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INTELLIGENZA ARTIFICIALE, TELEMEDICINA E TECNOLOGIE DIGITALI NELLA CURA DEI PAZIENTI CON TUMORI DELL'APPARATO DIGERENTE

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AULA MAGNA

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La Ricerca Internazionale sull'Intelligenza Artificiale del Decisions Lab di UNIRC: dalla Diagnostica sul Covid-19 agli Scenari Applicativi Futuri

- **Prof. Massimiliano Ferrara**
  Università "Mediterranea" di Reggio Calabria
  &
  Bocconi ICRIOS

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Direttore Scientifico: Massimiliano Ferrara

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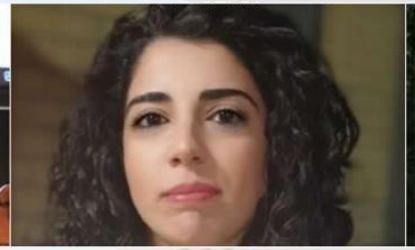

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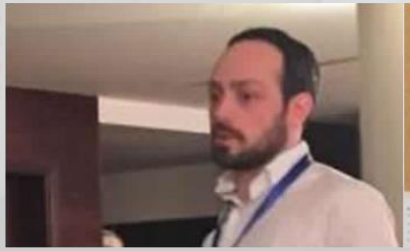

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NEWS / PROGETTI / RICERCA

Prime pubblicazioni scientifiche del Gruppo di Ricerca del Prof. Massimiliano Ferrara – Progetto "Dynamics of COVID-19"

A cinque mesi dall'inizio del Progetto sostenuto dall'Università Bocconi – ICRIOS e promosso dal Decisions_Lab, i primi risultati scientifici ottenuti dal Gruppo di Ricerca coordinato dal Prof. Ferrara, già trovano ...

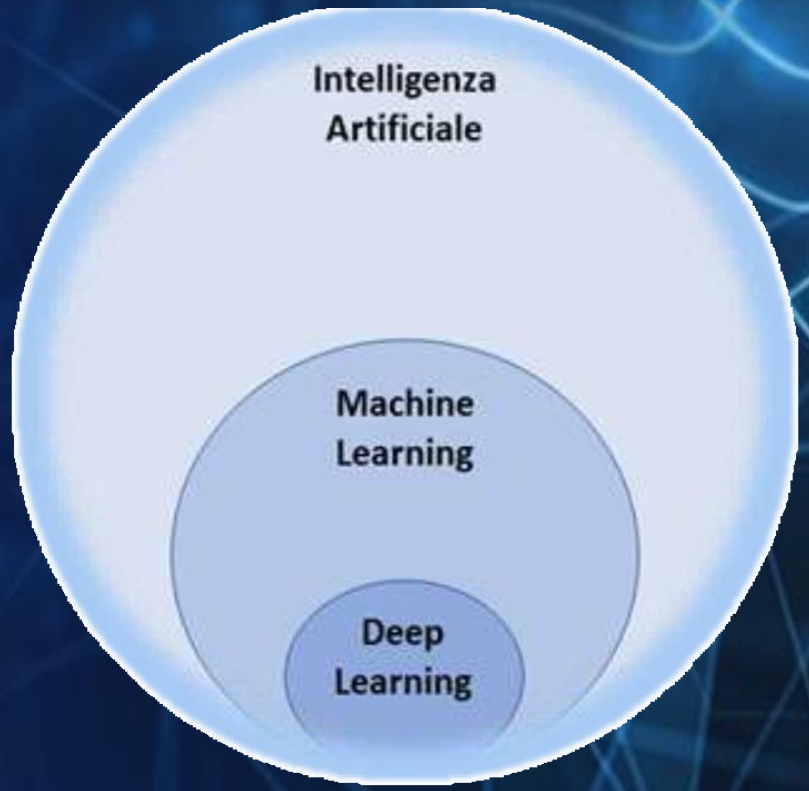
NEWS / RICERCA

Progetto di Ricerca internazionale sulla prevenzione alla diffusione del Covid-19

Il Prof. Massimiliano Ferrara, Direttore del Dipartimento di Giurisprudenza, Economia e Scienze Umane (Di.Gi.ES), Research Affiliate presso l'Università Bocconi e Delegato per l'Italia presso l'European Mathematical Society, guiderà un team ...

L’Intelligenza Artificiale (IA) (acronimo inglese Artificial Intelligence (AI)) può essere definita come la scienza che si propone di sviluppare macchine intelligenti.

Il **Machine Learning** è un sottoinsieme **dell'Intelligenza Artificiale** e, insieme al **Deep Learning**, costituisce un approccio moderno che sta riscuotendo un notevole successo



MACHINE LEARNING E DEEP LEARNING

1

MACHINE LEARNING

Si occupa principalmente di fare delle previsioni, «imparando» dai dati

2

DEEP LEARNING

E' un sottoinsieme del Machine Learning ed entra in gioco quando il Machine Learning non riesce ad ottenere i risultati desiderati

ALGORITMI DI MACHINE LEARNING

APPRENDIMENTO SUPERVISIONATO

Questi algoritmi utilizzano dataset in cui è già presente la «risposta giusta».

Da questi apprendono ed imparano a prevedere la risposta per un nuovo insieme di dati, che non è presente nell'insieme utilizzato per l'addestramento.

Questi algoritmi utilizzano dataset che non hanno delle risposte disponibili.

E' l'algoritmo stesso che, analizzando i dati, produce delle relazioni tra gli stessi e genera quelle che possono essere le possibili risposte, aiutando a scoprire nuove informazioni presenti nei dati.

APPRENDIMENTO NON SUPERVISIONATO

ALGORITMI DI MACHINE LEARNING

APPRENDIMENTO SEMI SUPERVISIONATO

Questi algoritmi utilizzano dataset in cui la risposta è disponibile solo per una piccola parte degli esempi.

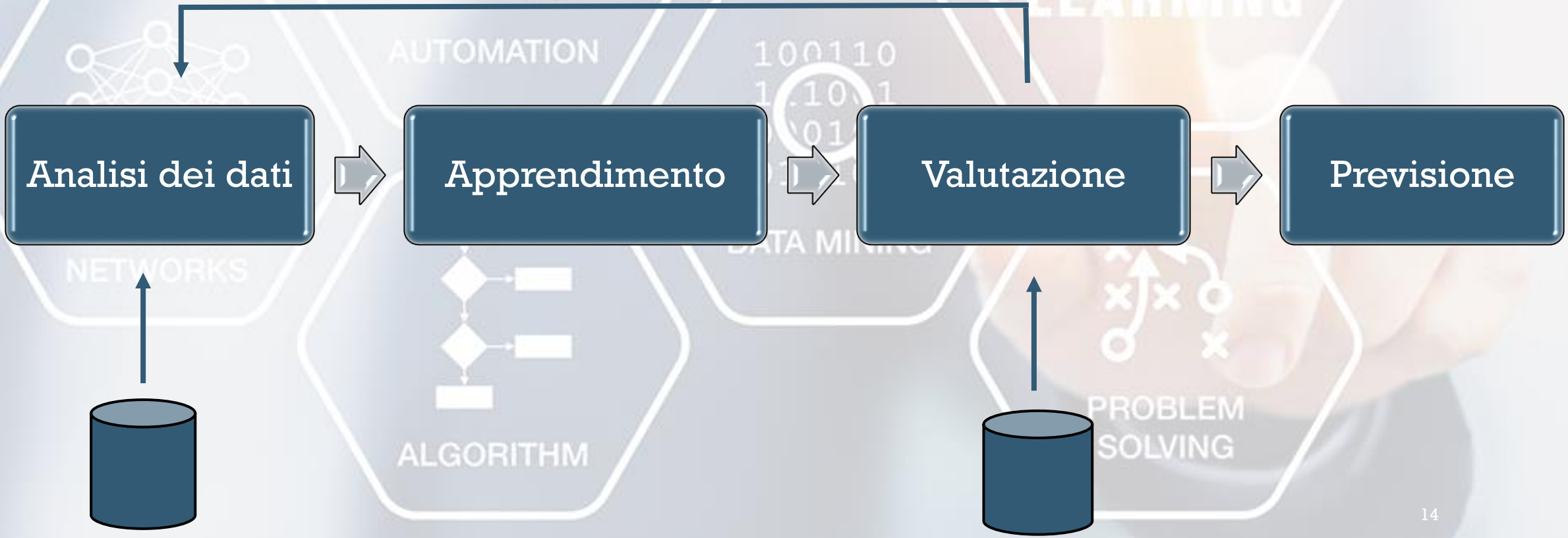
Si proverà, quindi, a sfruttare al meglio i pochi dati con risposta disponibile per ottenere una regola generale da sfruttare per i dati senza risposta

Questi algoritmi non prevedono un dataset di addestramento, per quest non hanno un'esperienza da utilizzare per imparare.

Pertanto da una sistuazione iniziale qualsiasi e, attraverso regole di premiazione o penalizzazione, cercano di arrivare al risultato ottimale.

APPRENDIMENTO PER RINFORZO

FASI DEL MACHINE LEARNING



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Fuzzy rank-based fusion of CNN models using Gompertz function for screening COVID-19 CT-scans

Rohit Kundu[1], Hritam Basak[1], Pawan Kumar Singh[2], Ali Ahmadian[3,4]✉, Massimiliano Ferrara[4] & Ram Sarkar[5]

DECISIONS_LAB.. FOR COVID-19
Il Team di Ricerca
Le Pubblicazioni

Fuzzy rank-based fusion of CNN models using Gompertz function for screening COVID-19 CT-scans

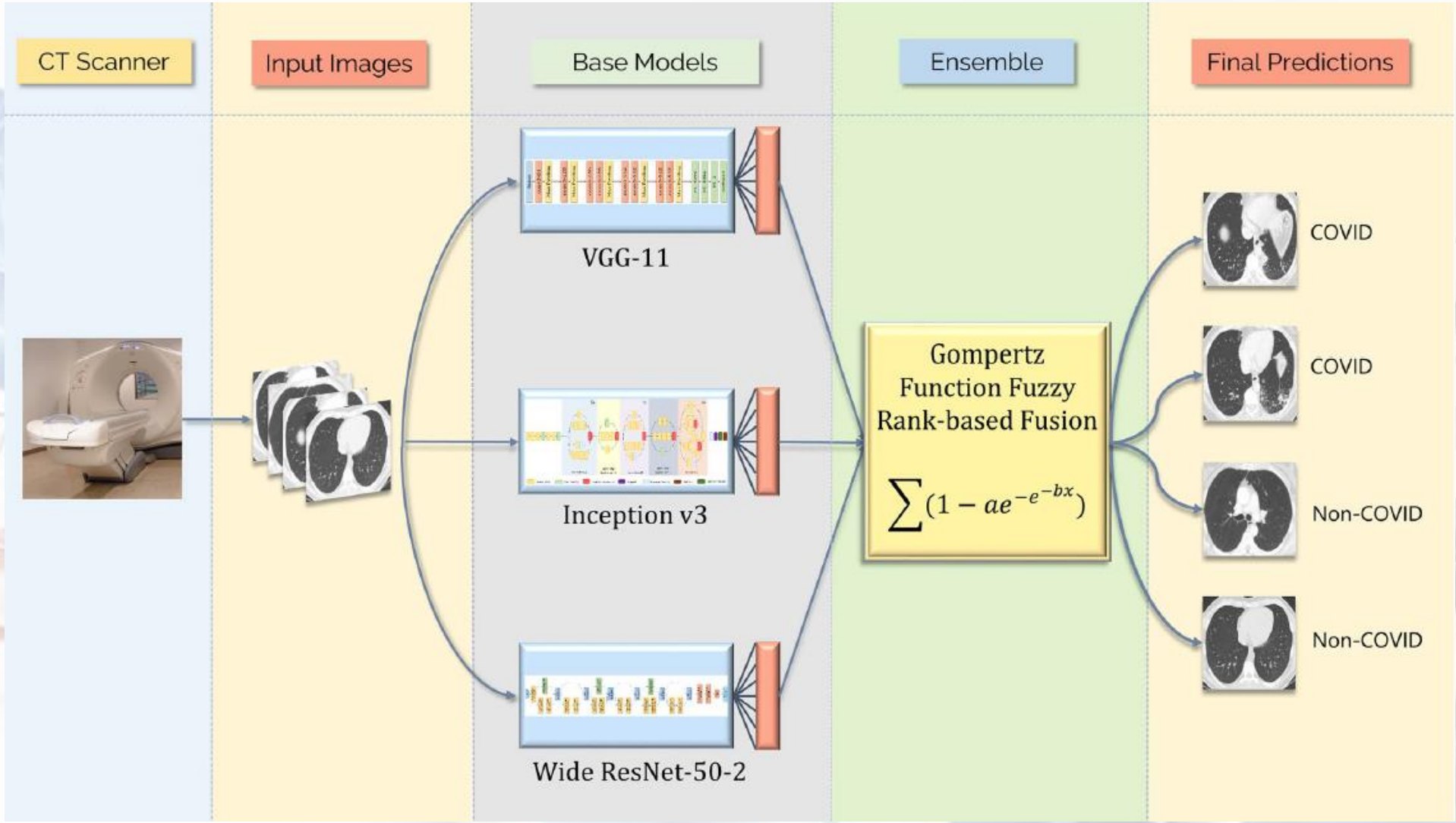
-C'è un disperato bisogno di una diagnosi precoce e accurata di COVID-19 per prevenire ancora di più la diffusione della malattia.

- L'attuale test RT-PCR gold standard è sensibile solo al 71% ed è un test laborioso da eseguire, che porta all'incapacità di condurre lo screening a livello di popolazione.

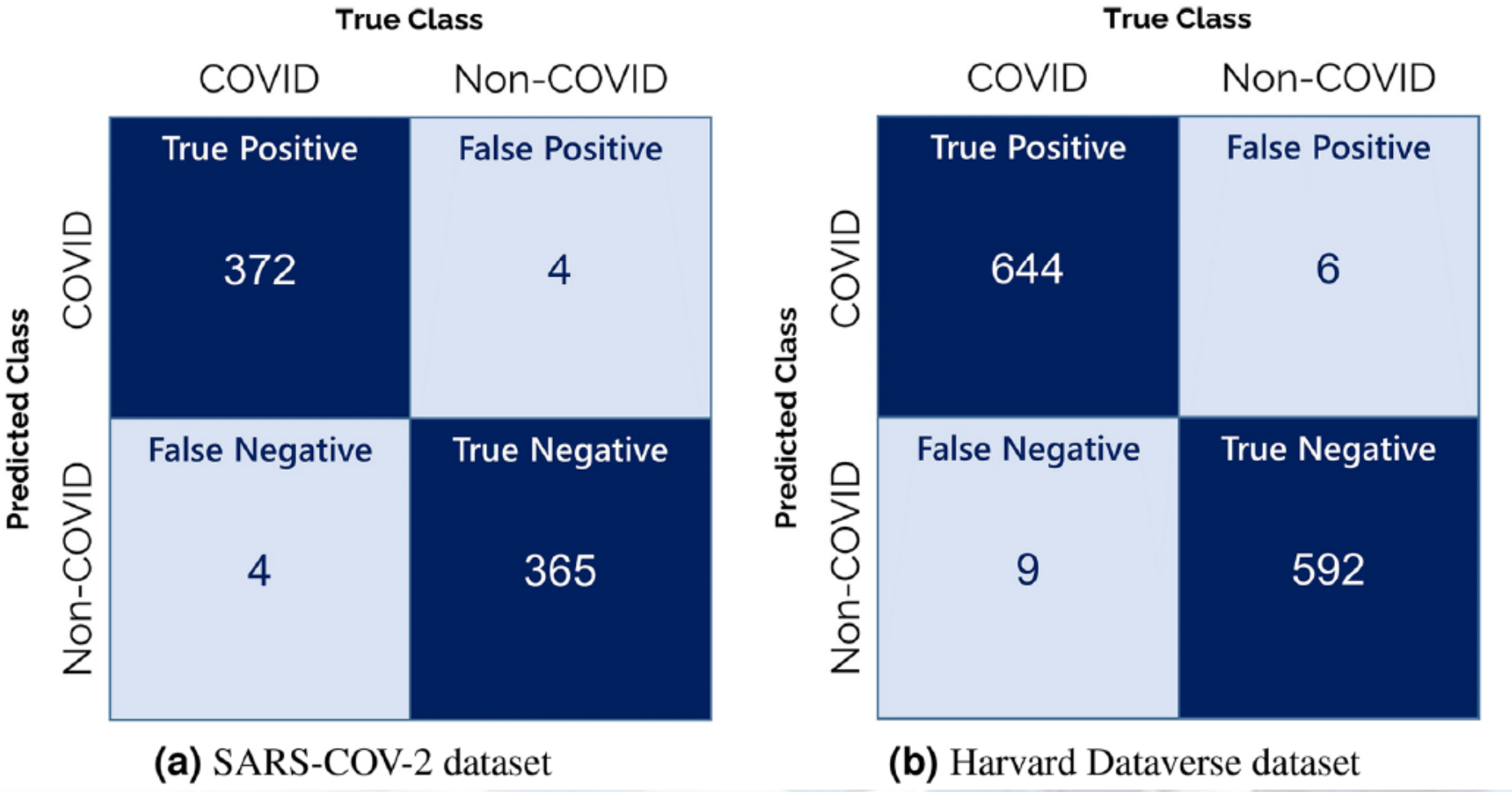
- A tal fine, in questo articolo, proponiamo un sistema di rilevamento automatizzato del COVID-19 che utilizza immagini TC-scan dei polmoni per classificare gli stessi in casi COVID-19 e non-COVID.

Fuzzy rank-based fusion of CNN models using Gompertz function for screening COVID-19 CT-scans

- Il metodo proposto applica una strategia d'insieme che genera ranghi fuzzy dei modelli di classificazione di base utilizzando la funzione di Gompertz e fonde i punteggi decisionali dei modelli di base in modo adattivo per fare le previsioni finali sui casi di test.
- Vengono utilizzati tre modelli di rete neurale convoluzionale basati sull'apprendimento del trasferimento, vale a dire VGG-11, Wide ResNet-50-2 e Inception v3, per generare i punteggi decisionali da fondere con il modello d'insieme proposto.
- Il framework è stato valutato su due set di dati di TC del torace pubblicamente disponibili ottenendo prestazioni allo stato dell'arte, giustificando l'affidabilità del modello.
- I codici sorgente rilevanti relativi al presente lavoro sono disponibili in: GitHub.



Overall workflow of the proposed framework. The CT Scanner image (open access) is obtained from the Progressive Diagnostic Imaging website and the chest CT scan images are from the SARS-COV-2 dataset used in this research.



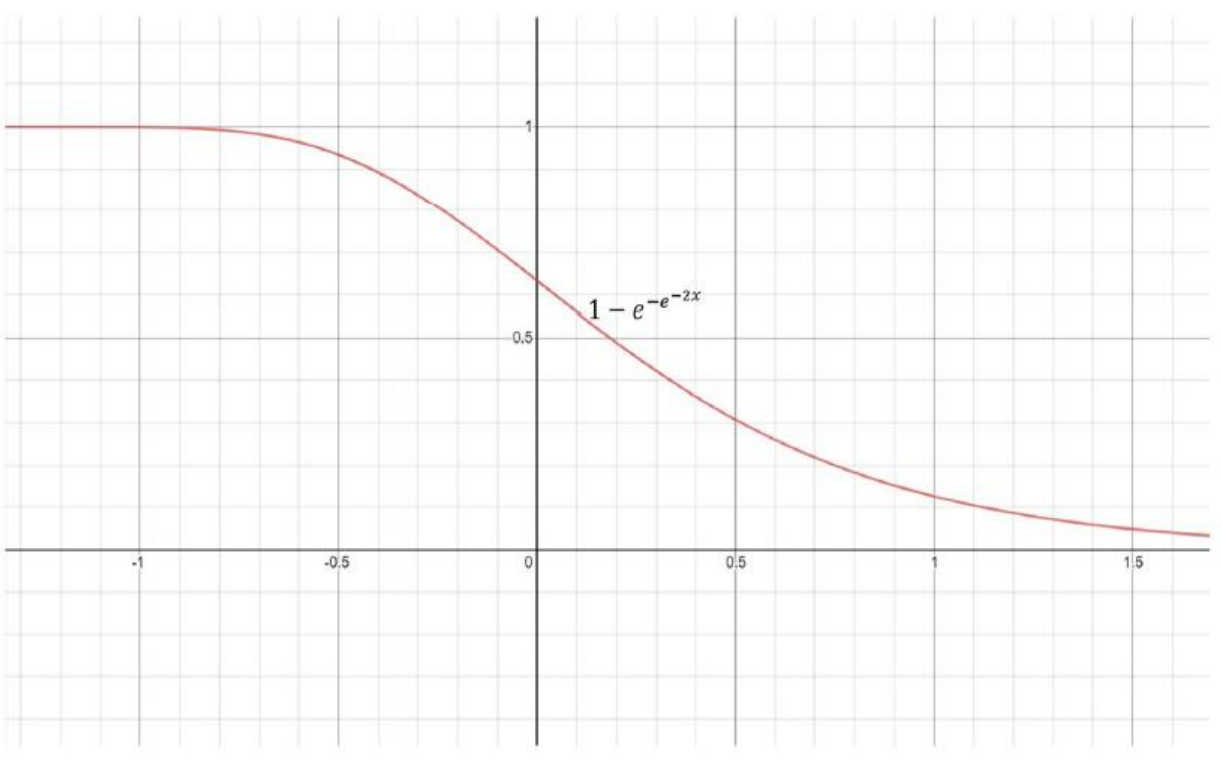
Confusion matrices obtained by the proposed ensemble model on the two datasets considered in the present work.

