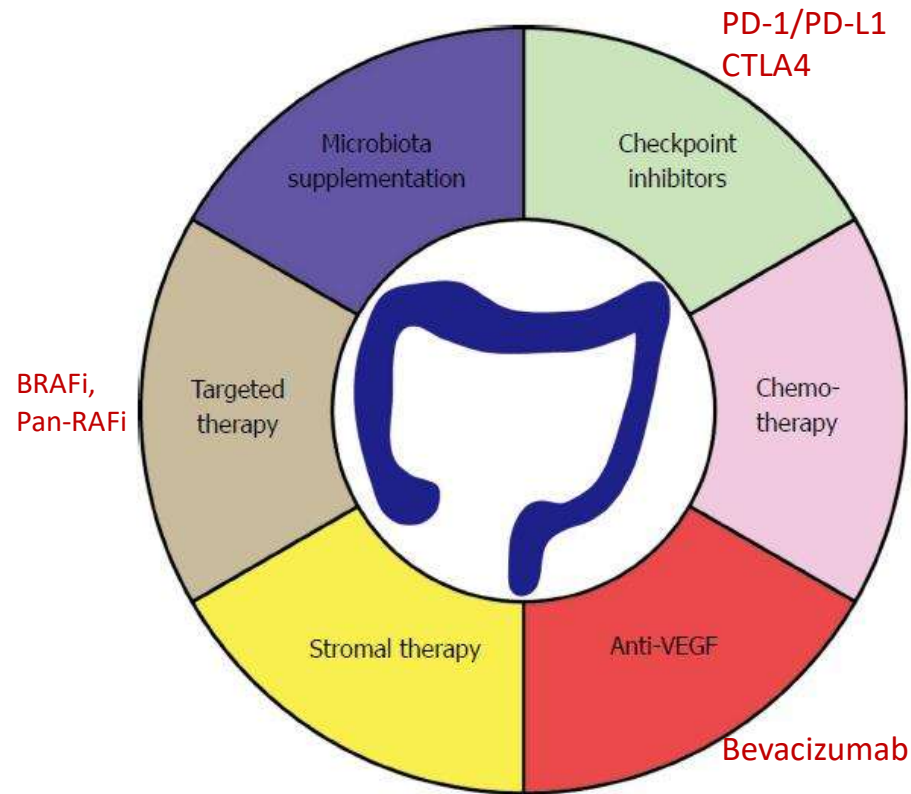
DOI: 10.1158/0008-5472.CAN-14-0013 Published June 2014

CANCER RESEARCH



Paradigm is shifting with a rise in cases of early-onset colorectal cancer

Therapeutic advances in Colorectal Cancer



*****Patients continue to relapse**

There are still gaps in knowledge on our understanding of drivers/promoters of colorectal cancer in young vs older patients

Knowing this critical information can lead to developing better treatments



How do we obtain this critical information to effectively beat colorectal cancer?

- 1) Discover biomarkers for screening and prevention (early-onset and late-onset colorectal cancer)
 - 2) Identify biomarkers to guide oncologists that treatment is working or has ceased to work
 - 3) Identify novel druggable targets for therapeutic intervention
 - 4) Test compounds with promising anti-cancer properties
- We need to employ multiple approaches/animal models to find answers*

Our Research is in intestinal Inflammation and Colorectal Cancer

STAT2

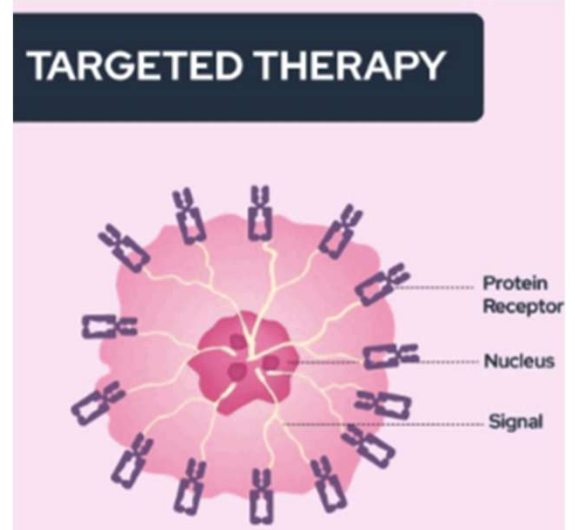
Abundant protein involved in protecting against viral infection and shaping beneficial immune responses

STAT2

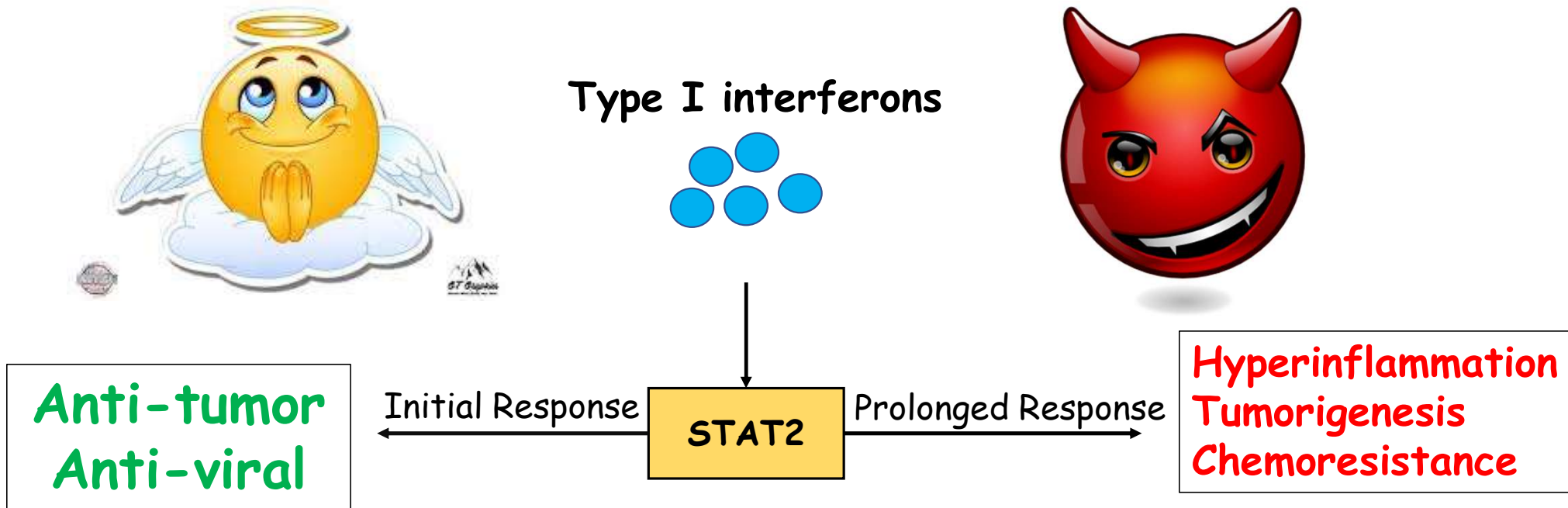
However, our studies found that STAT2 promotes inflammation and enhances tumor growth
Mechanism is unknown but knowing how STAT2 works can lead to improving cancer therapies

Therapeutic interventions

TARGETED THERAPY



The Two Faces of STAT2



Use of Colorectal cancer mouse models:

STAT2



1) Chemical model:

Azoxymethane (AOM) + Dextran Sulfate Sodium (DSS)

2) Genetic engineered models: *Apc* deletion,

3) Combination of chemical+ GEM: *Il10* deficiency + AOM



Wild type

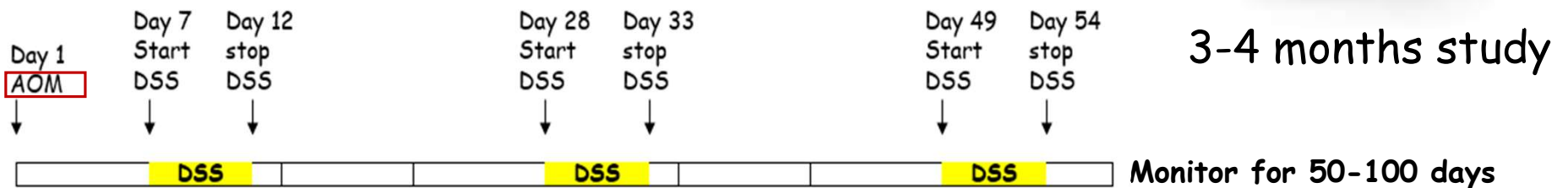


Stat2 deficient

*Strains must be registered with IBC

Chemical Model of AOM-DSS of Colorectal Cancer

- Involvement of Environmental Health & Radiation Safety (EHRS)
- Requires approval by IBC and IACUC