Let there be M number of decision scores (confidence factors of classifiers) $\{CF^1, CF^2, .. CF^M\}$ for each image $\mathbf{I}$. In our case, M = 3 , since we have used three CNN models to generate the confidence scores on the datasets. The decision scores are normalized which follow Eq. (1), where C is the number of classes in the dataset.

$$\sum_{c=1}^{C} CF_c^{(i)} = 1.0; \ \forall i, \ i = 1, 2, 3, \ldots, M \tag{1}$$

Corresponding to all samples belonging to different classes in the dataset, the confidence scores are used to generate the fuzzy ranks. The fuzzy rank for a class c using the i^{th}classifier's confidence scores is generated by the Gompertz function as in Eq. (2).

$$R_c^{(i)} = \left(1 - exp\left[-exp\left[-2.0 \times CF_c^{(i)}\right]\right]\right), \ \forall i, c; \quad i = 1, 2, \ldots, M; \ c = 1, 2, \ldots C \tag{2}$$



Displaying the re-parameterized Gompertz function used in the present study

- The value of $R_c^{(i)}$ lies in the range [0.127, 0.632] where the smallest value 0.127 is analogous to rank 1 (best rank), i.e., a higher confidence gives a lower (better) value of rank.
- Now, if K^i represents the top k ranks, i.e. ranks 1, 2, . . . , k , corresponding to class c, the fuzzy rank sum (FRSc) and the complement of confidence factor sum (CCFSc) are calculated as in Eqs. (3) and (4), respectively.

$$FRS_c = \sum_{i=1}^{M} \begin{cases} R_c^{(i)}, & \text{if } R_c^{(i)} \in K^{(i)} \\ P_c^R, & \text{otherwise} \end{cases} \tag{3}$$

$$CCFS_c = \frac{1}{M} \sum_{i=1}^{M} \begin{cases} CF_c^{(i)}, & \text{if } R_c^{(i)} \in K^{(i)} \\ P_c^{CF}, & \text{otherwise} \end{cases} \tag{4}$$

P_c^R and P_c^{CF} are the penalty values imposed on class *c*, if it does not belong to the top *k* class ranks. The value of P_c^R is 0.632, which is calculated by putting $CF_c^{(i)} = 0$ in Eq. (2), and the value of P_c^{CF} is set to 0.0. The penalty values ensure that class *c* does not become an unlikely winner. The final decision score is realized by the product of FRS_c and $CCFS_c$ which is used to generate the final predictions of the ensemble model. The final decision score (*FDS*) is calculated as in Eq. (5).

$$FDS_c = FRS_c \times CCFS_c \tag{5}$$

The final predicted class of instance **I** of the dataset is calculated by finding the class having the minimum*FDS* value and is given in Eq. (6).

$$class(\mathbf{I}) = \underset{c=1,2,\ldots,C}{\arg\min} \{FDS_c\} \tag{6}$$

The computational complexity of the proposed ensemble approach is $O(n)$ where '*n*' is the number of classes in the dataset.

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MRFGRO: a hybrid meta-heuristic feature selection method for screening COVID-19 using deep features

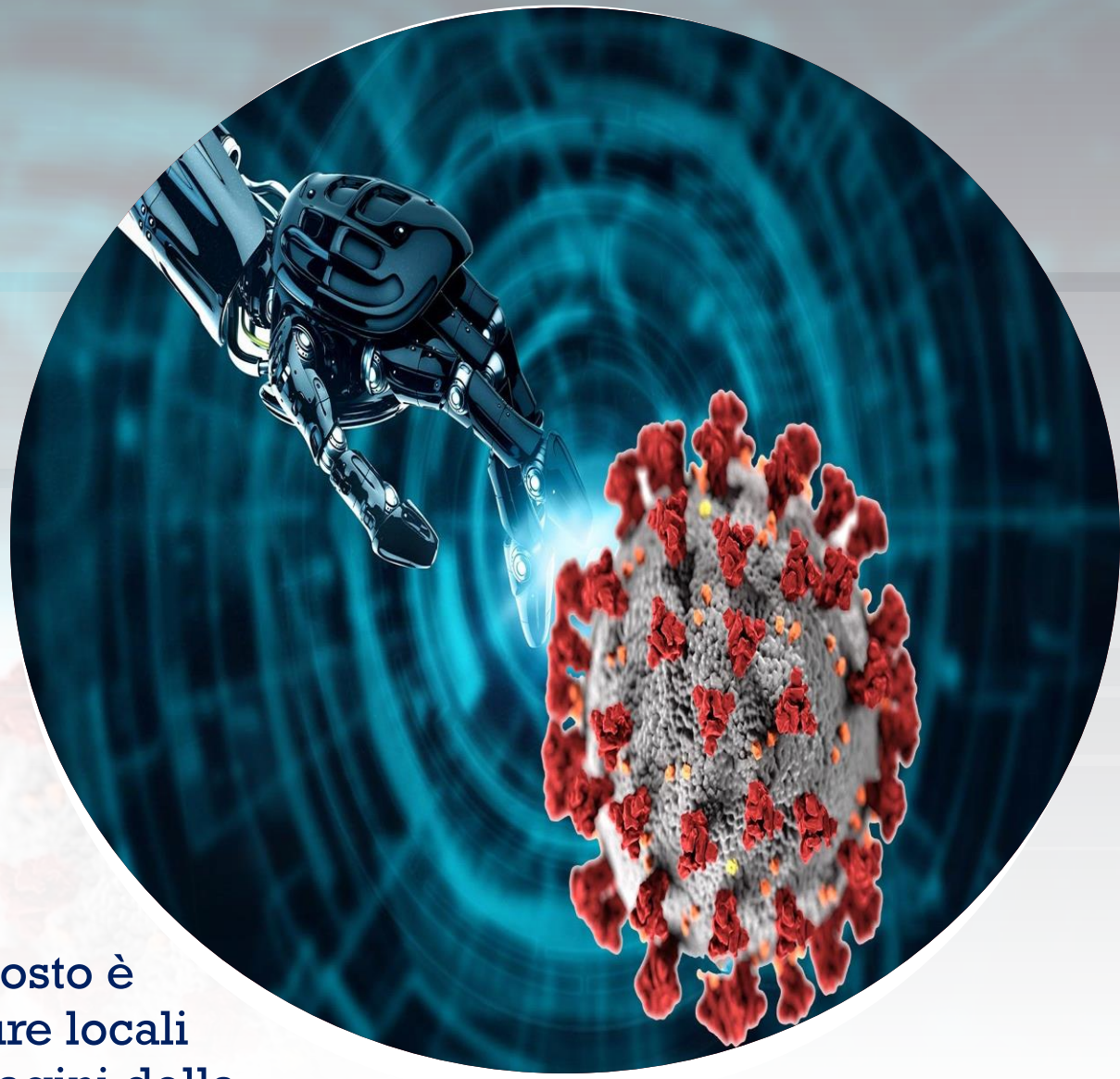
Arijit Dey[1], Soham Chattopadhyay[2], Pawan Kumar Singh[3], Ali Ahmadian[4,5,7✉], Massimiliano Ferrara[6✉], Norazak Senu[7] & Ram Sarkar[8]

DECISIONS_LAB.. FOR COVID-19
Il Team di Ricerca
Le Pubblicazioni

MRFGRO: a hybrid meta-heuristic feature selection method for screening COVID-19 using deep features

- Il modo più comune per la diagnosi di COVID-19 è la reazione a catena della trascrizione inversa della polimerasi (RT-PCR) in tempo reale che richiede una notevole quantità di tempo per ottenere il risultato.
- L'analisi dell'immagine medica basata su computer è più vantaggiosa per la diagnosi di tale malattia in quanto può fornire risultati migliori in meno tempo.
- Le scansioni di tomografia computerizzata (TC) vengono utilizzate per monitorare le malattie polmonari, incluso il COVID-19.
- In questo lavoro è stato sviluppato un modello ibrido per il rilevamento di COVID-19 che ha due fasi chiave.
- Nella prima fase, abbiamo messo a punto i parametri delle reti neurali convoluzionali pre-addestrate (CNN) per estrarre alcune caratteristiche dai polmoni affetti da COVID-19.

- Come CNN pre-addestrate, abbiamo utilizzato due CNN standard, ovvero GoogleNet e ResNet18.
- Abbiamo proposto un algoritmo ibrido di selezione delle caratteristiche meta-euristiche (FS), denominato Golden Ratio Optimizer (MRFGRO) basato su Manta Ray Foraging per selezionare il sottoinsieme di caratteristiche più significative.
- Il modello proposto è implementato su tre set di dati pubblicamente disponibili, vale a dire, set di dati COVID-CT, set di dati SARS-COV-2 e set di dati MOSMED, e raggiunge una precisione di classificazione all'avanguardia rispettivamente del 99,15%, 99,42% e 95,57%.



- I risultati ottenuti confermano che l'approccio proposto è abbastanza efficiente rispetto ai descrittori di texture locali utilizzati per il rilevamento di COVID-19 dalle immagini della TC del torace

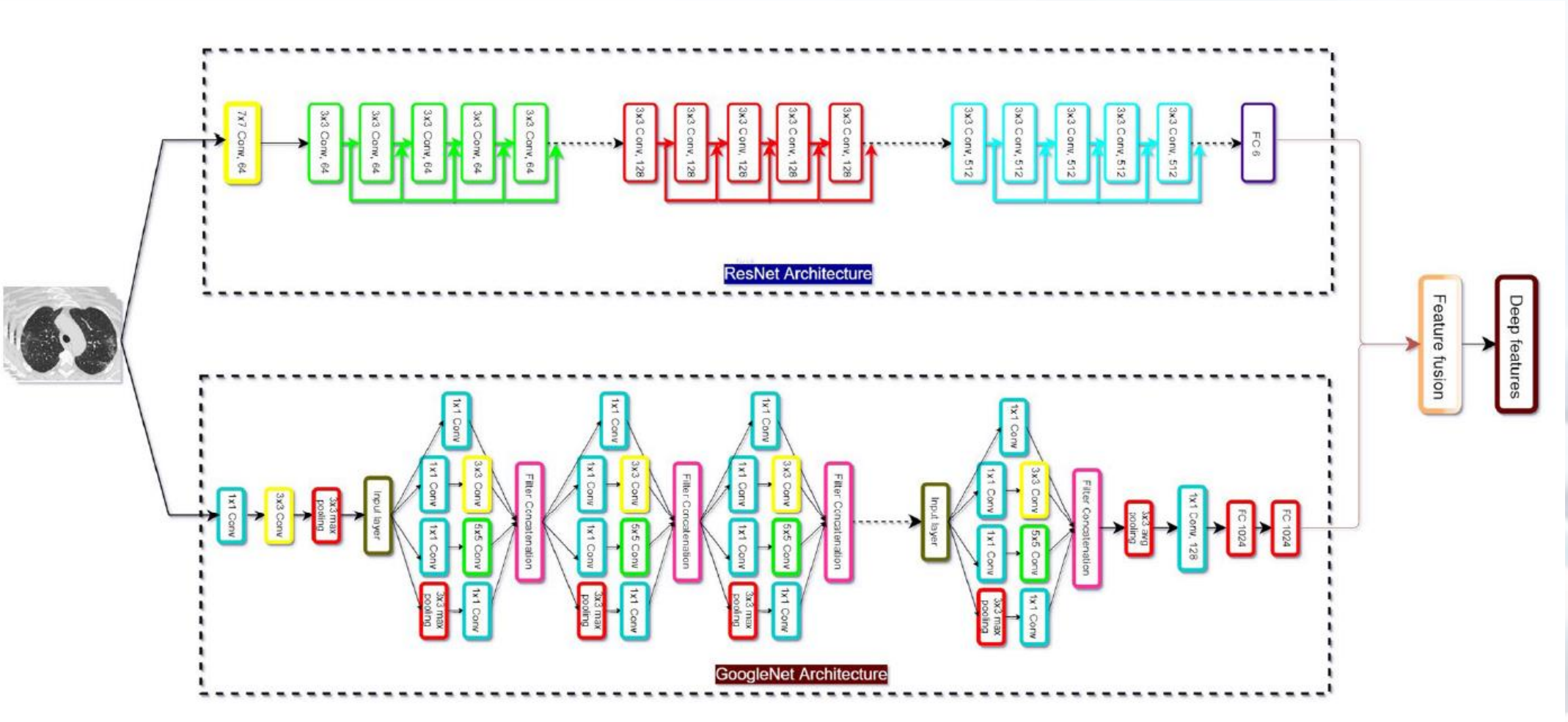


Illustration of the work flow of deep features extraction from GoogLeNet and ResNet18 architectures.
The input CT-scan images are taken from CARS-Cov-2 CT-scan dataset.

The mathematical expression of chain foraging is as followed:

$$p_j^{(n+1)} = \begin{cases} p_j^n + d(p_{best}^n - p_j^n) + \beta(p_{best}^n - p_j^n) & j = 1 \\ p_j^n + d(p_{j-1}^n - p_j^n) + \beta(p_{best}^n - p_j^n) & j = 2, \ldots, N \end{cases}, \quad (3)$$

at iteration n, the position of jth manta ray is given by p_j^n and, d, N and p_{best}^n are a random vector, number of manta rays and the best solution respectively. The weighting coefficient β is given by

$$2 \times d \times \sqrt{|log(d)|}. \quad (4)$$

Manta rays start forming chain in a combined manner and swim towards the prey following a spiral path, after being cognizant about the exact position of the plankton. In cyclone foraging, in addition to spiral motion, each manta ray is one step ahead towards its prior one, and thus a cyclonic motion in formed. The cyclonic foraging can be expressed in terms of two perpendicular components, which are given as follows:

$$X_j^{n+1} = X_{best} + d(X_{j-1}^n - X_j^n) + e^{a\omega} cos(2\pi\omega)(X_{best} - X_j^n), \quad (5)$$

$$Y_j^{n+1} = Y_{best} + d(Y_{j-1}^n - Y_j^n) + e^{a\omega} sin(2\pi\omega)(Y_{best} - Y_j^n), \quad (6)$$

where ω is a random number

Now similar to chain foraging, the position and movement of cyclone foraging towards the minimum can be expressed as given below:

$$p_j^{(n+1)} = \begin{cases} p_{best} + d(p_{best}^n - p_j^n) + \gamma(p_{best}^n - p_j^n) & j = 1 \\ p_{best} + d(p_{j-1}^n - p_j^n) + \gamma(p_{best}^n - p_j^n) & j = 2, ..., N \end{cases} . \quad (7)$$

Here, also γ is a weighting factor with the expression

$$\gamma = 2e^{d_1\left(\frac{I-n+1}{I}\right)} sin(2\pi d_1), \quad (8)$$

where I is the maximum iteration and $d1$ is a random number

Multimedia Tools and Applications (2022) 81:31–50
https://doi.org/10.1007/s11042-021-11319-8

1192: PIONEERING AI, DATA SCIENCE AND MULTIMEDIA TECHNIQUES AND FINDINGS FOR COVID-19

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ET-NET: an ensemble of transfer learning models for prediction of COVID-19 infection through chest CT-scan images

Rohit Kundu[1] · Pawan Kumar Singh[2] · Massimiliano Ferrara[3,4] · Ali Ahmadian[5,6,7] · Ram Sarkar[8]

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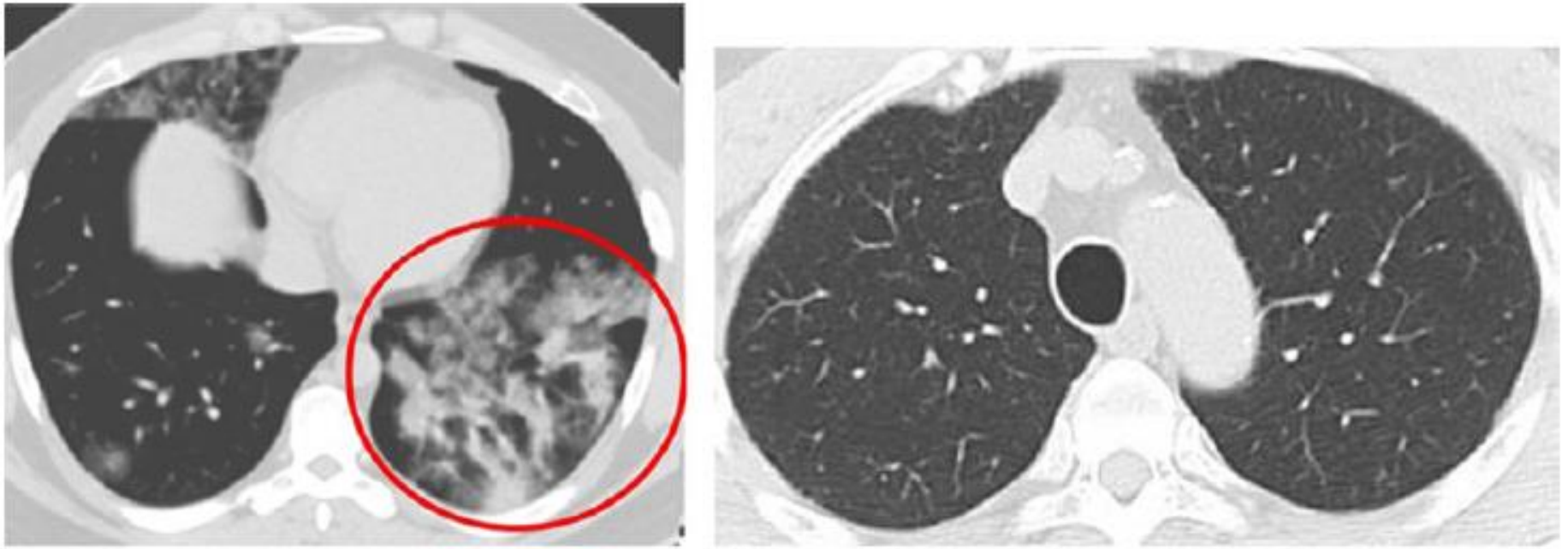
Il Team di Ricerca
Le Pubblicazioni

ET-NET: an ensemble of transfer learning models for prediction of COVID-19 infection through chest CT-scan images

- Sebbene il test in tempo reale della reazione a catena della polimerasi (RT-PCR) sia il test di riferimento per lo screening del COVID-19, non è accurato e sensibile in modo soddisfacente.
- D'altra parte, le immagini della tomografia computerizzata (TC) sono molto più sensibili e possono essere adatte per il rilevamento di COVID-19.
- A tal fine, con questo lavoro si è sviluppato un metodo completamente automatizzato per lo screening rapido di COVID-19 utilizzando immagini di TAC del torace che impiegano tecniche di Deep Learning.

- Per questo problema di classificazione delle immagini supervisionato, è stato utilizzato un insieme di aggregazione bootstrap o Bagging di tre modelli di apprendimento di trasferimento, ovvero Inception v3, ResNet34 e DenseNet201, per aumentare le prestazioni dei singoli modelli.

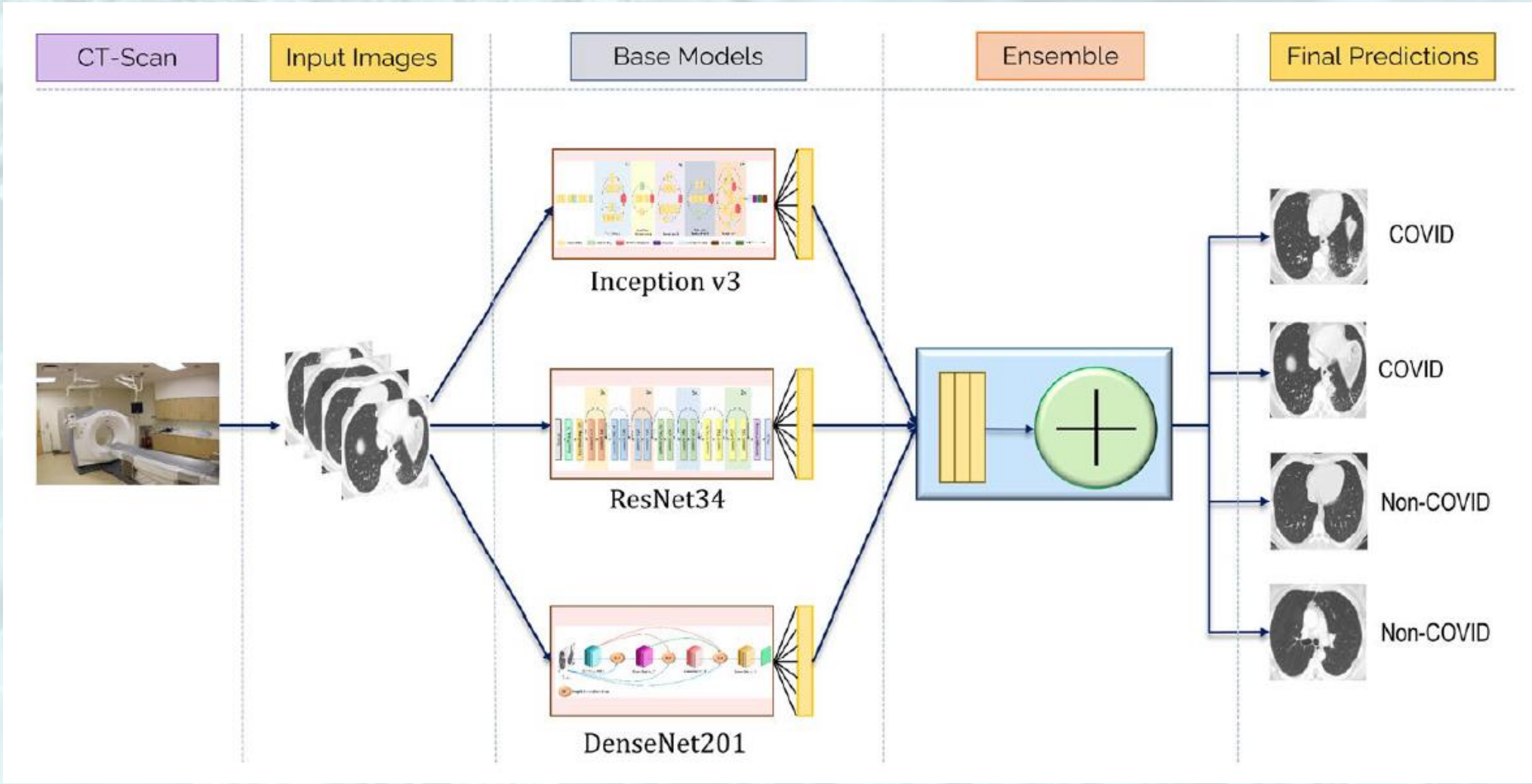
- Il framework proposto, chiamato ET-NET, è stato valutato su un set di dati pubblicamente disponibile, raggiungendo una precisione del 97,81 ± 0,53%, una precisione del 97,77 ± 0,58%, una sensibilità del 97,81 ± 0,52% e una specificità del 97,77 ± 0,57% su un cross-cross di 5 volte. validazione superando dell'1,56% il metodo all'avanguardia sullo stesso set di dati.