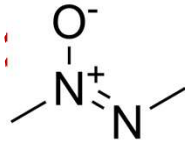


Single intraperitoneal injection of carcinogen Azoxymethane (AOM)

Inflammatory agent Dextran sodium sulfate (DSS; 2-3%) is given in the drinking water (3 cycles)

Azoxymethane (AOM):

- Colon carcinogen
- Sold in liquid and powder form
- Do not want to inhale or ingest
- Delivered intraperitoneally in mice

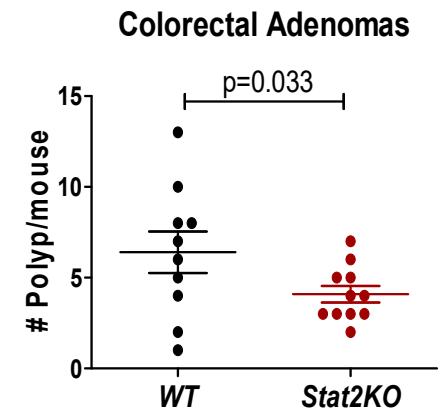
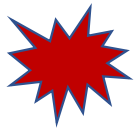


Dextran Sulfate Sodium (DSS):

- Inflammation in the colon
- Sold in powder form
- Do not inhale or ingest
- Dissolved in water
- Not considered hazardous by OSHA



Class II type B



Safety Practices: **AOM** in the Lab

We have Standard Operating Procedures (SOP) of how to handle chemicals

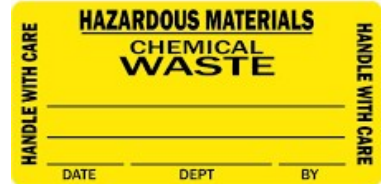
Wear protective protective equipment (PPE): Nitrile gloves, lab coat, mask, goggles, closed toe shoes

- Do not work with **AOM** if skin is cut or scratched
- Pregnant women should not handle this chemical
- Transport in a secondary container
- Do not forget to decontaminate
- Have the appropriate sharps container to dispose of syringes, pipettes, pipet tips



Safety first: **AOM** in the Animal Facility

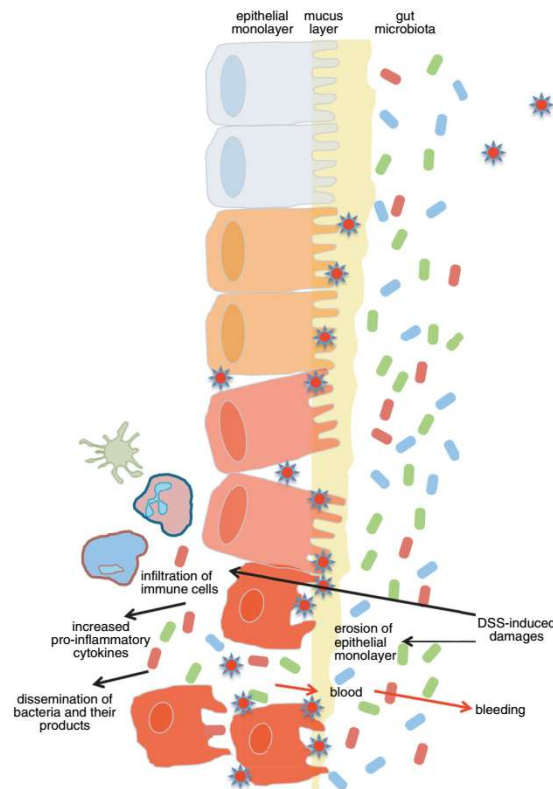
Wear PPE: Nitrile gloves, lab coat mask, goggles, shoe covers, head cover



- Place chemical hazard label on cages
- After injection, animal waste, bedding and cage are considered hazardous for at least 48 hours
- Always use a biological safety cabinet
- Dispose of needles in appropriate sharps container

Safety first: DSS in the lab

Wear PPE: Nitrile gloves, lab coat mask, goggles, shoe covers, closed toe shoes



- Classified as non-hazardous chemical
- Can cause irritation of eyes and skin, nausea
- Use a biological safety cabinet to minimize aerosolization
- Stable in solution for a week
- Its products of degradation are not toxic