(a) COVID-19 positive patient

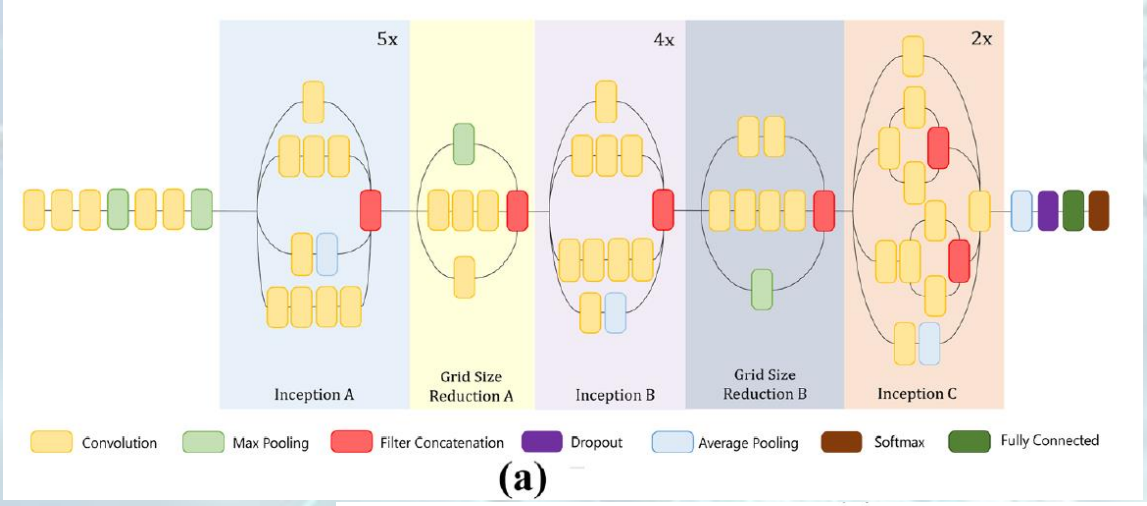
(b) COVID-19 negative patient

Illustration of chest CT image findings of two patients having: ***(a)*** *COVID-19 positive and* ***(b)*** *COVID-19 negative. The COVID-19 infection's characteristic "Ground Glass Opacity" has been marked with a red circle in the COVID-19 infected chest CT image*

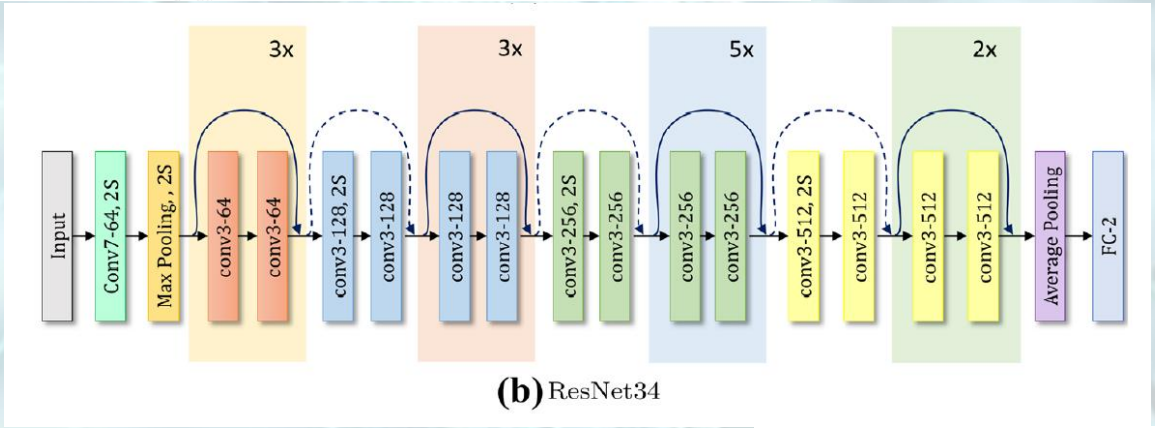


Overall workflow of the proposed ET-NET ensemble classifier model for COVID-19 detection from chest CT-scan images

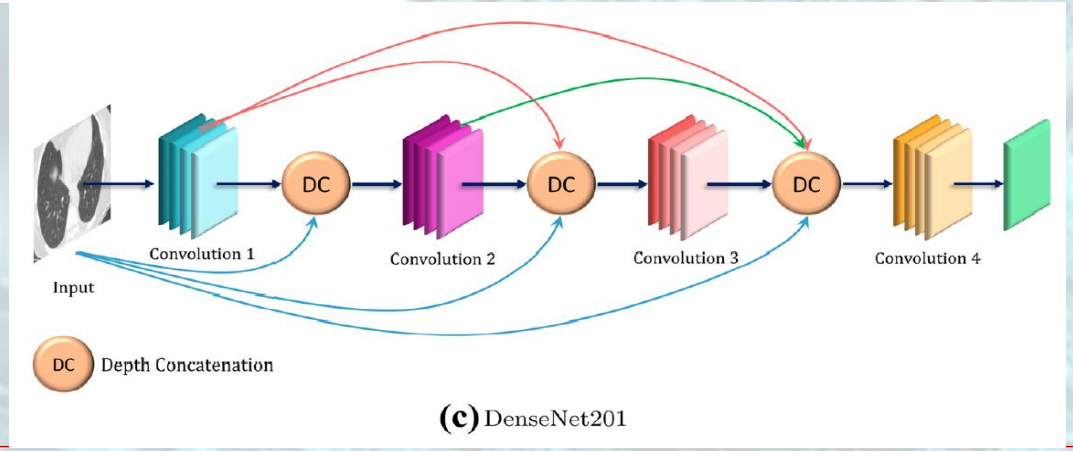
*Architectures of the three CNN base classifiers: **(a)** Inception v3, **(b)** ResNet34, and **(c)** DenseNet201 used to form the proposed ensemble model called ET-NET*



(a)



(b) ResNet34



(c) DenseNet201

ANALYSIS OF THE MENTAL HEALTH OF SCHOOL AND COLLEGE STUDENTS DURING THE PANDEMIC: ARTIFICIAL INTELLIGENCE TECHNIQUES

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Massimiliano Ferrara

0965 -1695446

massimiliano.ferrara@unirc.it

www.decisionslab.unirc.it

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INTELLIGENZA “NATURALE” E TRATTAMENTO DELLE INFEZIONI IN CHIRURGIA E NEI PAZIENTI TRAPIANTATI

Alfonso Recordare, MD

Dipartimento di Chirurgia Oncologica e d’Urgenza,
Ospedale Dell’Angelo Venezia Mestre
Professore a contratto Chirurgia Generale
Tbilisi State Medical University Georgia

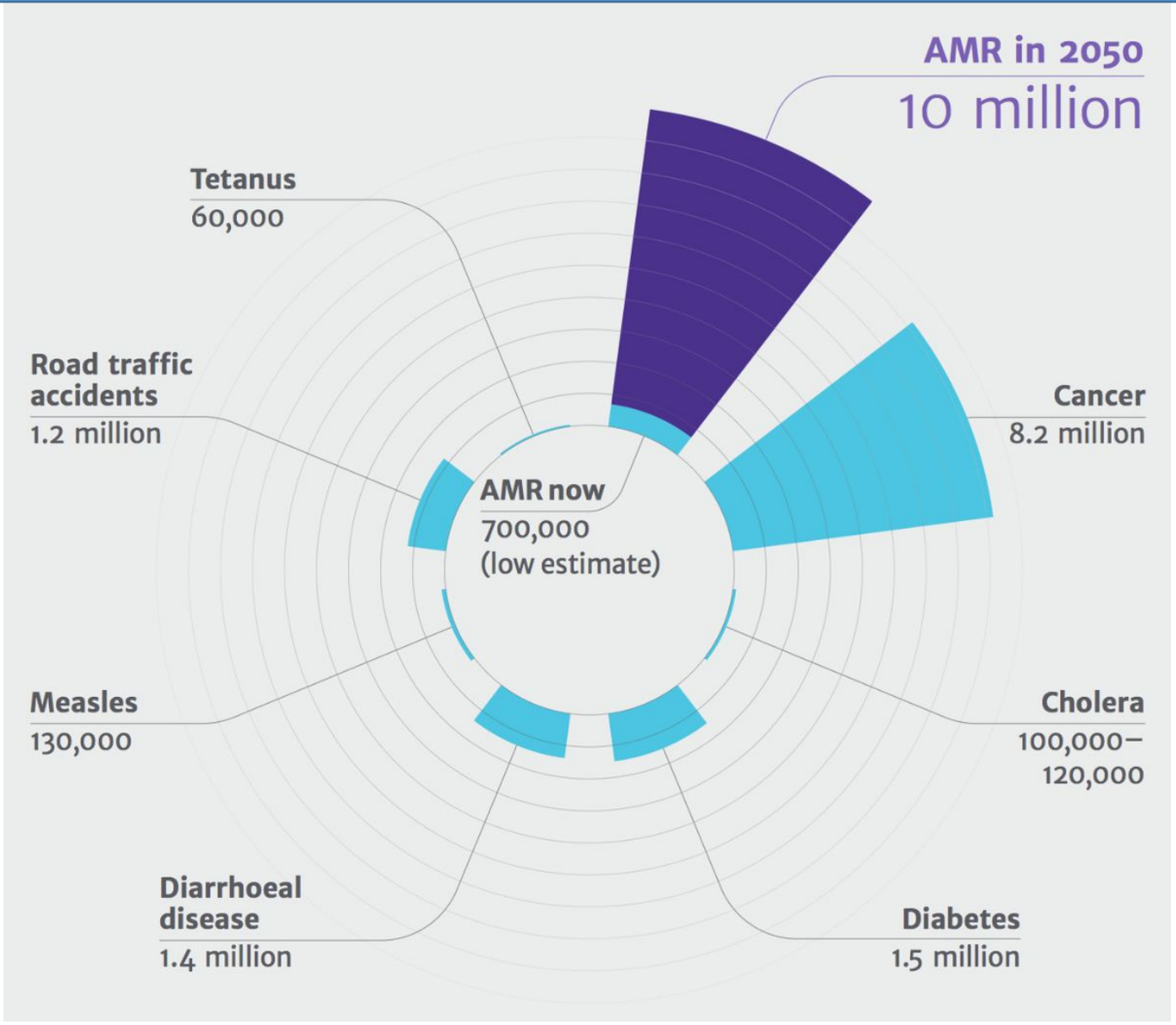
INTELLIGENZA “NATURALE” E TRATTAMENTO DELLE INFEZIONI IN CHIRURGIA NEI PAZIENTI TRAPIANTATI

AIMS

Academy for Innovation in Medical Sciences

Institute ELIAVA

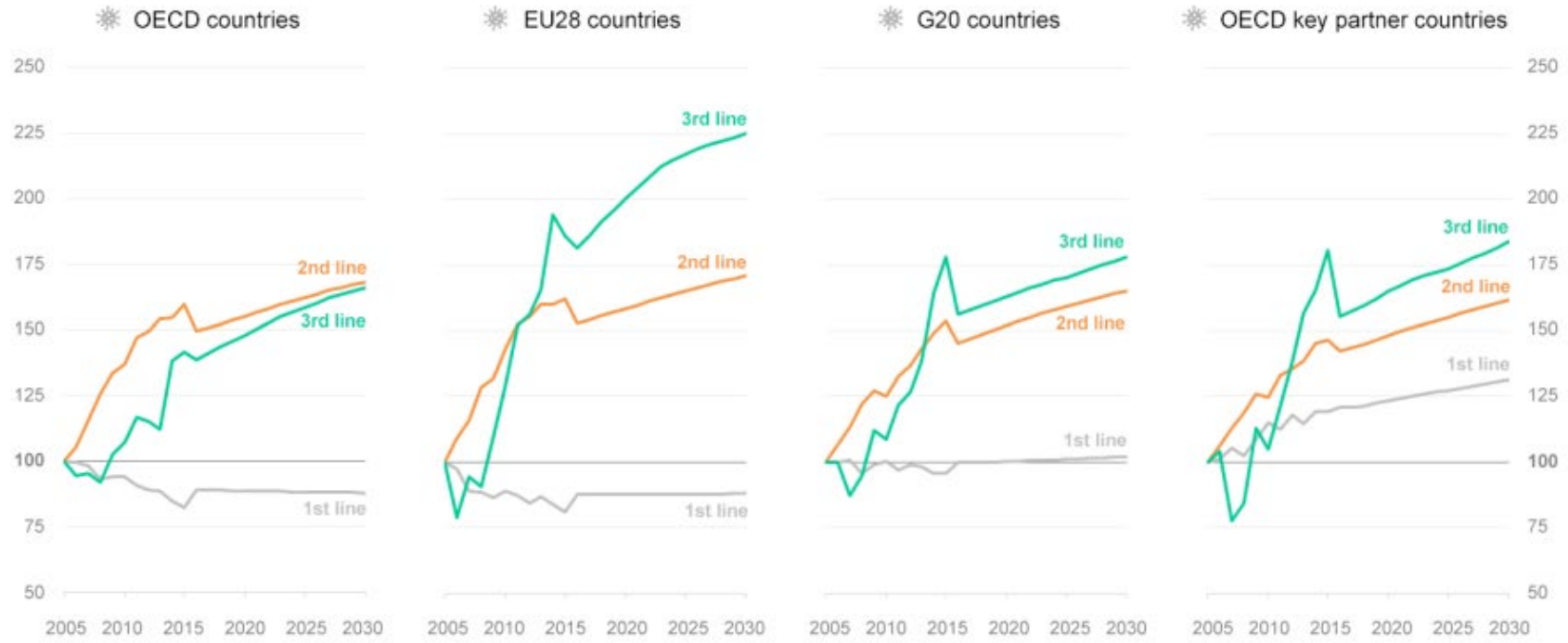
FORECAST


AMR in 2050
10 million
Tetanus
60,000
Road traffic accidents
1.2 million
Cancer
8.2 million
AMR now
700,000
(low estimate)
Measles
130,000
Cholera
100,000–120,000
Diarrhoeal disease
1.4 million
Diabetes
1.5 million

Trends antimicrobial resistance

Trends in antimicrobial resistance

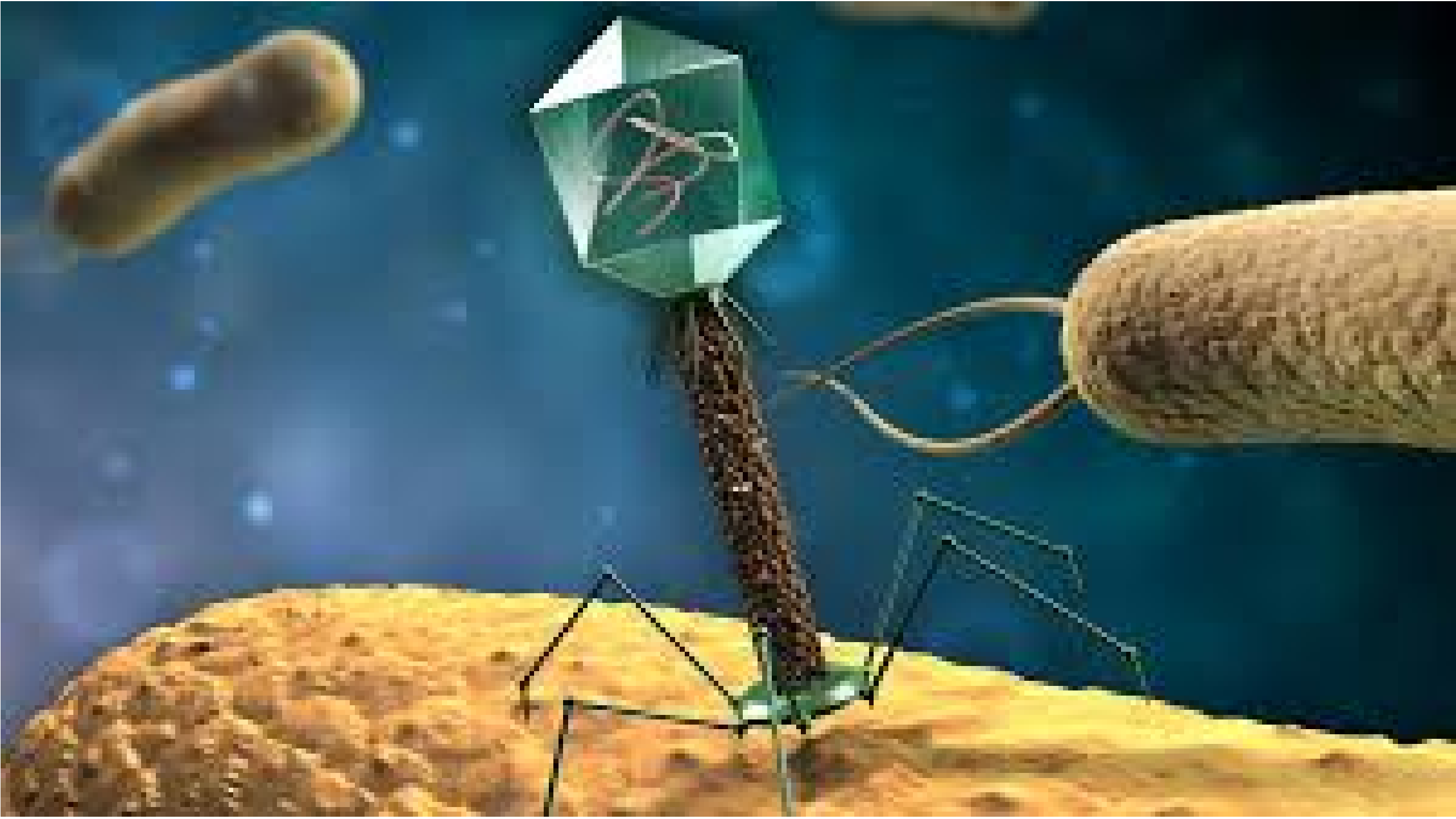
Selected regions and country groups among high-priority antibiotic-bacterium combinations, by line of treatment



Resistance to first-line treatments is defined as the average of the proportions of penicillin-resistant *S. pneumoniae* and methicillin-resistant *Staphylococcus aureaus*.
Resistance to second-line treatments is the average of the proportions of *E. coli* and *K. pneumoniae* resistant to 3rd-generation cephalosporins and of *E. coli* resistant to fluoroquinolones.
Resistance to third-line treatments is defined as the proportion of *K. pneumoniae* resistant to carbapenems.
OECD key partner countries refer to Brazil, China, India, Indonesia and South Africa.

Source: OECD analyses of data from surveillance networks included in ResistanceMap.

OECD



Phage therapy: history

The first evidence for a viral-like agent with antibacterial properties was reported by M. E. Hankin in 1896.

Found in the Ganges river in India, it was temperature sensitive, capable of passing through a porcelain filter, and could reduce titres of the bacterium *Vibrio cholerae* in laboratory culture.

Hankin suggested that it might help to decrease the incidence of cholera in people using water from the Ganges.

Adhya S and C. Merril. 2006. The road to phage therapy**.** *Nature* **443:** 754-755

Phage therapy: history

d'Herelle's first clinical experiences in 1920's

d'Herelle F. (1917). Sur un microbe invisible antagoniste des bacilles dysentériques. Acad. Sci. Ser. D 165:373

d'Herelle F. (1925) Essai de traitement de la peste bubonique par le bactériophage. La Presse Med. 33: 1393-94.

George Eliava starts the microbiology institute in Tbilisi (1923) and
d'Hérelle is invited by Stalin to the Eliava Institute (1936).

Commercialization of phages in France and USA in 1930's

L'Oréal: Bacté-intesti-phage, Bacté-pyo-phage, Bacté-staphylo-phage

Eli Lilly: Colo-lysate, Entero-lysate, Staphylo-lysate

Phage therapy was abandoned in the West, because of

lack of understanding of the high specificity and mode of action of phages

exaggerated claims of effectiveness: urticaria, herpes, eczema

the rise of **broad-spectrum antibiotics**

but phage therapy research continued in Eastern Europe ...

Eliava Institute – Tiblisi (Georgia)

Bacteriophages an alternative to the antibiotics

- Long history of success in the former Soviet Union
- Before discovery of antibiotics – it was wide spread in Europe and US (Institut Pasteur, France; Antipiol, Germany; Eli Lilly, US)
- Phage were successfully used for treatment and prophylactic purposes
- For today, Eliava Consortium (Eliava Institute of Bacteriophages, Diagnostic center, production facility, phage therapy center) – the World known center for research and application

Historical overview

REVIEW

Virulence 5:1, 226–235; January 1, 2014; © 2014 Landes Bioscience

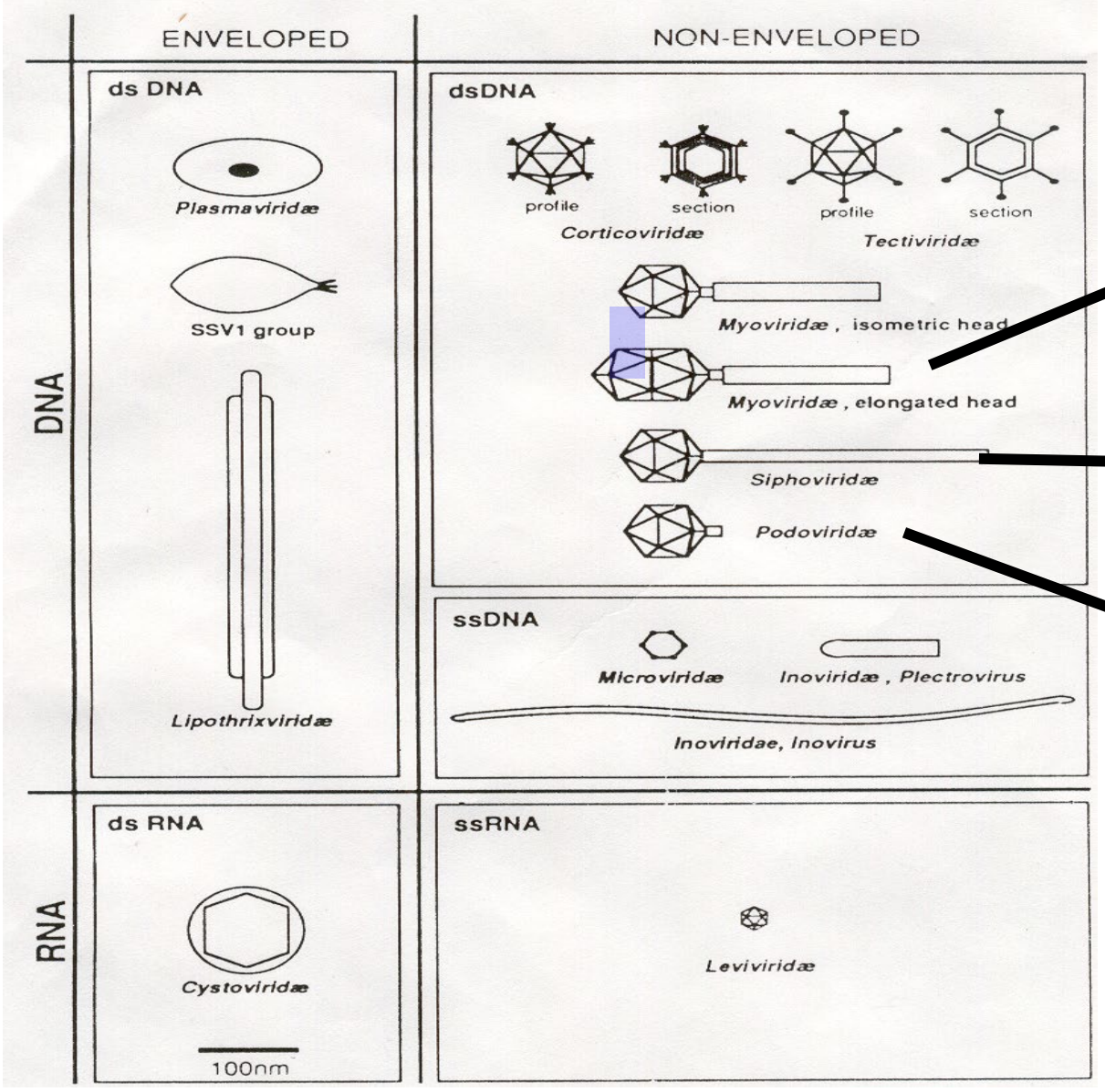
A historical overview of bacteriophage therapy as an alternative to antibiotics for the treatment of bacterial pathogens

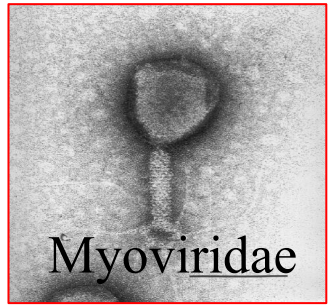
Xavier Wittebole[1,*], Sophie De Roock[2], and Steven M Opal[3,4]

[1]Critical Care Department; St Luc University Hospital; Université Catholique de Louvain; Brussels, Belgium; [2]High Care Burn Unit; Military Hospital; Brussels, Belgium; [3]The Infectious Disease Division; Memorial Hospital of RI; Providence, RI USA; [4]The Alpert Medical School of Brown University; Providence, RI USA

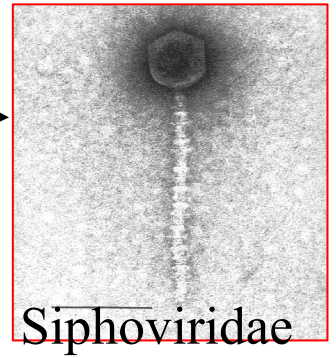
Keywords: sepsis, septic shock, multidrug resistant pathogens, bacteriophage therapy, phage therapy

Phages: genome and virion structure

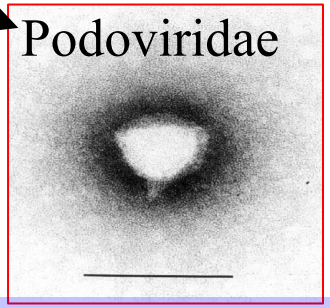




25%



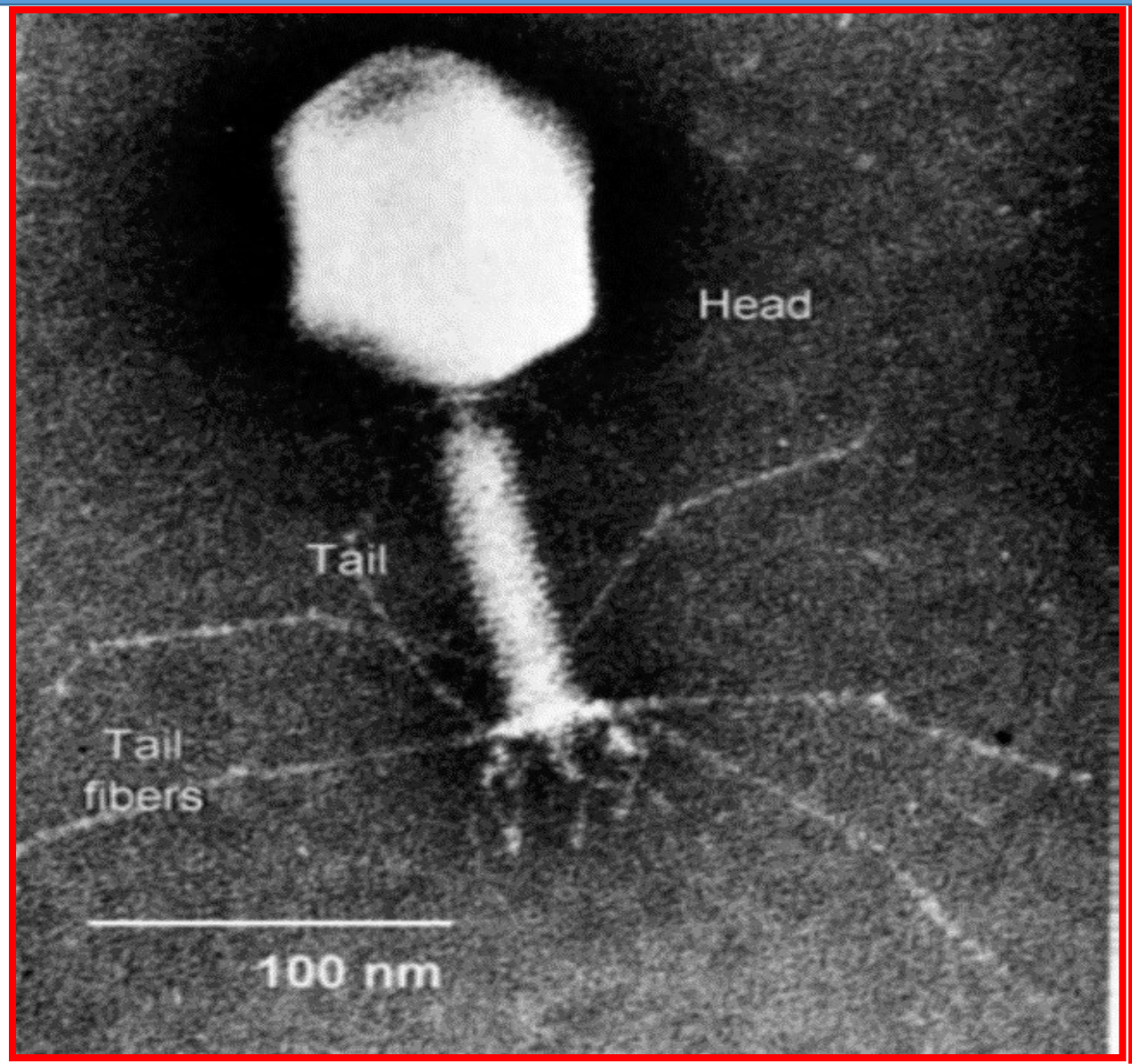
61%

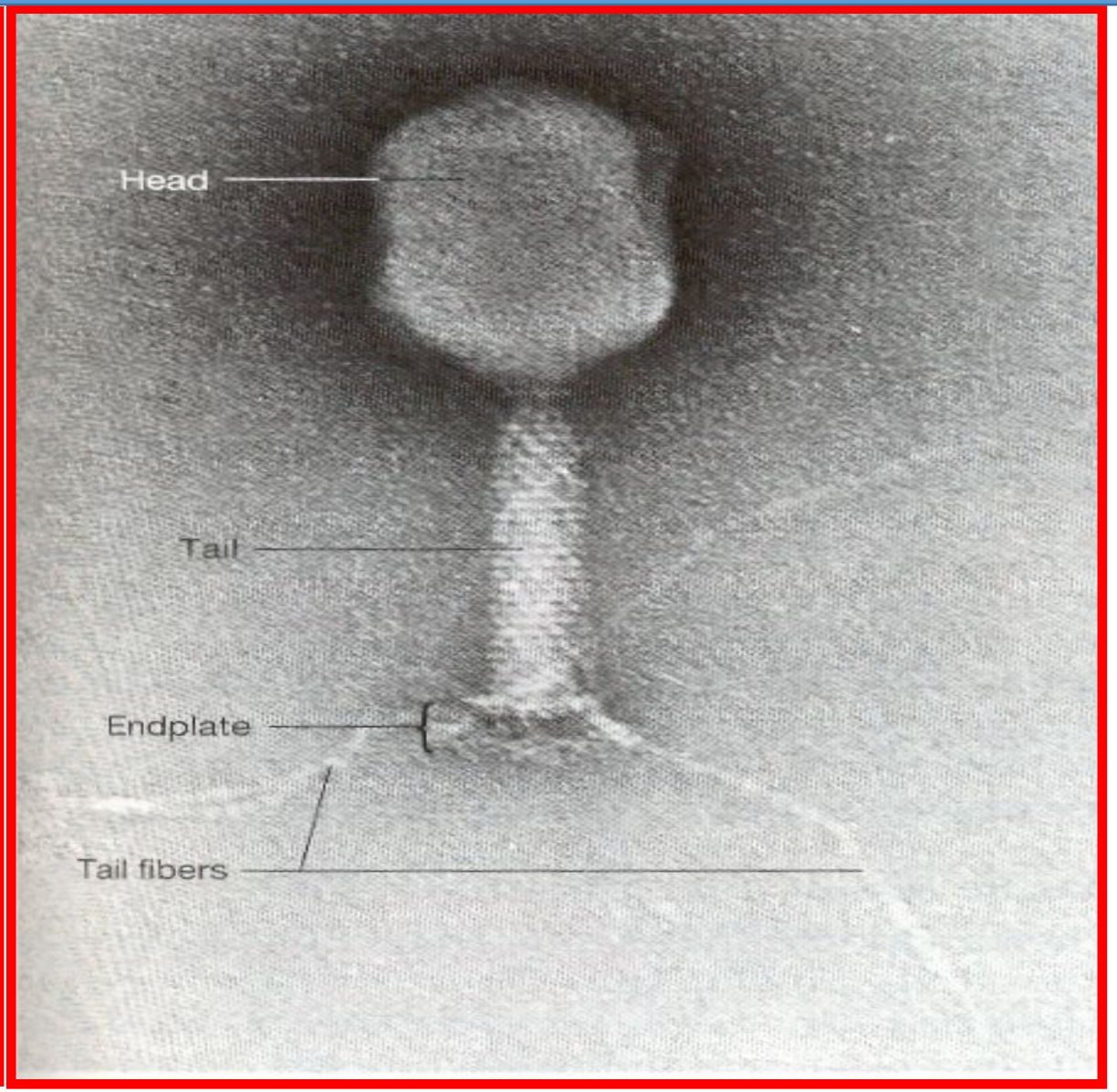


14%

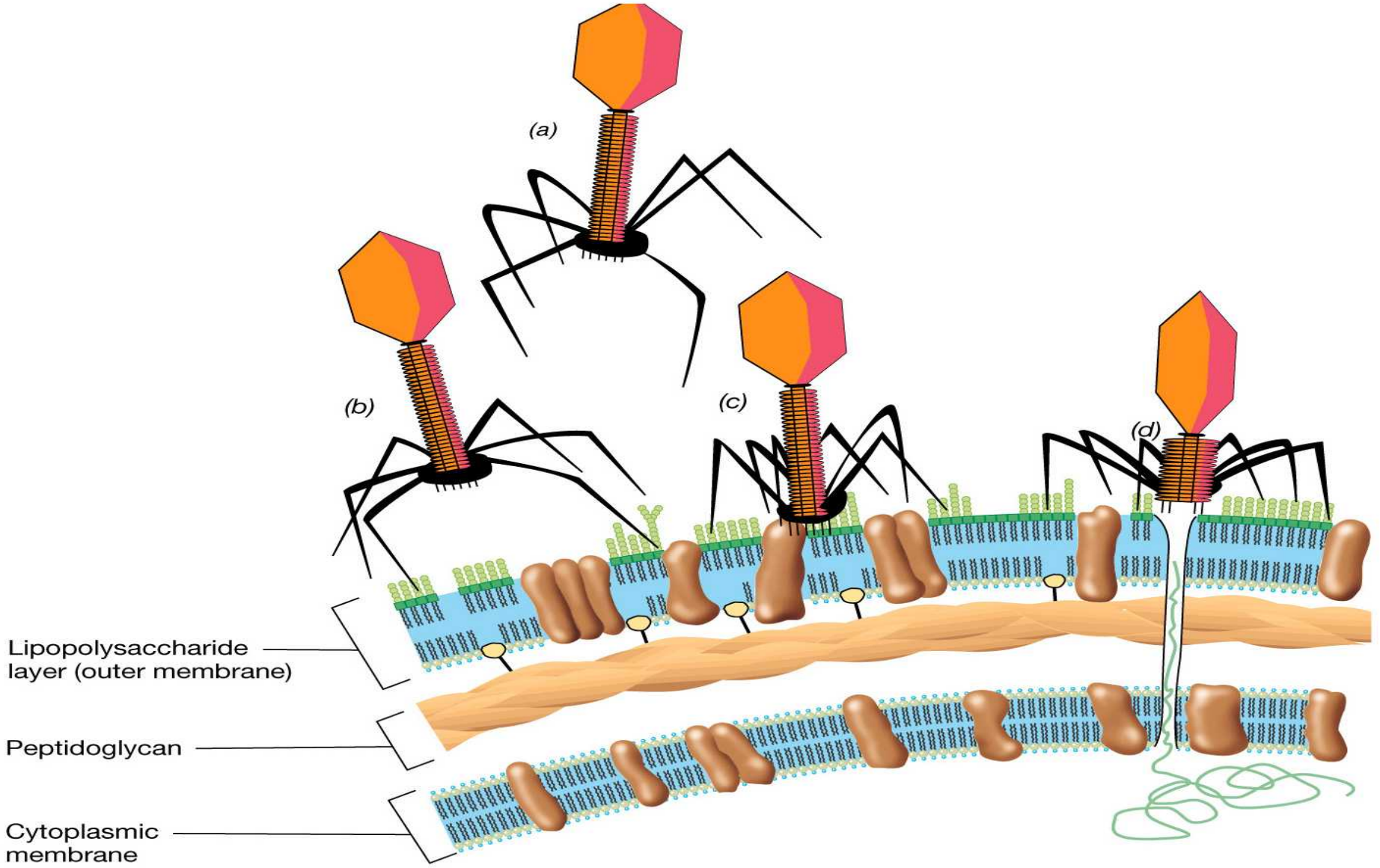
Caudovirales: tailed phages
n = 5000 = 96% of phages

E. coli phage T4 (Myoviridae)





Phages: Infection by *E. coli* T4-bacteriophage



Phages: Life cycles. Chronic, lytic, lysogenic

Chronic phages (e.g. *E. coli* phage M13):

after injection phage particles are formed immediately.

These leave the host cell without lysis

Lytic phages (e.g. *E. coli* phage T4):

Therapeutic phages

after injection phage particles are formed immediately and the

bacterial cell is lysed before duplication: **virulent phages**

Lysogenic phages (e.g. *E. coli* phage Lambda):

after injection the phage genome is incorporated into

the bacterial genome as a prophage

and duplicated together with the bacterial genome:

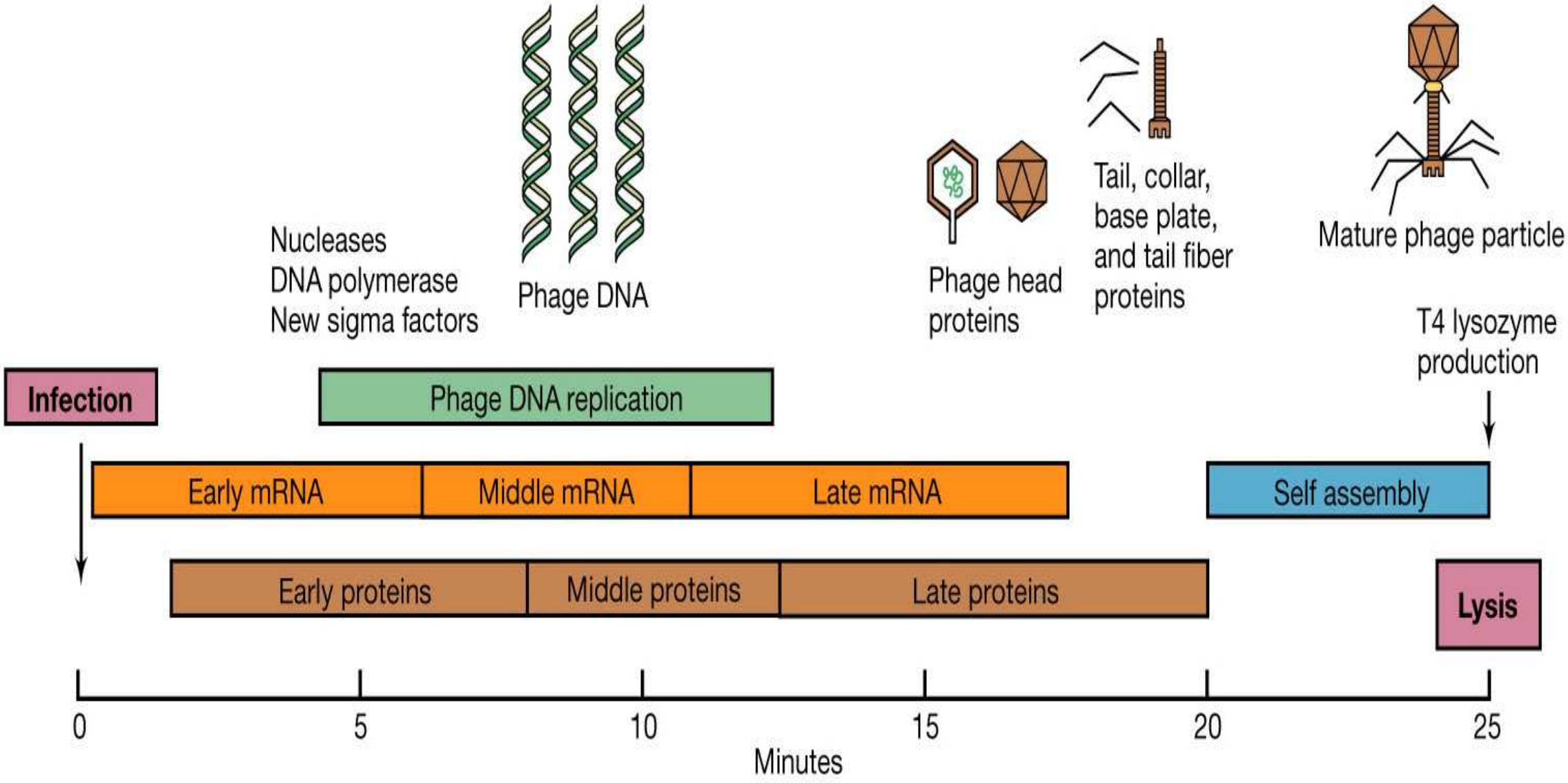
lysogenic phase

later the prophage can be activated and enter a lytic cycle:

lytic phase

temperate phages

Time course of lytic infection cycle



Phage therapy: advantages

Narrow spectrum

- no effect on commensal microflora
- no cross-resistance effects
- flexible: cocktail spectrum can be adapted to the clinical needs
  treatment can be customized/personalized

Different kinetics

- in theory one single dose can be sufficient to treat an infection
- less dependant on blood stream: phages pass also BBB

(Dabrowska et al. 2005. Bacteriophage penetration in vertebrates. **J. Appl. Microbiol. 98**: 7-13.)

- phage transfer to other individuals possible: prophylactic effect

No relation to antibiotic resistance: MDR bacteria can be treated.

Phage therapy: strategies - 1

1. Classic: use of **cocktails of lytic virulent** phages
Merril et al. 2003. The prospect for bacteriophage therapy in Western medicine.
Nature Reviews/Drug Discovery 2: 489-497.

2. Use of **phage-derived antibacterial** products:
T4-lysozyme, lysines, capsule polysaccharide depolymerases, ...
Loeffler et al. 2001. (group of Fischetti, also KULeuven: Volckaert, Lavigne)
Rapid killing of *Streptococcus pneumoniae* with a bacteriophage cell wall hydrolase.
Science 294: 2170-2172.

Two different lines of reasoning lead to the estimate that 2 billion phage genes are present, i.e. that only 0.0002% of the global phage genome – comprised in 100 million phage species has been sampled.
Rohwer, F. 2003. Global phage diversity. **Cell 113**: 171-182.

Phage therapy: strategies - 2

3. Genetically manipulated lysogenic phages for ***in situ* gene delivery**:
--> *in situ* delivery to bacterial cells of
* killing genes (doc)
* antisense RNA to block translation

Westwater et al. 2003. Use of a genetically engineered phage to deliver antimicrobial agents to bacteria: an alternative therapy for treatment of bacterial infections. **Antimicrob. Agents Chemother. 47:** 1301-1307.