Safety first: DSS in the animal facility



- Prepare freshly
- Place label on cage not to change water
- Use a biological safety cabinet to change water bottles
- Check volume in bottle daily

A hazardous studies door sign should be posted on the outside of the animal room

DANGER



HAZARDOUS CHEMICAL USED IN ANIMALS

NAME OF HAZARDOUS CHEMICAL AZOXYMETHANE

toxic if swallowed, skin and eye irritant, corrosive, mutagen, carcinogen

Minimum PPE Requirements: nitrile gloves, eye protection, face protection, skin protection, head cover, lab coat, shoe covers

Additional PPE or Other Requirements: Please refer to Manufacturer Safety Data Sheet

DANGER



HAZARDOUS CHEMICAL USED IN ANIMALS

NAME OF HAZARDOUS CHEMICAL DEXTRAN SULFATE (SODIUM SALT)

skin and eye irritant

Minimum PPE Requirements: nitrile gloves, eye protection, face protection, skin protection, head cover, lab coat, shoe covers

Additional PPE or Other Requirements: Please refer to Manufacturer Safety Data Sheet

Safety Issues of Concern:

- A bad habit to recap needles



- Walking around the lab with gloves that have touched chemicals, viruses

- Disposing contaminated tubes, unused solutions and tips in the wrong containers



VS



➤ Wearing inappropriate footwear



➤ Headphones



➤ Food and drinks in the lab



Water bottles!!



HOW TO MINIMIZE RISK?

- Restrict access to untrained staff
- Follow safety practices
- Train personnel to properly change bedding/food /water
- Always wear PPE when in contact with mice

What's next.....

In vitro studies to identify mechanistically how a protein or a chemical compound works

Use of Tumor Cell Lines to modify expression of genes

- 1) Overexpression
- 2) Silence expression (shRNA)
- 3) Delete gene of interest (Crispr/Cas9)



* Use of retroviral and lentiviral systems with SOP

*Every cell line of human or mouse origin must be registered and approved by IBC

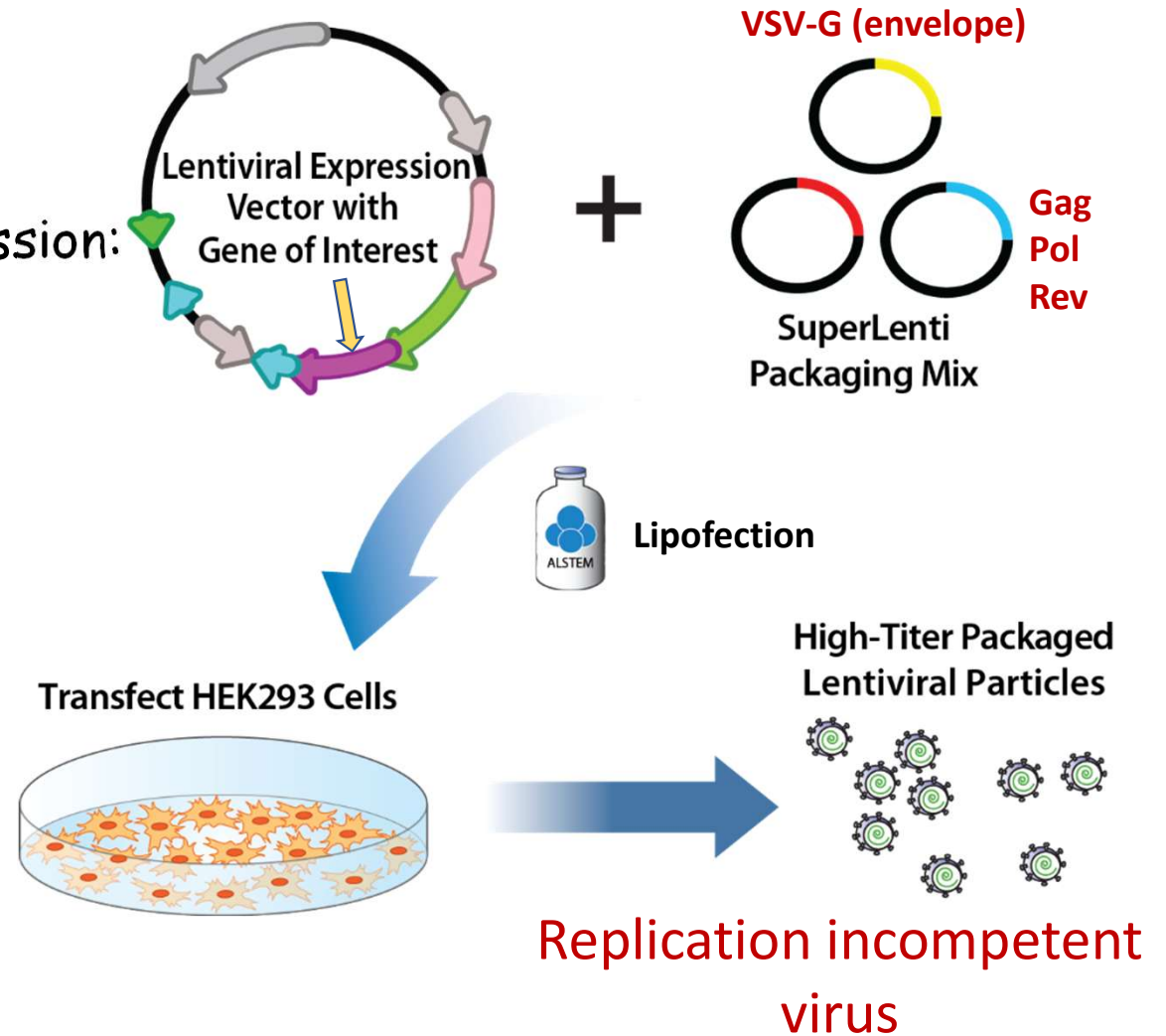
*Same applies for DNA constructs in which mutations have been introduced