4. Phages as **probiotics with immunomodulatory effects?**
Phages inhibit human T-cell activation and proliferation
Phages diminish cellular infiltration into allogeneic skin allografts

Gorski et al. 2006. Bacteriophages and transplantation tolerance. **Transplant. Proc. 38**: 31-333.

Phages: safety. Theoretical considerations - 1

Phages are safe by definition: viruses which infect bacteria only

1. Bacteriophages infect specifically bacteria
since they need to recognize bacterial cell wall structures: ***peptidoglycane, LPS***.

2. Bacteriophages that were manipulated genetically to infect mammalian cells
were ***not able to multiply inside*** the mammalian cells after infection.
Di Giovine *et al*. 2001. Binding properties, cell delivery, and gene transfer
of adenoviral penton based displaying bacteriophage. **Virology 282**: 102-112.

3. ***No bacteriophage genes*** can be found ***in the human genome***, whereas
retro-viruses have left hundreds of genes integrated into the human genome.

In summary,
bacteriophages have ***no tropism*** towards mammalian cells and ***cannot multiply*** in them.

Phages: safety. Theoretical considerations - 2

Bacteriophages are numerous and ubiquitous:

Numerous

Estimate of total number of tailed phage particles on Earth:

$4\text{-}6 \times 10^{31}$ = 10-fold of number of prokaryotes.

Bergh. 1989. **Nature 340**: 467-468

Whitamn et al. 1998. **PNAS 95**: 6578-6583

Ubiquitous

Up to log9 phages per ml of surface waters

In animal sera, in vaccines, in food

E. coli phages in 11% of faeces of healthy persons

B. fragilis phages in 68% of faeces of healthy persons

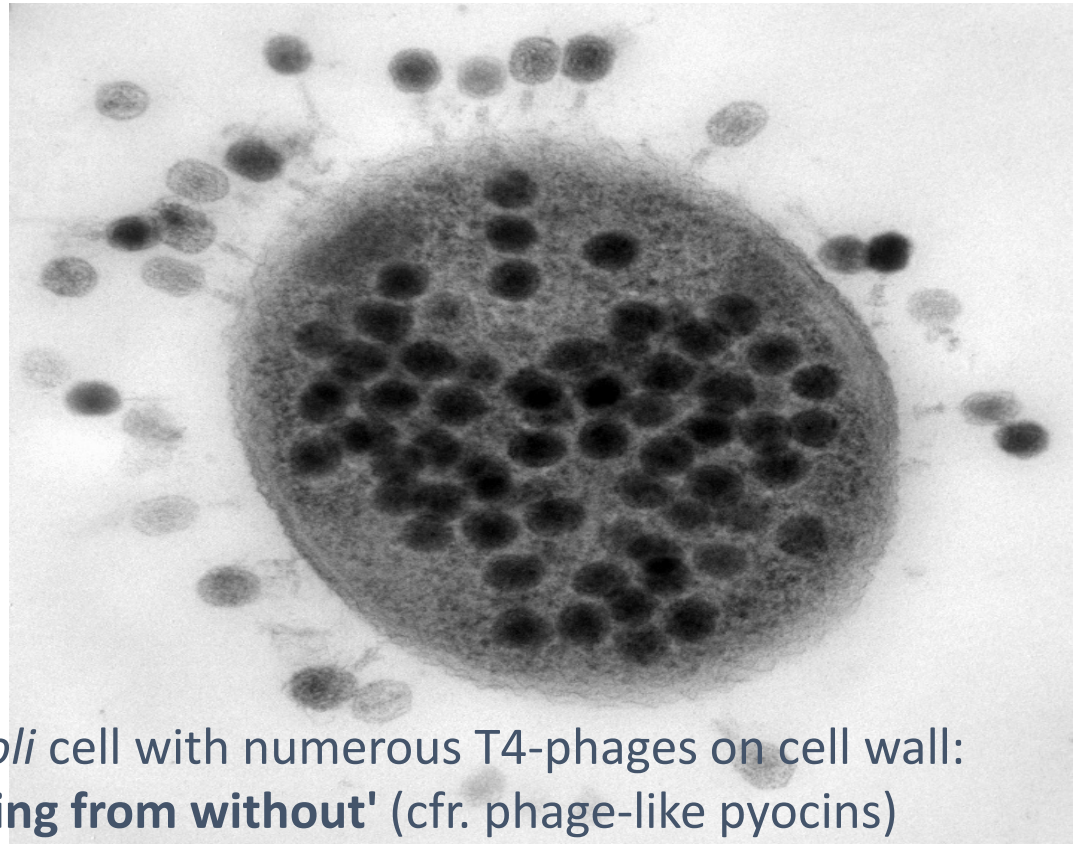
"We live in a sea of phages"

still no infections with phages have been reported

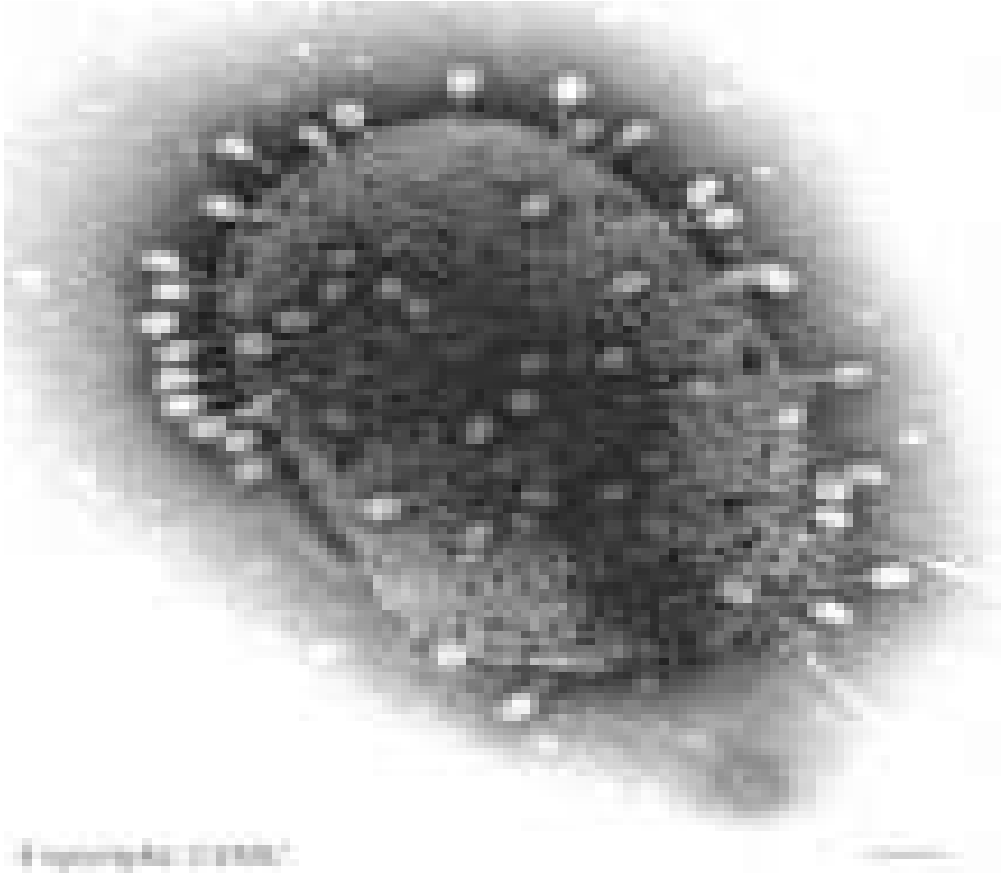
Phage therapy: safety. Lytic vs lysogenic

Use of lytic phages and not lysogenic phages:

3. Lytic phages eradicate bacterial populations more rapidly and completely:
No lysogenic cycle + 'Killing from without'



E. coli cell with numerous T4-phages on cell wall:
'Killing from without' (cfr. phage-like pyocins)



Phage therapy: safety in practice
Animal studies

Numerous animal experiments (see efficacy), without adverse effects.

Merril *et al.* (1996) and Capparelli *et al.* (2005)
selected bacteriophages for persistence in the mouse circulatory system,
indicating that their persistent systemic presence
does not pose a problem to mammals.

Merril et al. 1996. Long-circulating bacteriophage as antibacterial agents.
Proc Natl Acad Sci USA 93: 3188-3192.
Capparelli et al. 2005. Selection of an *Escherichia coli* O157:H7 bacteriophage
for persistence in the circulatory system of mice infected experimentally.
Clin. Microbiol. Infection 12: 248-253.

Phage therapy: Problem 1
Narrow spectrum

Advantage: commensal microflora not affected
Disadvantage: species and clone need to be identified before application.

Solutions:
1. Use of phage mixtures (cocktails)
2. Application in chronic infections: time to select appropriate phages
3. Broad spectrum phages (e.g. all *S. aureus*) exist.
(4. Add phages to antibiotics)

Phage therapy: Problem 2
Bacterial resistence

Most important strategies of bacteria for developing phage resistance:

1. Mutation of cell wall receptors which are used by phages as adherence ligand
2. DNA restriction/modification systems: nonmodified (phage) DNA is restricted.

Mutant bacteria can become susceptible for other phages.

Mutant bacteria can loose virulence.
E. coli K1-phages induce phage-resistant *E. coli*
but these are K1 negative: **reduced virulence** (Smith & Huggins 1982).

Phages can co-evolve (they do since 4 billion years).

Phages can be propagated in vivo to adapt to resistant hosts.

New phages can be found: fishing for phages.

Phage therapy: Problem 3
Can phages penetrate biofilms?

Hanlon *et al.* 2001. **Reduction in exopolysaccharide viscosity** as an aid to bacteriophage penetration through *Pseudomonas aeruginosa* biofilms.
Appl. Environ. Microbiol. 67: 2746-2753.

Sillankorva *et al.* 2004. *Pseudomonas fluorescens* infection by bacteriophage PhiS1: the influence of temperature, host growth phase and media.
FEMS Microbiol. Lett. 241: 13-20.

85% biomass reduction in planktonic as well as biofilm growth.

Hughes *et al.* 1998. Biofilm susceptibility to bacteriophage attack:
the role of phage-borne **polysaccharide depolymerase**.
Microbiology 144: 3039-3047.

The Sleeping Giant

Bacteriophage application in different fields

- Urology and Gynecology (Prostatitis, urethritis, vaginitis, cystitis etc)
- Surgical infections (chronic wounds, diabetic ulcers, prosthetic foot ulcers
- Internal medicine, ENT, Pediatrics (Gastrointestinal tract disease, respiratory system diseases, cystic fibrosis, skin and tissue disease)

- There are several clinical trials going on
- The first Phage therapy center in the US (San Diego)
- Global recognition is increasing

Pharmaceutical preparations used for clinical treatment

SES Batteriofago	Staphylococcus, E.coli, Streptococcus
Fersis Batteriofago	Staphylococcus, Streptococcus
ENCOfago	Shigella, Salmonella, E.coli , Staphylococcus
Intesti Batteriofago	Shigella, Salmonella, Staphylococcus spp., Proteus, E.coli, Pseudomonas aeruginosa, Enterococcus faecalis
Pyo Batteriofago	Staphylococcus, E.coli, Streptococcus, Pseudomonas, Proteus
Staphylofago	Staphylococcus spp.

"Preparazioni di Fagi individuali"

PHAGE THERAPY CENTER
ELIAVA INSTITUTE

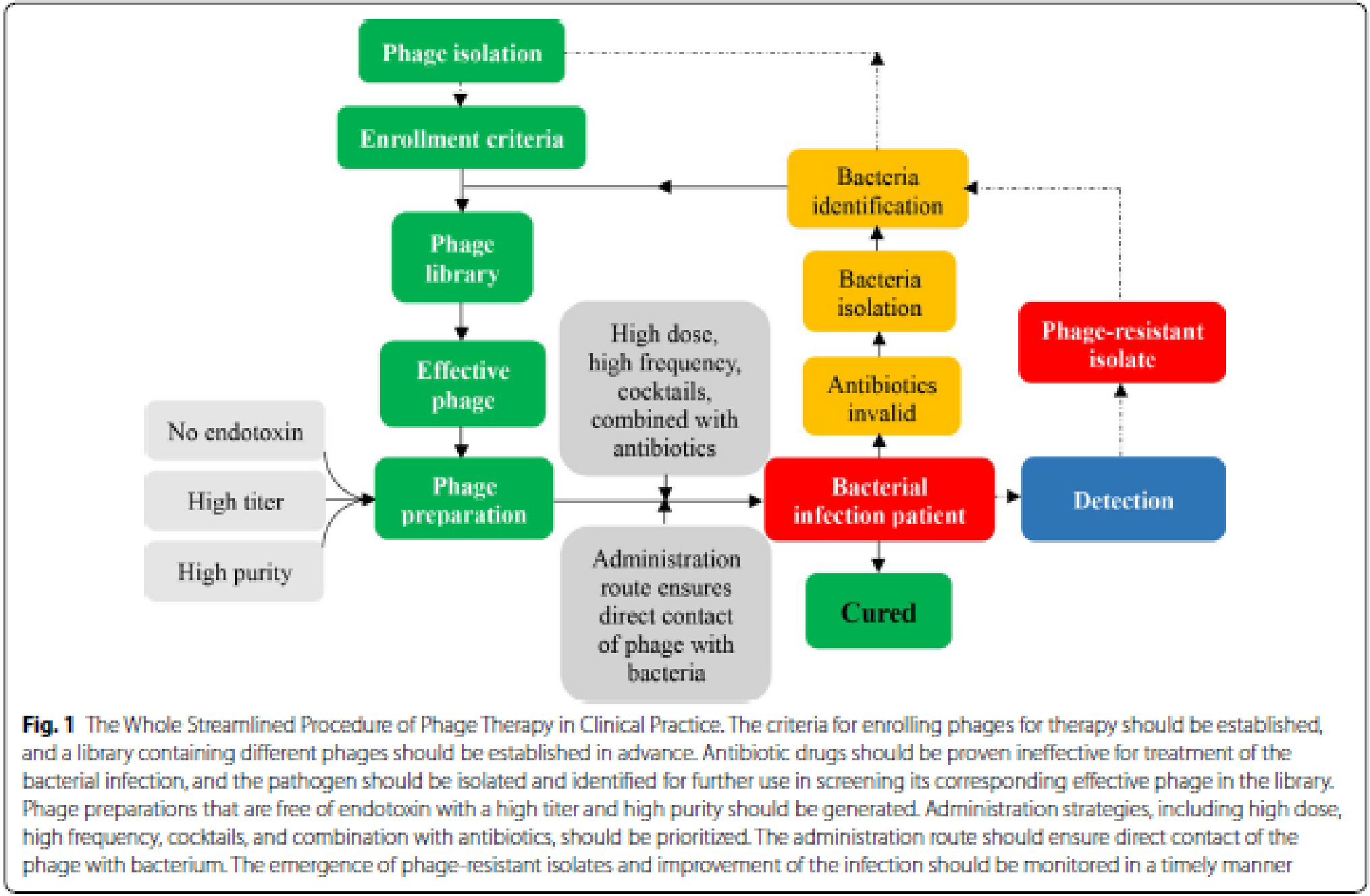
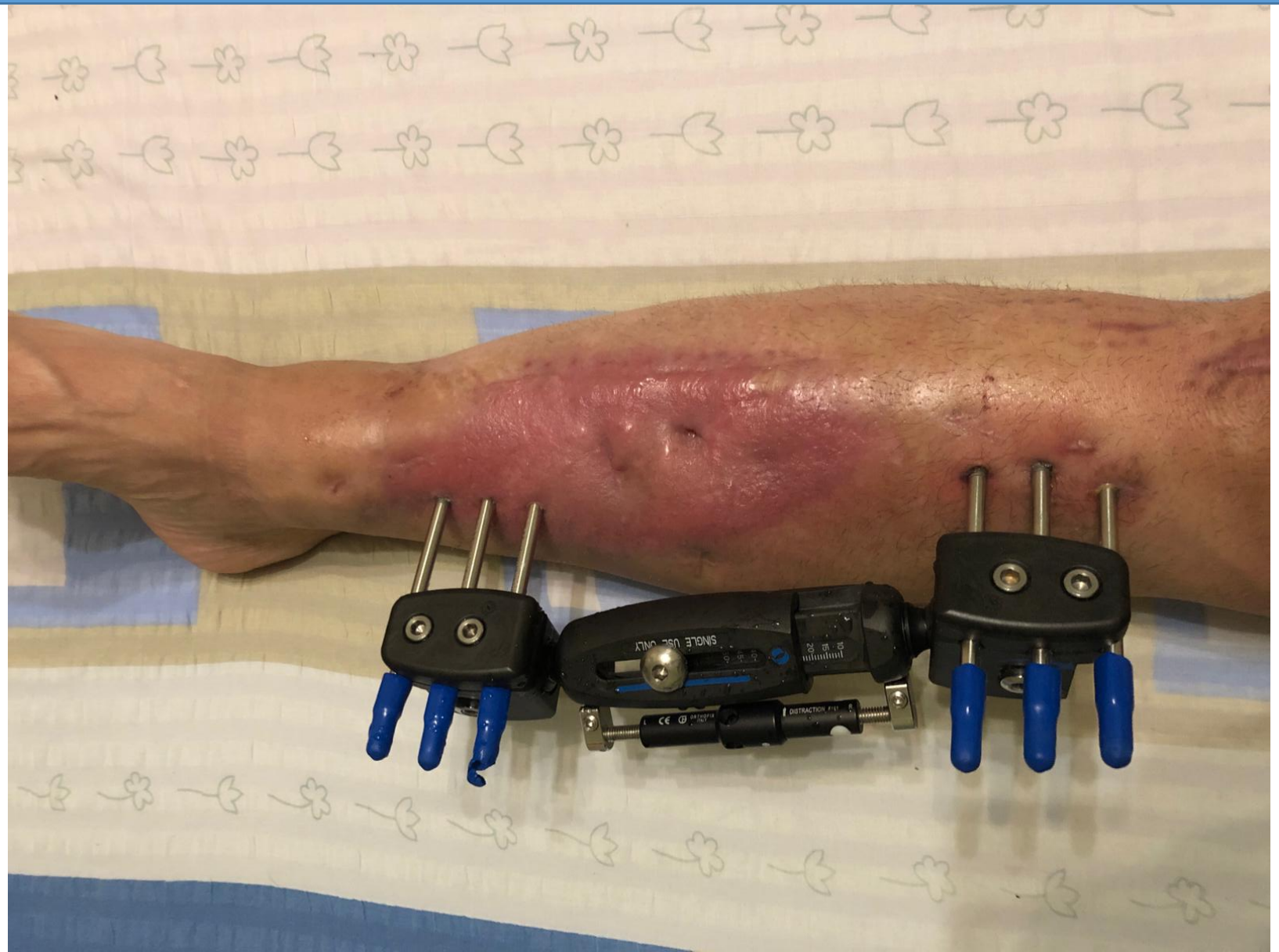


Fig. 1 The Whole Streamlined Procedure of Phage Therapy in Clinical Practice. The criteria for enrolling phages for therapy should be established, and a library containing different phages should be established in advance. Antibiotic drugs should be proven ineffective for treatment of the bacterial infection, and the pathogen should be isolated and identified for further use in screening its corresponding effective phage in the library. Phage preparations that are free of endotoxin with a high titer and high purity should be generated. Administration strategies, including high dose, high frequency, cocktails, and combination with antibiotics, should be prioritized. The administration route should ensure direct contact of the phage with bacterium. The emergence of phage-resistant isolates and improvement of the infection should be monitored in a timely manner

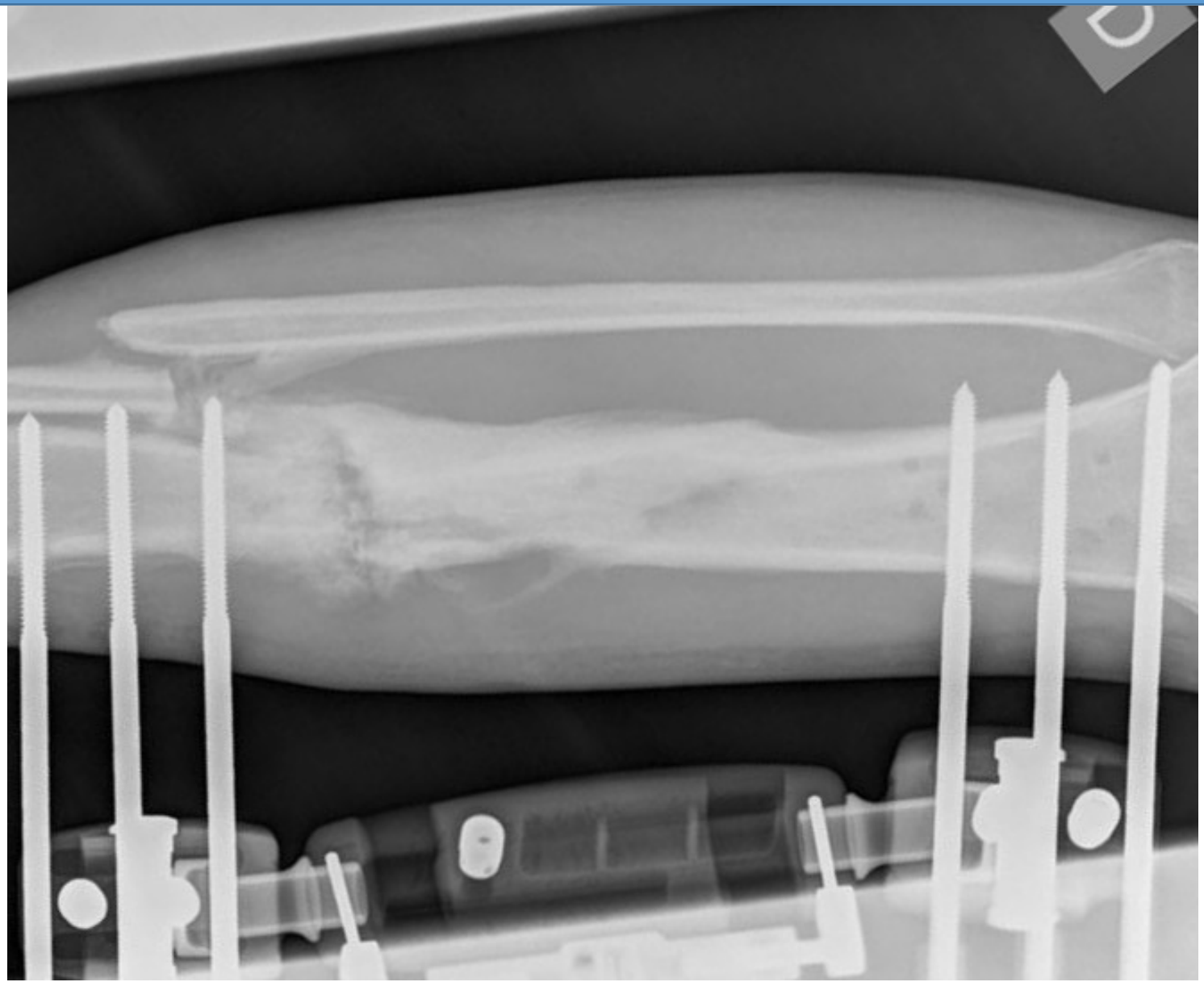
A clinical case in Italy – 1
Leg Pseudomonas ostheomyelitis after exposed fracture

43 yrs old man. Clinical picture after several operation performed on the infected leg. **Before the cure with bacteriophages**



A clinical case in Italy - 2

The fistula healed after 10 days. The X-ray taken after 40 days show the formation of new bone



A clinical case in Italy - 3

Clinical picture after 3 months of therapy.
The external fixators were removed. The patient can walk without any help or device.

CASE STUDY

EVOLUTION, MEDICINE, & PUBLIC HEALTH

Evolution, Medicine, and Public Health [2018] pp. 60–66
doi:10.1093/emph/eoy005

Phage treatment of an aortic graft infected with *Pseudomonas aeruginosa*

Benjamin K. Chan,[1] Paul E. Turner,[1,2] Samuel Kim,[3] Hamid R. Mojibian,[4] John A. Elefteriades[5] and Deepak Narayan*,[3]

[1]Department of Ecology and Evolutionary Biology, Yale University, New Haven, CT, USA; [2]Program in Microbiology, Yale School of Medicine, New Haven, CT, USA; [3]Section of Plastic and Reconstructive Surgery, Department of Surgery, Yale School of Medicine, New Haven, CT, USA; [4]Department of Radiology and Biomedical Imaging, Yale School of Medicine, New Haven, CT, USA and [5]Section of Cardiac Surgery, Department of Surgery, Yale School of Medicine, New Haven, CT, USA

*Corresponding author. Section of Plastic and Reconstructive Surgery, Yale University School of Medicine, P.O. Box 208062, New Haven, CT 06520-8062, USA. Tel: +203-785-7313; Fax: +203-785-5714; E-mail: deepak.narayan@yale.edu

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antibiotics

MDPI

Case Report

Bacteriophage Therapy for Critical Infections Related to Cardiothoracic Surgery

Evgenii Rubalskii [1,2,*], Stefan Ruemke [1,2,*], Christina Salmoukas [1,2], Erin C. Boyle [1], Gregor Warnecke [1], Igor Tudorache [1], Malakh Shrestha [1], Jan D. Schmitto [1], Andreas Martens [1], Sebastian V. Rojas [1], Stefan Ziesing [3], Svetlana Bochkareva [4], Christian Kuehn [1,2,5,6,†] and Axel Haverich [1,2,5,6,†]

1 Department of Cardiothoracic, Transplantation and Vascular Surgery, Hannover Medical School, 30625 Hannover, Germany; Salmoukas.Christina@mh-hannover.de (C.S.); Boyle.Colleen@mh-hannover.de (E.C.B.); Warnecke.Gregor@mh-hannover.de (G.W.); Tudorache.Igor@mh-hannover.de (I.T.); Shrestha.Malakh.lal@mh-hannover.de (M.S.); Schmitto.Jan@mh-hannover.de (J.D.S.); Martens.Andreas@mh-hannover.de (A.M.); Rojas.Sebastian@mh-hanover.de (S.V.R.); Kuehn.Christian@mh-hannover.de (C.K.); Haverich.Axel@mh-hannover.de (A.H.)

2 Lower Saxony Centre for Biomedical Engineering, Implant Research and Development, 30625 Hannover, Germany

3 Institute for Medical Microbiology and Hospital Epidemiology, Hannover Medical School, 30625 Hannover, Germany; Ziesing.Stefan@mh-hannover.de

4 G.N. Gabrichevsky Research Institute for Epidemiology and Microbiology, Moscow 125212, Russia; cip1989@gmail.com

5 German Center for Lung Research (DZL), 30625 Hannover, Germany

6 Clinical Research Group (KFO 311), German Research Foundation, 30625 Hannover, Germany

* Correspondence: Rubalskii.Evgenii@mh-hannover.de (E.R.); Ruemke.Stefan@mh-hannover.de (S.R.); Fax: +49-511-532-5404 (E.R. & S.R.)

† These authors contributed equally to this work.

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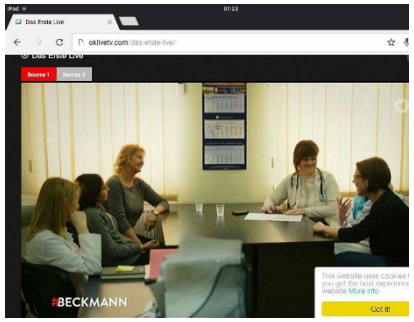
check for updates

Our patients around the world

Media Exposure

Beckmann, German TV



Reuters

VICE, Motherboard (US, Holland)

Dutch- Zorg

BBC -2

French TV-5, French Radio

Norwegian TV

Antico Forno Nonna Esterina
Nenti social...
sulu cu prova
torna!!!

Bacteriophage therapy: an overview and the position of Italian Society of Infectious and Tropical Diseases

Novella Cesta[1], Mariagrazia Di Luca[2], Mario Corbellino[3], Marcello Tavio[4], Massimo Galli[3,5], Massimo Andreoni[6]

[1]Infectious Diseases Clinic, University Hospital "Tor Vergata", Rome, Italy;
[2]Department of Biology, Microbiology Unit, University of Pisa, Italy;
[3]Division of Infectious Diseases, Azienda Socio-Sanitaria Territoriale (ASST), Fatebenefratelli Sacco, Milano, Italy;
[4]Unit of Emerging and Immunosuppressed Infectious Diseases, Department of Gastroenterology and Transplantation, Azienda Ospedaliero-Universitaria "Ospedali Riuniti", Torrette Ancona, Italy;
[5]Luigi Sacco Department of Clinical and Biomedical Sciences, University of Milano, Milano, Italy;
[6]Department of Systems Medicine, University of Rome "Tor Vergata", Rome, Italy; Infectious Diseases Clinic, University Hospital "Tor Vergata", Rome, Italy

Clinical Infectious Diseases

BRIEF REPORT

Eradication of a Multidrug-Resistant, Carbapenemase-Producing *Klebsiella pneumoniae* Isolate Following Oral and Intra-rectal Therapy With a Custom Made, Lytic Bacteriophage Preparation

Mario Corbellino,[1] Nicolas Kieffer,[2] Mzia Kutateladze,[3] Nana Balarjishvili,[3] Lika Leshkasheli,[3] Lia Askilashvili,[3] George Tsertsvadze,[3] Sara Giordana Rimoldi,[4] Deia Nizharadze,[5] Naomi Hoyle,[5] Lia Nadareishvili,[5] Spinello Antinori,[1,6] Cristina Pagani,[4] Daniele Giuseppe Scorza,[4] Ai Ling Loredana Romanò,[7] Sandro Ardizzone,[6,8] Piergiorgio Danelli,[6,9] Maria Rita Gismondo,[4,6] Massimo Galli,[1,6] Patrice Nordmann,[2] and Laurent Poirel[2]

[1]III Division of Infectious Diseases, Azienda Socio Sanitaria Territoriale (ASST) Fatebenefratelli Sacco, Milano, Italy; [2]Medical and Molecular Microbiology, Faculty of Science and Medicine, Institut National de la Santé et de la Recherche Médicale (INSERM) European Unit (IAME, France), University of Fribourg, Fribourg, Switzerland; [3]G. Eliava Institute of Bacteriophages, Microbiology and Virology, Tbilisi, Georgia; [4]Division of Microbiology, ASST Fatebenefratelli–Sacco, Milano, Italy; [5]Eliava Phage Therapy Center LLC, Tbilisi, Georgia; [6]Luigi Sacco Department of Clinical and Biomedical Sciences, University of Milano, Milano, Italy; [7]Division of Urology, ASST Fatebenefratelli - Sacco, Milano, Italy; [8]Division of Gastroenterology, ASST Fatebenefratelli - Sacco, Milano, Italy; and [9]Division of General Surgery, ASST Fatebenefratelli - Sacco, Milano, Italy

antimicrobial resistance who were without a history of contact with medical care while abroad, with a demonstrated length of carriage of at least 6 months [4–6].

Besides the use of antibiotics, alternatives are urgently needed to significantly contribute to the eradication of MDR bacteria in general, and CP Gram-negative bacteria in particular. Among those alternative strategies, the use of phage therapy is currently being reconsidered for treating corresponding infections. Custom-made bacteriophage therapy (BT) consists of the clinical use of viruses that have been preliminarily selected *in vitro* for their specific and strictly lytic activity against a bacterial pathogen isolated in culture, with the aim of treating the infection sustained by the pathogen [7]. Several examples of the successful treatment of infections caused by MDR bacteria have been reported [7–9]. However, to the best of our knowledge, although it has been suggested [10], no gut decolonization strategy using bacteriophages has been reported to date.

We describe herein a patient for whom custom-made BT was

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Author manuscript
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Early clinical experience of bacteriophage therapy in three lung transplant recipients

Saima Aslam[1,*], **Andrew M. Courtwright**[2,*], **Christine Koval**[3], **Susan M. Lehman**[4], **Sandra Morales**[4], **Carrie-Lynn Langlais Furr**[4], **Francisco Rosas**[4], **Michael J. Brownstein**[5], **Joseph R. Fackler**[5], **Brittany M. Sisson**[5], **Biswajit Biswas**[6], **Matthew Henry**[6], **Truong Luu**[6], **Brittany N. Bivens**[6], **Theron Hamilton**[6], **Christopher Duplessis**[6], **Cathy Logan**[1], **Nancy Law**[1], **Gordon Yung**[7], **Jason Turowski**[8], **Judith Anesi**[9], **Steffanie A. Strathdee**[1], **Robert T. Schooley**[1]

[1]Division of Infectious Diseases and Global Public Health, University of California San Diego, La Jolla, CA

[2]Department of Pulmonary and Critical Care Medicine, University of Pennsylvania, Philadelphia, PA

[3]Department of Infectious Diseases, Cleveland Clinic Foundation, Cleveland, OH

[4]AmpliPhi Biosciences, San Diego, CA

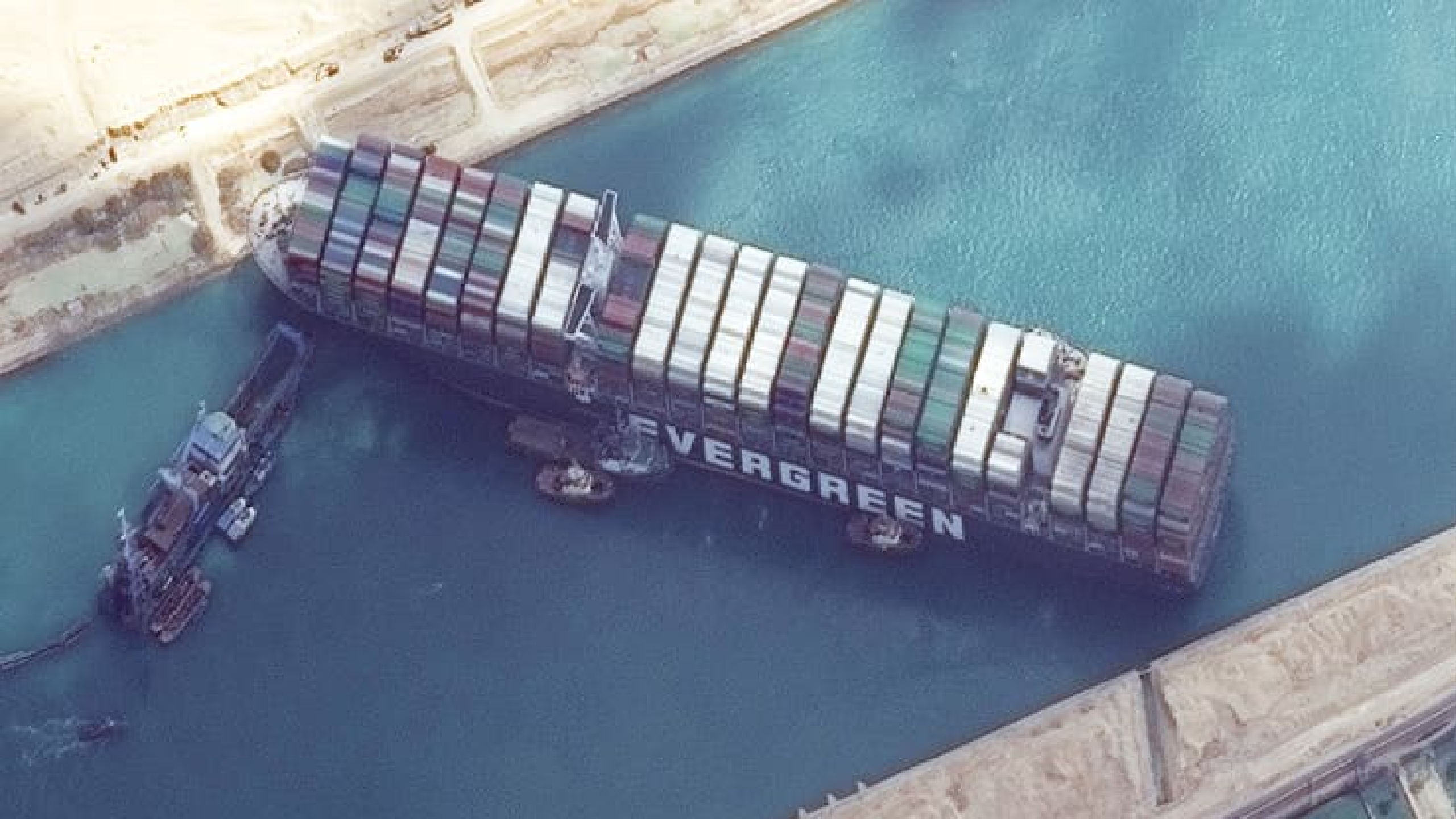
[5]Adaptive Phage Therapeutics, Gaithersburg, MD

[6]Naval Medical Research Center, Biological Defense Research Directorate, Fort Detrick, MD

[7]Division of Pulmonary, Critical Care & Sleep Medicine, University of California San Diego, La Jolla, CA

[8]Department of Pulmonary Medicine, Cleveland Clinic Foundation, Cleveland, OH

[9]Division of Infectious Diseases, University of Pennsylvania, Philadelphia PA


EVERGREEN

Helsinki Declaration

- ***In the treatment of a patient, where proven prophylactic, diagnostic and therapeutic methods do not exist or have been ineffective, the physician, with informed consent from the patient, must be free to use unproven or new prophylactic, diagnostic and therapeutic measures, if in the physician's judgement it offers hope of saving life, re-establishing health or alleviating suffering.***
- ***Where possible, these measures should be made the object of research, designed to evaluate their safety and efficacy.***
- ***In all cases, new information should be recorded and, where appropriate, published.***
- ***The other relevant guidelines of this Declaration should be followed.***

Randomized Open Label, Parallel Group, Controlled Study to Evaluate the Safety and operative procedures Sparing Effect of Phage Therapy With Antibiotics for Patients with recurrent cholangitis

Study Description

- Brief Summary:
- This is a study designed to evaluate bacteriophage therapy in patients with recurrent cholangitis in PTBD carriers.

Condition or disease

- **Intervention/treatment Phase**
- Recurrent Cholangitis
- Biological: Phage Therapy Procedure , antibiotics:
- Phase 1Phase 2

Detailed Description:

- This is a study designed to evaluate bacteriophage therapy in immunosuppressed patients with recurrent cholangitis and PTBD carriers, caused by the following organisms: Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus sp., Enterococcus faecium, Enterococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, Klebsiella or pneumonia or other bacteria sensitive to available preparations of phages cocktails.
- This study will also compare the safety and efficacy of phage therapy in conjunction with antibiotics versus standard of care (SOC) antibiotics only.

- **Outcome Measures**

- **Primary Outcome Measures :**
- Safety and tolerability of phage therapy [Time Frame: Day 1 through Week 26]
- Incidence and type of adverse events

- **Secondary Outcome Measures :**
- Efficacy of phage therapy to prevent cholangitis and the need for interventional radiology procedures in patientscarriers of PTBD with recurrent cholangitis . [Time Frame: 6 weeks after completion of phage therapy]
- Proportion of phage-treated patients with no need for repeated interventional radiology and no evidence of bile duct infection.
- Efficacy of phage therapy to improve quality of life as assessed by outcome questionnaire. [Time Frame: Week 26]
- Time to reach minimum clinically important difference in dysfunction and outcome indicators.
- Incidence of recurrent postoperative infection from the preoperative isolated bacterial strain

Phage therapy: Summary

Phages are everywhere:

The world is a phage. We live in a sea of phages.

Different strategies are possible:

lytic phages
lytic phage products
modified lysogenic phages for gene delivery
phages as probiotics?

Phages are safe

Phages are efficient, also against antibiotic resistant bacteria and against bacteria in biofilm

Clinical trials are held back because of 'safety' considerations and lack of appropriate regulatory framework

https://www.phages.healthcare/

alfonso.recordare@phages.healthcare

UKRAINE
أوكرانيا
UKRAINE

PEACE & LOVE UKRAINE
STAY STRONG LOVE UKRAINE
Be Peace Ukraine
FORÇA UCRANIA
STAY STRONG
Stay strong UKRAINE
Pray for Ukraine
STOP WAR
WE ARE WITH U! SRILANKA
WE LOVE UKRAINE
Stay strong!
Stay safe, we love you!
NO WAR BE LOVE ALL COUNTRY
WE STAND WITH YOU
STAY STRONG UKRAINE
Stay strong UKRAINE
STAY STRONG
Your fight for freedom is inspiring for whole Europe and the world.
WE LOVE UKRAINE!

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TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

Prof. Antonio Crucitti

Direttore U.O.C. Chirurgia Generale e Mininvasiva

Osp. Generale Cristo Re

Università Cattolica del S. Cuore - Roma

XENIA
WE DEVELOP YOUR IDEAS

Xenia S.a.s. di Francesca Mazza & C.
87030 RENDE (CS)
Via G. Verdi, 144
P. IVA: 03346870789

e-mail: xeniaeventi@gmail.com

Il sottoscritto

ai sensi dell'art. 76 comma 4 dell'Accordo Stato-Regioni del 2 febbraio 2017 e in accordo con il Codice Etico della Xenia S.a.s.

dichiara

per l'evento in oggetto l'esistenza negli ultimi due anni di rapporti di natura finanziaria e lavorativa con le seguenti imprese commerciali operanti in ambito sanitario

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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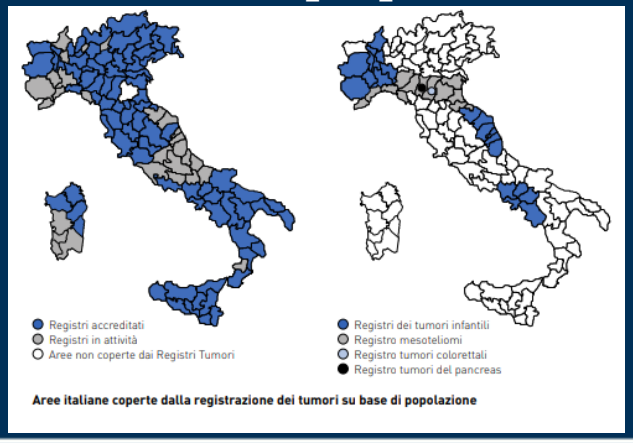
Dimensioni del problema

In Italia, sulla popolazione totale, il tumore del colon-retto è il secondo più frequentemente diagnosticato con 43.702 casi stimati nel 2020 pari all'11,6% di tutti i tumori, preceduto solo dal tumore della mammella.

In base ai dati ISS (AIRTUM 2020) si calcola che 1 uomo ogni 12 ed una donna ogni 19 aa. svilupperanno un tumore del colon retto nell'arco della propria vita, verosimilmente entro gli 84 anni.



AIRTUM Associazione Italiana Registri Tumori

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Dimensioni del problema

Il cancro colo-rettale risulta al secondo posto in quanto a mortalità tra tutti i tumori dopo quello del polmone, con una proporzione del 10,8% sul totale dei decessi oncologici (ISTAT 2017).