Lentiviral System

Application to modify gene expression:

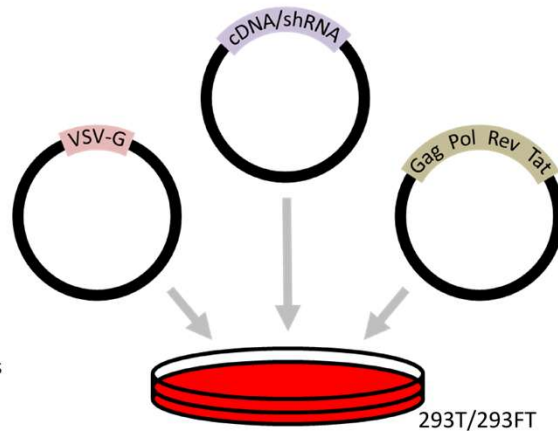
- Primary Cells
- Difficult to transfect cells

***Every plasmid or vector DNA must be registered and approved by IBC**



Minimize hazards:

Lentivirus (LV)



1) Transfect packaging cells

2) Collect virus particles

48-72 hours

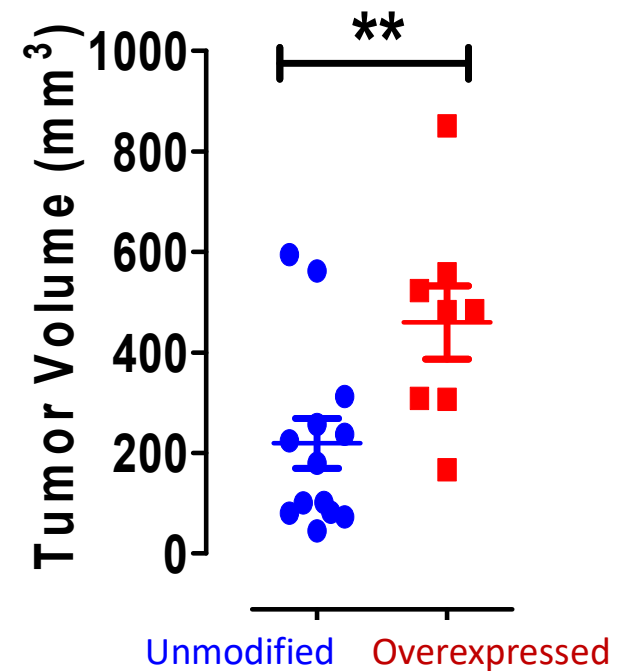
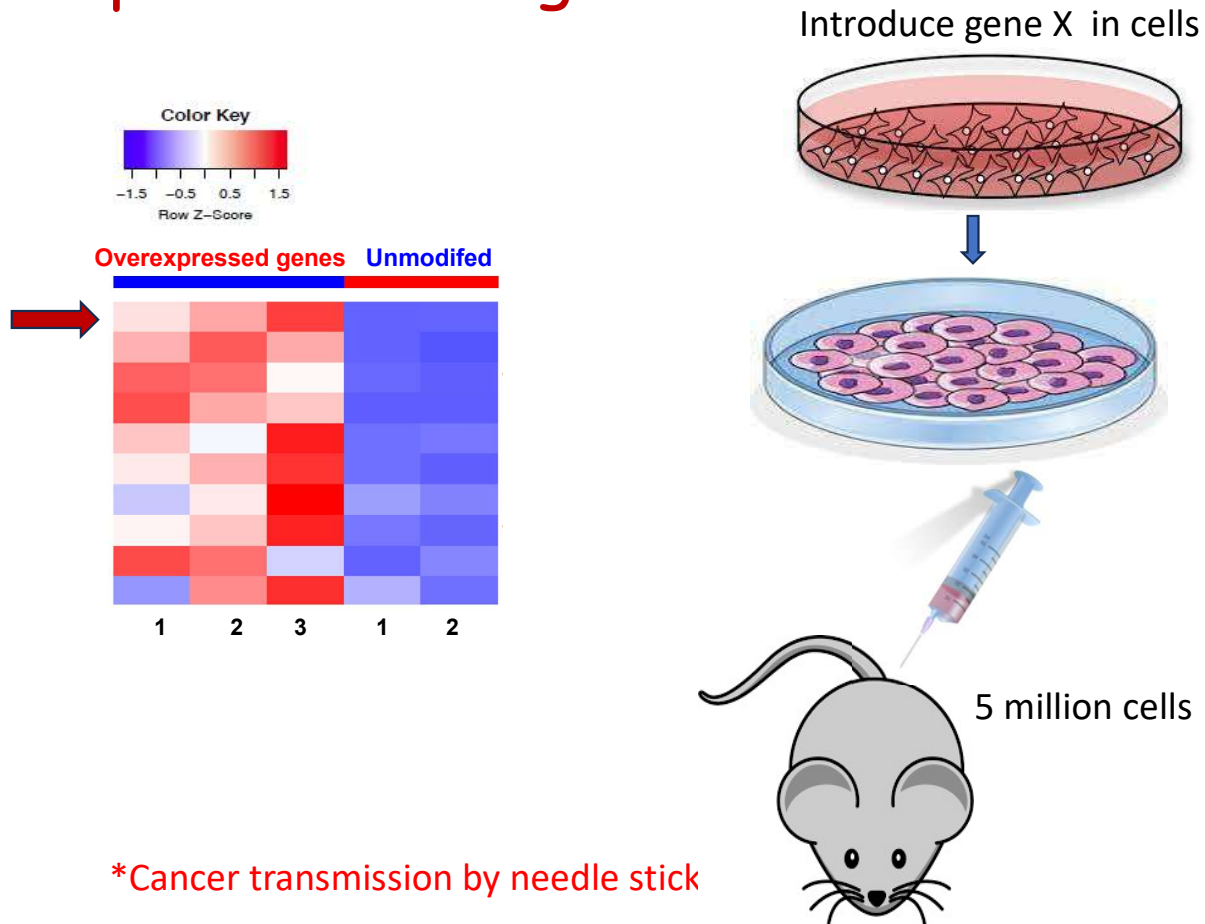
3) Transduce target cells

**Antibiotic selection to
Generate stable cell line**



- Treat with 10% bleach:
 - media containing virus
 - Pipettes, pipet tips and tissue culture supplies
 - Dispose as biohazardous waste