Istat
Istituto Nazionale di Statistica

COLON RETTO	
Incidenza	Nel 2020, sono attese circa 43.700 nuove diagnosi (maschi = 23.400; femmine = 20.300)
Mortalità	Nel 2020, sono stimati 21.600 decessi (maschi = 11.300; femmine = 10.300).
Sopravvivenza netta a 5 anni dalla diagnosi	65% in entrambi i sessi
Sopravvivenza di ulteriori 5 anni condizionata ad aver superato il primo anno dopo la diagnosi	76% nei maschi e 77% nelle femmine
Prevalenza	Sono 513.500 le persone viventi in Italia dopo una diagnosi di tumore del colon retto (maschi = 280.300; femmine = 233.200)

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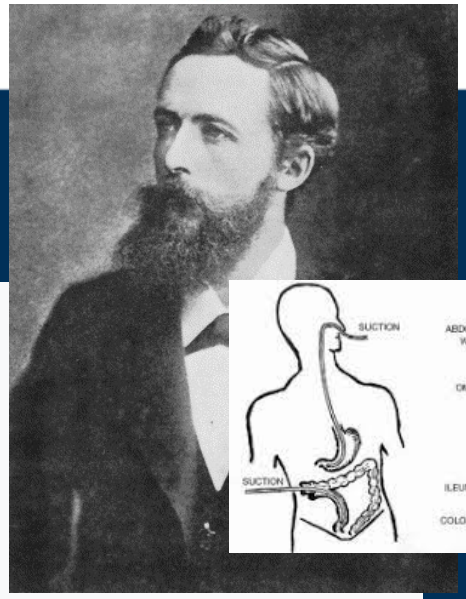
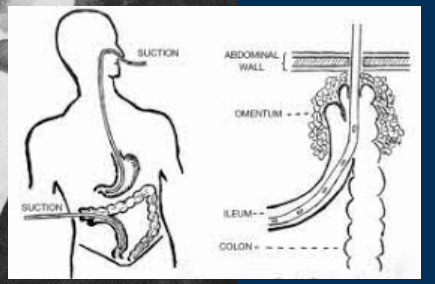
Chirurgia colo-rettale





Nel 1823, un praticante di nome Reybard fu accreditato di aver eseguito la prima resezione del colon.

Da allora abbiamo assistito a grandi progressi nella chirurgia del cancro del colon; basato su una migliore comprensione della malattia e del suo comportamento e sui numerosi progressi in tecniche chirurgiche sicure e innovative da parte di chirurghi pionieri.

- La chirurgia continua ad essere il trattamento con maggiori probabilità di curare il cancro del colon-retto.
- Diversi approcci chirurgici a seconda della posizione, colon o retto, dello stadio e delle dimensioni del tumore o se il tumore è metastatico.
- Altre opzioni di trattamento includono radioterapia e chemioterapia da sole o in combinazione.

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Dalla chirurgia a cielo aperto al «buco della serratura»: la laparoscopia

La forma più tradizionale di chirurgia del cancro del colon è nota come «colectomia»

- un'unica lunga incisione nell'addome
- per molti anni (?) è rimasto il cardine

Alla fine del 20° secolo nasce la chirurgia colorettale mininvasiva o laparoscopica **(keyhole surgery)**

- molte incisioni più piccole
- strumenti speciali
- una minuscola videocamera per vedere il colon

Le colonne laparoscopiche di oggi sono molto performanti ed hanno abbattuto i bias che potevano avere quelle di prima generazione

- monitor sempre più grandi
- touch-screen
- riscaldano il gas e riducono l'appannamento delle lenti
- riducono al minimo le % di CO_2 (vantaggi per il tasso di CO_2 ematico)
- 3 o 4 HD, 3D....
- telecamere autofocus e utilizzabili con i coloranti vitali (ICG-verde indocianina)
- grandi memorie per le riprese video .....

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Dalla chirurgia a cielo aperto al «buco della serratura»: la laparoscopia

La **chirurgia laparoscopica** per il trattamento chirurgico dei tumori colo-rettali è patrimonio di molti centri
I vantaggi della chirurgia laparoscopica:

- ridotte perdite di sangue
- incisioni più piccole
- minor trauma e minor dolore minor infezioni minor laparoceli
- tempi di recupero ridotti
- più rapido ripristino della funzionalità intestinale
- degenze ridotte
- aspetti immunitari/oncologici

....non significa che sia l'opzione giusta per tutti, la decisione dovrebbe essere presa dopo una discussione informata tra il paziente e il chirurgo!!!

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Dalla chirurgia a cielo aperto al «buco della serratura»: la laparoscopia

...ma è proprio vero ?

Medicina scienza e ricerca

Chirurgia laparoscopica: Italia ancora in ritardo nel trattamento del carcinoma del colon retto

Clinici e istituzioni si confrontano venerdì 23 ottobre a Milano nella tavola rotonda "Chirurgia laparoscopica del colon retto: il paradosso Italia" all'interno del 117° Congresso Nazionale della Società Italiana di Chirurgia

di Redazione Aboutpharma Online | 21 Ottobre 2015

Un paradosso tutto italiano. È la situazione della chirurgia laparoscopica del colon retto nel nostro paese. Pur annoverando a livello nazionale strutture cliniche all'avanguardia in grado di essere benchmark virtuosi sia in termini di qualità delle cure che di ottimizzazione dell'uso delle risorse economiche, la tecnica non è ancora diffusa in Italia come in altri paesi occidentali. Una sfida ancora oggi da affrontare per consentire al BelPaese di raggiungere i livelli delle altre nazioni europee nel trattamento mininvasivo del carcinoma del colon retto, il tumore a maggiore insorgenza nella popolazione italiana.

.....raccomandazioni dedicate al corretto utilizzo delle tecniche laparoscopiche nella chirurgia colorettale, che in Italia non supera il 29%. (2020)

L'obiettivo è promuovere una corretta formazione dei chirurghi e di conseguenza implementare le loro abilità nell'utilizzo di queste tecniche.

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La chirurgia robotica

La chirurgia robotica è un'altra forma di chirurgia colorettale minimamente invasiva:

- robot è controllato dal chirurgo tramite una console (comfort)
- maggiore visibilità (3D)
- un computer fornisce precisione e minimo trauma tissutale (nervi....)
- gamma di movimento più precisa rispetto alla mano e al polso umani
- movimento del polso un'articolazione in più della mano umana (wrist)
- minor tasso di complicazioni e infezioni
- più rapido recupero postoperatorio
- riduce significativamente degenza ospedaliera

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La chirurgia robotica

Il primo robot chirurgico **ZEUS robotic surgical system (ZRSS),** sviluppato e prodotto dalla statunitense Computer Motion fu approvato dalla FDA nel 2001.

Il predecessore di tale sistema, chiamato AESOP, fu approvato dalla Food and Drug Administration nel 1994 per assistere i chirurghi nella chirurgia mininvasiva.
Il sistema ZEUS fu cessato nella produzione nel 2003, a seguito della fusione della società produttrice Computer Motion con la sua rivale **Intuitive Surgical**

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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La chirurgia robotica:DA VINCI

- Il sistema chirurgico da Vinci, in onore a Leonardo da Vinci, fu messo a punto nella Silicon Valley dalla Intuitive Surgical, e nel 2000 ha ottenuto l'autorizzazione dall'FDA per l'utilizzo in chirurgia laparoscopica.

21 anni, quarta generazione, oltre 8,5 milioni di interventi chirurgici, leader nella robotica chirurgica, al 31.12.19, Intuitive Surgical ha installato 5.582 sistemi da Vinci, 3.531 negli U.S.A., 977 in Europa, **(111 in Italia/22 in Lombardia),** 780 in Asia e 294 nel resto del mondo, aumentando l'adozione della chirurgia mininvasiva, in un'ampia gamma di procedure chirurgiche con configurazioni flessibili, architettura aggiornabile, interfaccia coerente, ampia dotazione di strumenti

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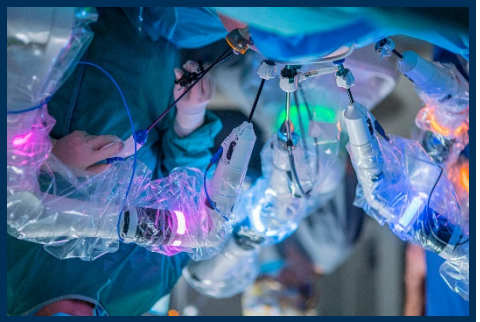
La chirurgia robotica: DA VINCI

Il chirurgo, seduto in console, manovra a distanza quattro bracci robotici che migliorano i gesti umani, eliminandone il fisiologico tremore e garantendo una visione 3D e immersiva del campo operatorio, con la possibilità di raggiungere aree anatomiche difficili anche con un unico accesso

Diverse specialità:

- urologia
- chirurgia generale
- ginecologia
- chirurgia toracica
- cardiochirurgia
- chirurgia pediatria
- otorinolaringoiatria
- chirurgia dei trapianti



TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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La chirurgia robotica: VERSIUS

2014

January 2014: Company was founded with the purpose of transforming surgery for millions of people.

July 2014: The CMR Surgical version of the Palo Alto garage is created. The CMR Surgical "barns" become home to the development of Versius.

2016

June 2016: First series of cadaveric trials completed.

2017

December 2017: CMR Surgical named one of the UK's top 10 business disruptors to watch & one of the year's 'Fierce 15'.

2018

June 2018: CMR Surgical closes Series B funding round, raising $100 million – Europe's largest funding round in the medical technology sector.

September 2018: Versius is introduced to the world for the first time.

December 2018: CMR Surgical named Britain's sixth-fastest growing business.

December 2018: CMR Surgical launches partnership with Florida Hospital's Nicholson Center to launch the first Versius training programme in the US.

2019

May 2019: CMR Surgical welcomes Lord Prior, Chair NHS England to open new global headquarters in Cambridge UK.

May 2019: Company announces successful completion of first 30 in-human surgical procedures using Versius.

September 2019: CMR Surgical raises $240 million in Series C funding – Breaking our own record for Europe's largest private financing round in the medical technology sector.

October 2019: CMR Surgical announces the first commercial introduction of Versius at Galaxy Care Hospital in Pune, India.

2020

January 2020: Per Vegard Nerseth is appointed as Chief Executive Officer.

February 2020: CMR Surgical announces the introduction of Versius into the NHS at NHS Lothian and Milton Keynes University Hospital.

June 2020: CMR appoints former SpaceX Senior Director, Barrington D'Arcy as Chief Operations Officer.

September 2020: CMR launches Versius in France as it extends global footprint.

November 2020: Over 1,000 surgeries completed using Versius.

2021

February 2021: CMR announces the introduction of Versius into leading surgical robotics markets Australia and Germany.

June 2021: CMR Surgical becomes the Official Medical Devices Partner of ParalympicsGB.

June 2021: CMR Surgical raises $600 million in Series D financing, the largest ever private MedTech raise.

- Sistema Versius su base digitale, modulare, compatto e con singoli bracci robotici compatibili per dimensioni con qualsiasi sala operatoria
- specialità: Chirurgia Generale, Ginecologia, Urologia e Chirurgia Toracica
- interventi di laparoscopia avanzata
- strumenti completamenti articolati
- sistema di visione 3D full HD 3D HD,
- comandi posizionati su una console ergonomica

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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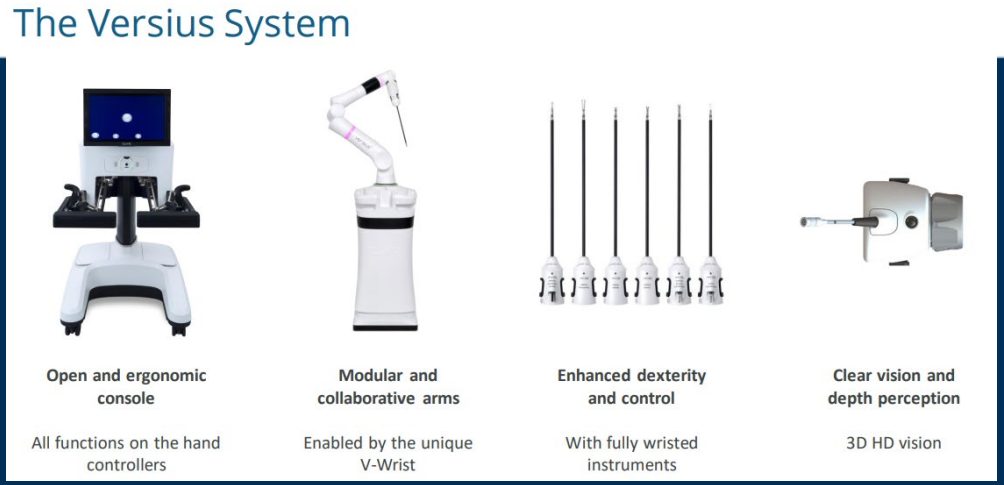
La chirurgia robotica: VERSIUS



- sistema modulare
- bracci robotici indipendenti tra loro, liberi intorno al letto operatorio
- disposizione dei trocar tipica delle procedure laparoscopiche
- set-up clinico facilitato
- approccio di tipo "ibrido" alla procedura (robotica/mininvasiva tradizionale),
- utilizzo alternato di strumenti mininvasivi tradizionali e robotici
- massimizzazione di valore
- ottimizzazione dei tempi e dei costi
- utilizzo del sistema robotico anche per l'intero intervento

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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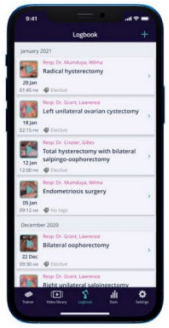
La chirurgia robotica: VERSIUS

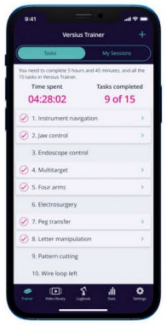
Successful clinical introduction

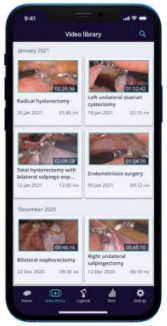
Online modules	Versius trainer	Validated training programme	Implementation	Proctoring	Ongoing support
At home: 13 online modules Develop familiarity with functionality and capability of Versius Prepares teams for Practical Training Average 10 hours completion time	**In your hospital:** 15 virtual tasks ranging from simple to complex tasks Every console comes with a VT Develop and refine motor and cognitive skills Minimum 5:45hrs	**In the cadaveric lab:** Practical training for the entire surgical team Equip team to be fully competent operating Versius Provided by dedicated team of CMR Senior Technical Trainers NB: Will not include	**In your hospital:** Minimum half day OR set up Understand how Versius fits into your OR Working alongside CMR Senior Technical Trainers and Customer Engagement	**In your hospital:** Independent clinicians providing case proctoring Heavily supported by Senior Technical Trainers and Customer Engagement	**In your hospital:** Continuous product support Ongoing customer service Maintenance and servicing

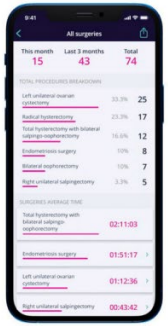
CMR SURGICAL

The Versius Connect app


A real time logbook


Training Statistics


Video library


View key procedure stats

The Versius Trainer

Digital Surgical Skills Simulator

Prof. Antonio Crucitti

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La chirurgia robotica: HUGO

Il sistema Hugo™ RAS è stato progettato con i chirurghi di tutto il mondo per rendere possibile di più nella chirurgia robotica assistita.

- Modulare e portatile
- Configurazioni flessibili o spazio della sala operatoria, alla procedura e alle esigenze specifiche del paziente
- Visualizzazione e strumentazione migliorate
- Usa la stessa tecnologia collaudata su open, laparoscopica e RAS.
- Opzione di registrazione video sicura e senza interruzioni
- Analizza e migliora le prestazioni ovunque ti trovi con Touch Surgery™ Enterprise
- Accessibile e scalabile
- Progettato per ridurre il costo totale di proprietà e ottimizzare l'utilizzo del sistema

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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La chirurgia robotica: ALF-X

SOFAR è conosciuta per aver sviluppato l'avanzato sistema **TELELAP ALF-X** per interventi chirurgici minimamente invasivi, ora s**otto il controllo di TransEnterix**

- **Puntamento oculare (3D)**

Total Laparoscopic (S-LPS) versus TELELAP ALF-X Robotic-Assisted Hysterectomy: A Case-Control Study

F. Fanfani, S.Restaino, C. Rossitto[3], S.Gueli Alletti, Barbara Costantini , Giorgia Monterossi, Serena Cappuccio, Emanuele Perrone, Giovanni Scambia J. Min. Inv. Gynecol. Sep-Oct 2016;23(6):933-8.

140 patients

Rossitto C, Gueli Alletti S, Romano F et al. Use of robot-specific resources and operating room times: the case of Telelap Alf-X robotic hysterectomy . The International Journal of Medical Robotics and Computer Assisted Surgery. 2016; 12(4): 613-619

L'analisi dei costi su **81 pazienti** sottoposti a isterectomia robotica Telelap ALF-X. L'analisi del caso base ha mostrato un costo / paziente di € 3391,82. Il nuovo dispositivo robotico richiede un basso consumo di materiali robotici. L'analisi di sensibilità ha mostrato che il fattore di costo più sensibile era l'uso della sala operatoria.

Impedenza tattile.....!?

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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La chirurgia robotica: il problema costi

ottimizzazione dei costi:

- crescente domanda di automazione
- migliore decorso p.o.
- calo morbilità, mortalità
- minore riabilitazione nella popolazione geriatrica.....

ma.....nel 2020 Statzon dichiara che in chirurgia robotica il mercato globale ammonta a 5,4 miliardi di dollari con una crescita prevista del 13,8% fino al 2028 (pari a 15 MLD US dollars)

STATZON
No. 1 Source of Global Robotics Industry Data

Collegio Italiano dei Chirurghi

- **Vittorio CREAZZO** (SICCH), Garante
- **Massimo PERACHINO** (AURO), Garante
- **Domenico PITTELLA,** Consigliere giuridico
- **Simonetta DE CHIARA RUFFO**, Consigliere alla comunicazione
- **Eliana RISPOLI**, Segreteria nazionale

Sono assenti giustificati: - **Alessandro GRONCHI** (SICO), **Antonio LIMA** (SICP), **Giancarlo D'AMBROSIO** (SICE), **Paolo RUSCITO** (SIOeChCF).

ORDINE DEL GIORNO

- Approvazione verbale del 18 ottobre 2021
- Proposta di modello web-app
- Ulteriori specificazioni del contratto ufficio stampa
- Aggiornamento Commissione DRG (Prof. M. Piemonte)
- Costituzione Commissione Pari Opportunità
- Eventuali e varie

CONSIGLIO DIRETTIVO CIC
12 Novembre 2021 ore 18.00 – 19.30
Riunione in modalità telematica

AGENAS
Agenzia Nazionale per i Servizi Sanitari Regionali

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CONSULTAZIONE E REVISIONE APERTA

Carissimi Presidenti,
sono felice di comunicare che il sito **AGENAS** dedicato alla Revisione Aperta tramite Consultazione Pubblica dei **DRG** sarà accessibile da domani al sito https://www.agenas.gov.it/consultazione-e-revisione-aperta . Sia la registrazione che il vostro intervento diretto seguono regole intuitive ma necessitano del riferimento dei tabulati già inviati.

Ringrazio il Prof. Domenico Mantoan, Direttore Generale dell'AGENAS, per averci dato questa possibilità d'intervento, l'On. M. Misiti, nostro Segretario, per avere operato con sagacia e determinazione a questo scopo, il Prof. M. Piemonte e l'intera Commissione DRG per il lavoro svolto e tutti voi per quanto avete fatto e saprete fare.

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

UNIVERSITÀ CATTOLICA del Sacro Cuore

.....and LITERATURE??????

Comparison of robot-assisted surgery, laparoscopic-assisted surgery, and open surgery for the treatment of colorectal cancer

A network meta-analysis

Shihou Sheng, PhD[a], Tiancheng Zhao, PhD[b], Xu Wang, PhD[c,*]

Sys rew and Met.: 40 art.; open vs lps vs robotic

12.825 pts

Primary end points:

- operation time,
- estimated blood loss,
- length of hospital stay
- complication,
- mortality
- anastomotic leakage

only operative time was better for open cases!!!!
RACS was better for the rest of the items...

the present network meta-analysis suggested that RACS might be a better treatment for CRC!!!

Indian Journal of Surgical Oncology (December 2020) 11(4):633–641
https://doi.org/10.1007/s13193-020-01105-7

ORIGINAL ARTICLE

Evolution of Robotic Surgery in a Colorectal Cancer Unit in India

Jitender Rohila[1] · Praveen Kammar[1] · Anadi Pachaury[1] · Ashwin de'Souza[1] · Avanish Saklani[1]

Received: 18 November 2019 / Accepted: 13 May 2020 / Published online: 18 June 2020
© Indian Association of Surgical Oncology 2020

Equal!!!!

Editorial: Advances in and Application of Robotic-Assisted Surgery for Colorectal Cancer

Po-Jung Chen[1], Jaw-Yuan Wang[1,2,3,4,5*†] and Baoqing Jia[6†]

[1] Division of Colorectal Surgery, Department of Surgery, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan, [2] Department of Surgery, Faculty of Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan, [3] Graduate Institute of Clinical Medicine, College of Medicine, Kaohsiung Medical University, Kaohsiung, Taiwan, [4] Colorectal Surgery Department, Ministry of Health and Welfare Pingtung Hospital, Pingtung, Taiwan, [5] Pingtung Hospital, Ministry of Health and Welfare, Pingtung, Taiwan, [6] Department of General Surgery, The First Medical Centre, Chinese PLA General Hospital, Beijing, China

Keywords: colorectal cancer, robotic surgery, selective ligation of IMA, anastomotic leakage, anal dysfunction management

Editorial on the Research Topic

Advances in and Application of Robotic-Assisted Surgery for Colorectal Cancer

Better !!!!

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Retrospective multi-institutional studies: lps vs robotic

Robotic Colorectal Surgery

Poppy Addison, MD[a], Jennifer L. Agnew, MD[a], Joseph Martz, MD[a,b,*]

Surg Clin N Am ■ (2020) ■–■
https://doi.org/10.1016/j.suc.2019.12.012
0039-6109/20/© 2020 Elsevier Inc. All rights reserved.

Table 2
Summary of studies comparing laparoscopic and robotic colon surgery

First Author, Year	Design	Sample Size	Endpoints	Follow-up (Median)	Conclusion
Bhama et al,[37] 2016	Retrospective	11,477	30-d outcomes	30 d	Longer operative times, decreased length of stay, and decreased conversion rate for robotic
Bhama et al[37] 2016	Retrospective	4796	Conversion	n/a	Lower conversion rate for robotic
Kang et al,[26] 2016	Retrospective	96 33 open, 43 laparoscopic, 20 robot	Overall survival Disease-free survival Cost	40 mo	Similar outcomes for robotic vs laparoscopic
Tam et al,[39] 2016	Retrospective	2735	Conversion Length of stay	n/a	Lower conversion rate and shorter length of stay for robotic
Widmar et al,[31] 2016	Retrospective	276	Incisional hernia	1 y (robot)	Similar incisional hernia rate
Vasudevan et al,[34] 2016	Retrospective	227	Short-term clinical outcomes Cost	90 d	Similar outcomes
Cleary et al,[35] 2018	Retrospective	2940 1061 open, 1 604 lap, 275 robot	Cost Conversion rate	n/a	Higher cost, decreased conversion rate with robotic
Harr et al,[36] 2018	Retrospective	29,172	30-d outcomes	30 d	Fewer conversions, shorter length of stay with robotic
Law et al,[98] 2018	Retrospective	238	Mental and physical workload	n/a	Less mental demand, physical demand and effort in robot group
Lujan et al,[30] 2018	Retrospective	224	Short-term clinical outcomes Incisional hernia	30 mo (robot)	Less blood loss, shorter incisions, longer specimen in the robotic group
Armijo et al,[99] 2019	Retrospective	28	Physical fatigue	n/a	Similar physical fatigue
Polat et al,[25] 2019	Retrospective	378	Radical margins, number of retrieved lymph nodes, locoregional recurrence	15 mo	No difference in oncologic outcomes

- longer operative times
- lower conversion rate
- shorter lenght of stay
- less blood loss
- no differences in oncologic outcomes

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La fluorescenza

Indocyanine green-enhanced fluorescence to assess bowel perfusion during laparoscopic colorectal resection

Luigi Boni[1] · Giulia David[1] · Gianlorenzo Dionigi[1] · Stefano Rausei[1] · Elisa Cassinotti[1] · Abe Fingerhut[2,3]

Surg Endosc (2016) 30:2736–2742
DOI 10.1007/s00464-015-4540-z

107 patients lps colorectal surgery (May 2013 October 2014)

Intraoperative ICG-enhanced fluorescence colonic perfusion after intestinal resection, prior to and after completion of the anastomosis

- *right colectomy (n = 40),*
- *splenic flexure segmental resections (n = 10),*
- *left colectomy (n = 35)*
- *anterior resection (n = 22)*

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Surg Endosc (2016) 30:2736–2742
DOI 10.1007/s00464-015-4540-z

"Re-resection" up to an "adequate" fluorescent part in 4/107 patients (3.7 %)

ICG provides :
real-time evidence of perfusion of the bowel prior to proximal transection, after division of the mesentery and before the completion of the anastomosis in its definitive anatomic position

intraoperative ICG fluorescence might offer the possibility to:
- lower the rate of anastomotic leaks
- reduce the resulting morbidity and mortality rate

0% leakage

Results have to be confirmed by larger prospective studies

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Review

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https://doi.org/10.3393/ac.2021.05.07

Annals of Coloproctology
pISSN 2287-9714 eISSN 2287-9722
www.coloproctol.org

Multifunctional Indocyanine Green Applications for Fluorescence-Guided Laparoscopic Colorectal Surgery

Gyung Mo Son[1,2,3], Hong-min Ahn[1], In Young Lee[2,3], Gi Won Ha[4]

[1]Department of Surgery, Pusan National University Yangsan Hospital, Yangsan; [2]Research Institute for Convergence of Biomedical Science and Technology, Pusan National University Yangsan Hospital, Yangsan; [3]Medical Research Center, Pusan National University School of Medicine, Yangsan; [4]Research Institute of Clinical Medicine of Jeonbuk National University-Biomedical Research Institute of Jeonbuk National University Hospital, Jeonju, Korea

World Journal of Gastroenterology

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DOI: 10.3748/wjg.v27.i38.6374
ISSN 1007-9327 (print) ISSN 2219-2840 (online)
REVIEW

Intraoperative use of indocyanine green fluorescence imaging in rectal cancer surgery: The state of the art

Roberto Peltrini, Mauro Podda, Simone Castiglioni, Maria Michela Di Nuzzo, Michele D'Ambra, Ruggero Lionetti, Maurizio Sodo, Gaetano Luglio, Felice Mucilli, Salomone Di Saverio, Umberto Bracale, Francesco Corcione

The multifunctional ICG are: fluorescent tumor localization, fluorescence lymph node mapping (FLNM), and intraoperative angiography in colorectal cancer surgery can be performed within a single surgery under a laparoscopic or robotic NIR-imaging system.

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La fluorescenza

Surg Oncol. 2021 March ; 36: 84–90. doi:10.1016/j.suronc.2020.11.018.

A Review of Tumor-Specific Fluorescence Guided Surgery for Colorectal Cancer

Hannah M. Hollandsworth, MD[1,2], Michael A. Turner, MD[1,2], Robert M. Hoffman, PhD[1,2,3], Michael Bouvet, MD[1,2,4]

[1]Department of Surgery, University of California San Diego, San Diego CA

[2]Moores Cancer Center, University of California San Diego, San Diego, CA

[3]AntiCancer Inc., San Diego, CA

[4]VA San Diego Healthcare System, San Diego, CA

Mouse studies and clinical studies use of **Fluorescence Guided Surgery** in CRC

- **decreased residual tumor**
- **decrease rates of recurrence**

intraoperative fluorescence imaging can help locate tumor margins, visualize occult micro-metastases and drive surgical decision making!!!

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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La fluorescenza

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.elsevier.com/locate/ijsu

Effectiveness and safety of tumor site marking with near-infrared fluorescent clips in colorectal laparoscopic surgery: A case series study

Satoshi Narihiro[a,*], Masashi Yoshida[a], Hironori Ohdaira[a], Takayuki Sato[b], Daisuke Suto[c], Sojun Hoshimoto[a], Norihiko Suzuki[a], Rui Marukuchi[a], Teppei Kamada[a], Hideyuki Takeuchi[a], Yutaka Suzuki[a]

[a] Department of Surgery, International University of Health and Welfare Hospital, 537-3, Iguchi, Nasushiobara City, Tochigi, 329-2763, Japan
[b] Center for Photodynamic Medicine, Kochi University, Kohasu Oko-cho 185-1, Nankoku, Kochi, 783-8505, Japan
[c] Department of Internal Medicine, International University of Health and Welfare Hospital, 537-3, Iguchi, Nasushiobara City, Tochigi, 329-2763, Japan

- 30 patients (May 2019 - October 2019)
- disadvantages of tattoo marking/intraoperative endoscopy-based tumor localization tumor
- site marking with the near-infrared fluorescent clips, ZEOCLIP FS clips (Zeon Med. Co., Ltd., Tokyo, Japan) placed 1–2 days before surgery.

First report on the case series using near-infrared fluorescent marking clip

Early results colorectal laparoscopic surgery:

- effectiveness
- safety

Fluorescent clips could be detected in 94.1% of tumor lesions (lower rectum, obese pts???)

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Artificial intelligence

- Artificial Intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence.
- AI technology has made great progress, mainly owing to the development of analytical methods such as support vector machines and deep learning.
- continuous learning from data and experience accumulation, the task processing ability of the machine is greatly enhanced.
- AI has been improved through algorithm learning and knowledge management. It has gradually been applied in imaging and pathological diagnosis, disease management, drug research and development and promoting the development of genetics and molecular medicine

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Endoscopy

Prevention failure

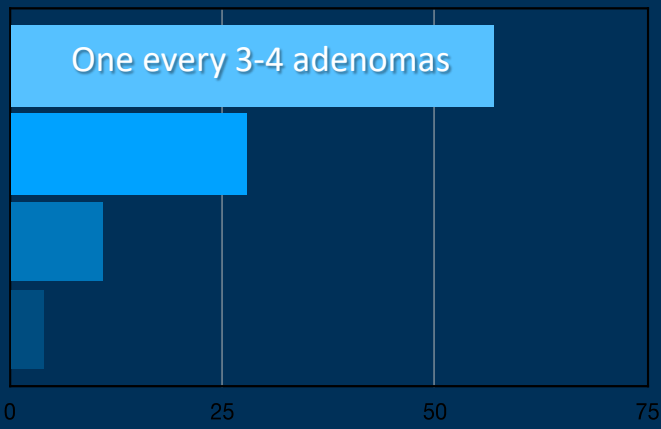
Colonoscopy for CRC: Prevention failure

In a typical career of 20K colonoscopies a **low-detecting colonoscopists** may **fail to prevent up to 80-100 CRCs !!!**

4 plausible explanations

Assuming colonoscopy interval was correct based on family history, genetic risk and prior findings on colonoscopy

- Missed polyps or CRC
- Incomplete polypectomy
- Inaccurate pathology
- *De Novo* progression



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TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Artificial intelligence

In recent years, the application of artificial intelligence in the diagnosis and treatment of colorectal polyps and cancer has increased. These applications include automated polyp detection and classification as well as qualitative and staging diagnosis of colorectal cance

World Journal of Gastroenterology

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MINIREVIEWS

Potential applications of artificial intelligence in colorectal polyps and cancer: Recent advances and prospects

Ke-Wei Wang, Ming Dong

ORCID number: Ke-Wei Wang 0000-0002-3816-1024; Ming Dong 0000-0003-2685-1420

Ke-Wei Wang, Ming Dong, Department of Gastrointestinal Surgery, the First Affiliated Hospital of China Medical University, Shenyang 110001, Liaoning Province, China

- Evaluated on 17.574 frames from 18 endoscopic videos, the proposed method could find frames with polyps with an accuracy of 88.6%

- With the advent of deep learning algorithms and significant advances in computer capabilities, more and more AI assistance, some of which may be used in real time during colonoscopy, is now being implemented.

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Artificial intelligence

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MINIREVIEWS

Potential applications of artificial intelligence in colorectal polyps and cancer: Recent advances and prospects

Ke-Wei Wang, Ming Dong

ORCID number: Ke-Wei Wang 0000-0002-3416-1858; Ming Dong 0000-0001-7696-1856

Ke-Wei Wang, Ming Dong, Department of Gastrointestinal Surgery, the First Affiliated Hospital of China Medical University, Shenyang 110001, Liaoning Province, China

Table 1 Characteristics of studies on artificial intelligence in the detection and classification of colorectal polyps

Ref.	Study type	Algorithm	Imaging modality	Image type	Training set	Testing set	Processing time
Mori *et al*[13]	Pilot study	-	EC	Real-time	-	-	0.3 s/image
Misawa *et al*[14]	*Ex vivo*	Machine learning: SVM	EC, NBI	Still	979 images (381 non-neoplasms, 598 neoplasms)	100 images (50 non-neoplasms, 50 neoplasms)	0.3 s/image
Kominami *et al*[15]	-	Machine learning: SVM	Colonoscopy, NBI	Real-time	2247 cutout training images from 1262 colorectal lesions	118 images	20 frame/s
Mori *et al*[16]	International web-based trial	Machine learning: SVM	EC	Still	6051 endocytoscopic images	205 small polyps (147 neoplastic and 58 non-neoplastic)	0.2 s/image
Misawa *et al*[17]	Pilot study	Machine learning: SVM	EC, NBI	Still	1661 EC-NBI images (1213 neoplasm images, 448 non-neoplastic images)	124 (19 neoplastic and 105 non-neoplastic)	-
Chen *et al*[18]	Pilot study	Deep neural network	Colonoscopy, magnifying NBI	Still	2157 (1476 neoplastic polyps *vs* 681 hyperplastic polyps)	284 (96 hyperplastic and 188 neoplastic polyps)	0.45 s/imag
Misawa *et al*[19]	*Ex vivo*	Machine learning	Colonoscopy, WL	Video	411 (105 positive and 306 negative)	135 (50 positive and 85 negative)	-
Shin *et al*[20]	Pilot study	Machine learning	Colonoscopy, WL	Video	1525 (561 polyp patches and 964 normal patches)	366 (196 polyp patches and 170 normal patches)	95 ms/fram
Wang *et al*[21]	*Ex vivo*	Deep learning	Colonoscopy, WL	Still	5545 (3634 images contained polyps and 1911 images did not contain polyps)	27 113 (5541 images contained polyps and 21572 images did not contain polyps)	-
Kudo *et al*[22]	Pilot study	Texture analysis	EC stained or NBI image	Still	69 142 EC images (43197 stained images and 25945 NBI images)	100 polyps	0.4 s/image
Min *et al*[23]	Pilot study	Gaussian mixture model	Colonoscopy, linked color imaging	Still	139 images of adenomatous polyps and 69 images of non-adenomatous polyps	115 images of adenomatous polyps and 66 images of non-adenomatous polyps	-
Sánchez-Montes *et al*[24]	Pilot study	SVM	Colonoscopy, WL	Still	-	-	-
Horiuchi *et al*[25]	Pilot study	-	Colonoscopy, autofluorescence	Real-time	-	-	-

Performance of artificial intelligence in the detection and classification of colorectal polyps

Ref.	Patients, *n*	Samples, *n*	Sensitivity, %	Specificity, %	Accuracy, %	NPV, %	PPV, %
Mori *et al*[13]	152	176	92.0	79.5	89.2	-	-
Misawa *et al*[14]	-	100	84.5	97.6	90.0	82.0	98.0
Kominami *et al*[15]	41	118	95.9	93.3	94.9	93.3	95.9
Mori *et al*[16]	123	205	89.0	88.0	89.0	76.0	95.0
Misawa *et al*[17]	58	64	94.3	71.4	87.8	83.3	89.2
Chen *et al*[18]	193	284	96.3	78.1	90.1	91.5	89.6
Misawa *et al*[19]	73	155	90.0	63.3	76.5	-	-
Shin *et al*[20]	-	366	95.9	95.9	95.9	-	96.4
Wang *et al*[21]	1138	27113	94.4	95.9	-	-	-
Kudo *et al*[22]	89	100	96.9 (stained)	100.0	98.0	94.6	100.0
			96.9 (NBI)	94.3	96.0	94.3	96.9
Min *et al*[23]	91	181	83.3	70.1	78.4	71.2	82.6
Sánchez-Montes *et al*[24]	-	225	92.3	89.2	91.1	87.1	93.6
Horiuchi *et al*[25]	77	258	80.0	95.3	91.5	93.4	85.2
Byrne *et al*[26]	-	106	98.0	83.0	94.0	97.0	90.0

29.451 samples from 14 Authors!!!!

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Artificial Intelligence and Endoscopy

AI FOR GI MEETINGS
CAD (COMPUTER ASSISTED DETECTION

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Artificial intelligence

- Recently, a novel AI system (GI-Genius, Medtronic) was reported to have a sensitivity of 99.7% in the detection of colorectal polyps.

- Lo studio, disegnato e coordinato dal prof. Alessandro Repici Direttore del Dipartimento di Gastroenterologia ed Endoscopia digestiva (Humanitas) ha visto la partecipazione degli ospedali Regina Margherita di Roma e Valduce di Como.

- The proportion of false positive frames found from colonoscopy was less than 1% of the total frames.

- Furthermore, the reaction time was shorter using this novel AI system compared with visual inspection by endoscopists in 82% of the cases

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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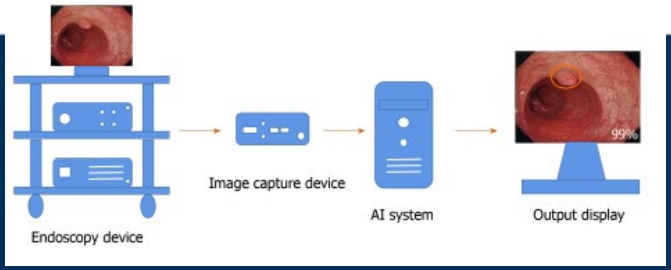
Artificial intelligence



World Journal of Gastroenterology

Potential applications of artificial intelligence in colorectal polyps and cancer: Recent advances and prospects

Ke-Wei Wang, Ming Dong

- although the results from previous studies appear to be promising, supporting evidence of AI systems applied in colonoscopy is still lacking as most studies were designed retrospectively
- due to the retrospective nature of most studies and the potential selection bias involved, further prospective double-blinded clinical trials are required to confirm the role of AI-assisted colonoscopy in clinical practice
- the establishment of a clinical AI system requires the use of a large amount of clinical data from patients
- the application of medical data also involves protection of patient privacy and ethical issues
- once the information is leaked, it may cause unpredictable consequences
- the safe management of medical data should be a key issue
- only after these problems are appropriately addressed, AI can be used clinically for colorectal diseases

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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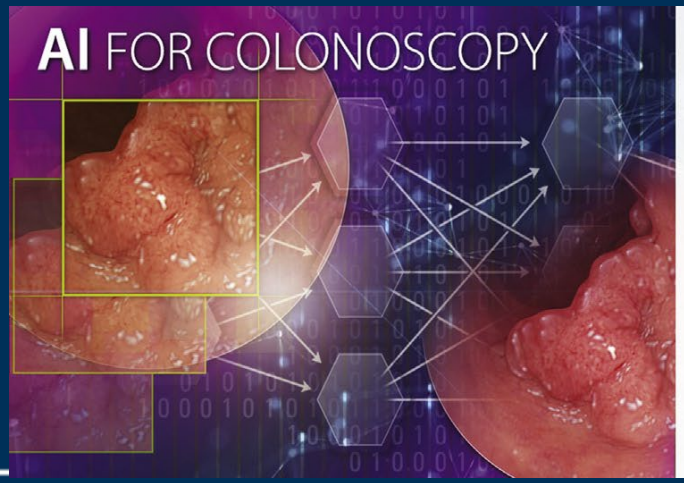
Artificial Intelligence and Colonoscopy

CADe (Computer Assisted Detection)

CADx (Computer Assisted Diagnosis)



Comparative effectiveness of CAD versus control group on ADR

Study / Subgroup	CAD Events	CAD Total	WL Events	WL Total	Weight	Risk ratio M-H, Random, 95% CI
Su et al, 2020	89	308	52	315	11.7%	1.75 [1.29-2.37]
Wang et al, 2019	151	522	109	536	18.8%	1.42 [1.15-1.76]
Wang et al, 2020	165	484	134	478	21.7%	1.22 [1.01-1.47]
Liu et al, 2020	199	508	124	518	22.0%	1.64 [1.36-1.97]
Repici et al, 2020	187	341	139	344	25.8%	1.36 [1.16-1.59]
Total (95% CI)		**2163**		**2191**	**100.0%**	**1.44 [1.27-1.62]**
Total events	791		558			

Heterogeneity: $Tau^2 = 0.01$, $Chi^2 = 6.91$, $df = 4$ ($P = 0.14$); $I^2 = 42\%$
Test for overall effect: $Z = 5.93$ ($P < 0.00001$)

Risk ratio M-H, Random, 95% CI
0.2 0.5 1 2 5

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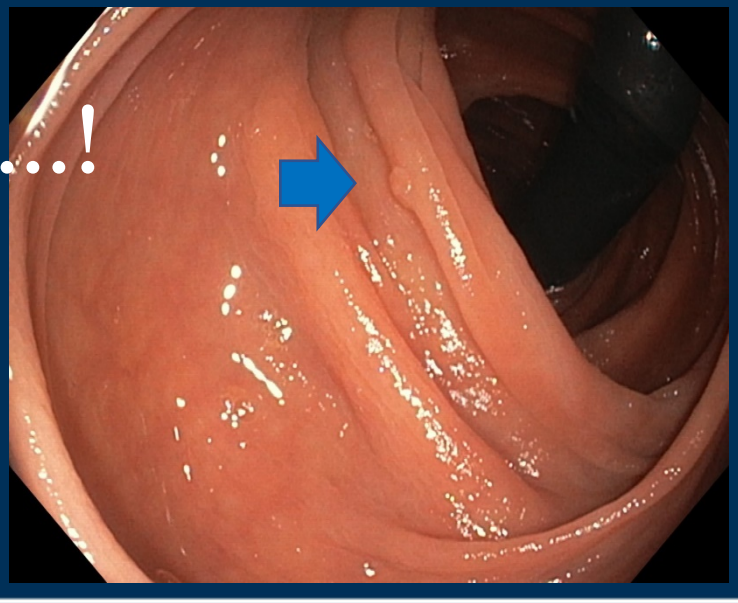
Artificial Intelligence and Colonoscopy

Artificial Intelligence in Colonoscopy still limited by Human behaviors

STILL……!



…slow Withdrawal, Twist, Angle and Retroflex

TECNOLOGIA IN CHIRURGIA ONCOLOGICA del COLON-RETTO

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Take home messages

La MIS è il presente della chirurgia colo-rettale, la robotica sarà il futuro

- La penetranza della tecnologia è in aumento, da noi al di sotto delle mediane di altri paesi, è rallentata dalla diffidenza ma anche dai costi di gestione
- L'utilizzo della FGS i.o. comporta un minor residuo microscopico del tumore e reduce il tasso di recidiva nei tumori colo-rettali, offre risultati oncologici migliori
- L'utilizzo dell'AI necessita di grandi numeri e studi prospettici per verificarne efficacia
- Studi internazionali multicentrici ne dovranno valutare riproducibilità e stabilità per tutti i tipi di lesioni ed in diversi gruppi di pazienti
- La realtà aumentata comporta una riduzione del carico cognitivo ma anche un aumento dell'efficienza e quindi dei risultati

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Take home messages

- L'arrivo del 5G con velocità di 10 GB sec. (latenze 2 sec.) annullerà le latenze nella chirurgia a distanza

Le review dell' ACS-NSQIP e del Michigan Surgical Quality Collaborative Database documentano che la RACS ha tempi operatori più lunghi ed una degenza p.o. significativamente più breve (4.3 gg. vs 5.3 gg), con tassi di conversione minori

Questi grandi numeri consentono di valutare e riconoscere minime differenze tra i diversi gruppi di pazienti anche senza raggiungere una validità statistica

Given the small effect sizes in these studies, robotic surgery should be considered to have clinically equivalent outcomes compared with laparoscopic

L'efficacia della RACS dovrà essere riconsiderata in ulteriori studi prospettici e multicentrici con casistiche ampie e gruppi diversi di pazienti

RACS potrebbe in futuro essere il miglior trattamento per il cancro colo-rettale

TECNOLOGIA IN CHIRURGIA ONCOLOGICA
del
COLON-RETTO

Grazie per l'attenzione!!

antonio.crucitti@unicatt.it