Effects of a gene product in tumor growth when expressed at high levels



Result: increased tumor size

*Cancer transmission by needle stick

IBC



IACUC

In vitro

Chemicals

Biologics

Tumor cell lines

DNA vectors

- Oncogenes
- Tumor suppressors
- Introduce mutations

In vivo

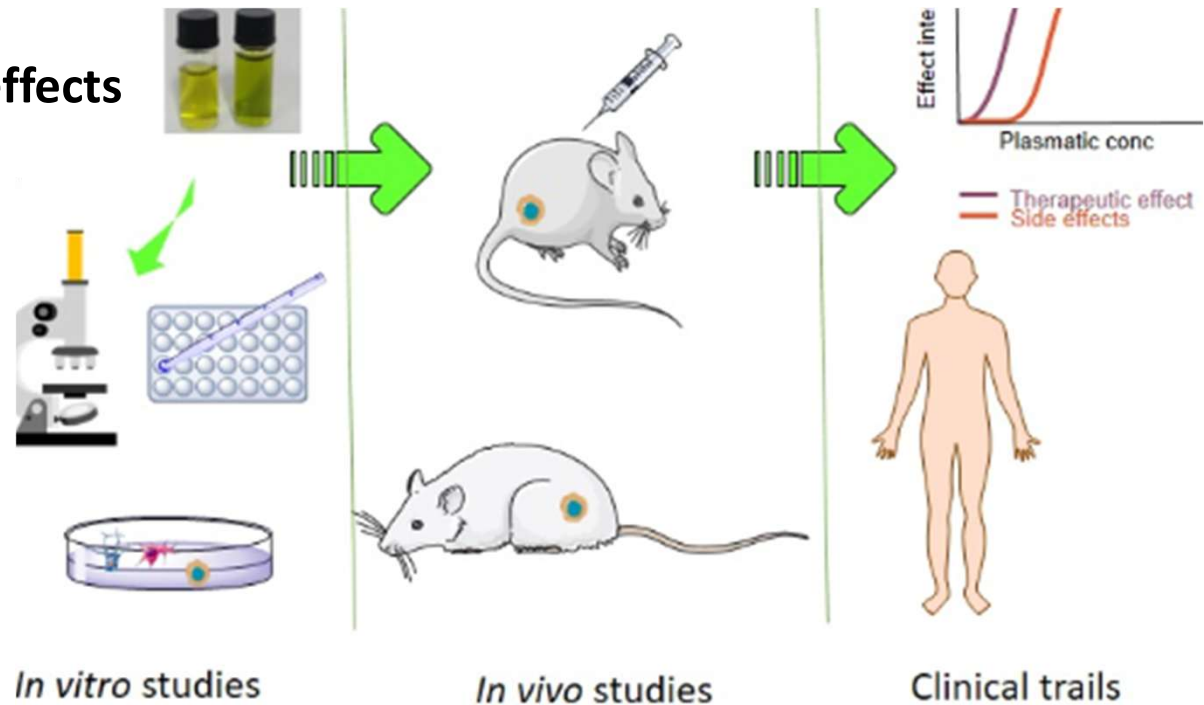
Tumor cell lines (*Mycoplasma free*)

Clinical grade drugs (*Preferred*)

Reduce pain/distress

How to evaluate new drugs for cancer interventions?

Evaluate compounds for anticancer effects
Example: Cannabinoids



IRB



IBC



IACUC

Clinical materials

- Blood products
- Surgical samples
- Build tumoroid biobank
 - Young and older patients

In vitro

Chemicals

Biologicals

Test compounds

Tumor cell lines/tumoroids

DNA vectors

In vivo

TISSUE DECELLULARIZATION PROTOCOL

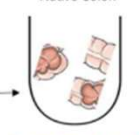
A. Surgical resection

B. Sample processing

C. Decellularization



Native Colon



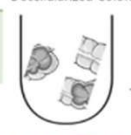
Healthy Tumoral

Lam DAPI

Methods

- Chemical**
Hypotonic/isotonic solutions, acids and bases, ionic/non ionic detergents, Zwitterionic detergents.
- Enzymatic**
nucleases, trypsin, collagenase, lipase, dispase
- Physical**
freeze-thawing, mechanical agitation, sonication, electroporation, perfusion

Decellularized Colon



Healthy Tumoral

Lam DAPI

- Oncogenes
- Tumor suppressors
- Introduce mutations

Other factors that can jeopardize biosafety in the lab

- High cost of research and availability of funding



- Plastic vs glass pipettes



- Cost of continuous purchase of plastic red biohazard waste containers
- Insufficient training of personnel working in labs with open design
- Sharing of tissue culture rooms (handling of retrovirus/lentivirus and chemicals)
- Incorrect disposal of broken glass/biologicals/chemicals

ACKNOWLEDGEMENTS

Gamero Lab

Jorge Canar
Vera Kramer-Rodrigo
Maddie Bono
Gaurav Sahai



STAT2



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