

Aluminium i vaksiner

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Vaksiner inneholder

- Antigen (vaksineantigen)
Virkestoff (aktiv komponent)
- **Adjuvans** *Tilsetningstoff
(hjelpstoff)*



Adjuvans *adjuvare (latin) = å hjelpe*

=

Stoff som tilsettes vaksiner for å gjøre de mer effektive

Adjuvans øker den spesifikke immunresponsen til vaksineantigener

Hva oppnår vi ved å tilsette adjuvans til vaksiner?

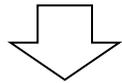
- Økt mengde/kvalitet på antistoffer
- Økning i cellulære immunresponser (CMI)
- Lenger varighet av immunresponsen
- Bedre immunrespons i populasjoner med dårlig immunsvare (eldre, spedbarn, immunsupprimerte)
- Klare oss med lavere dose av antigen
- Klare oss med færre vaksinedoser



Hvordan virker adjuvans?

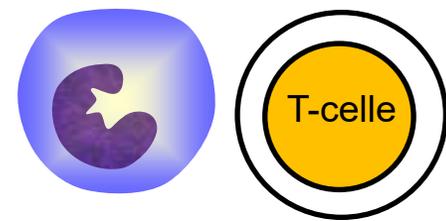
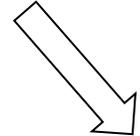
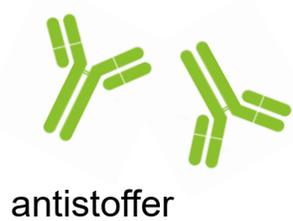
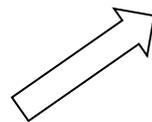
Adjuvans aktiverer det medfødte immunforsvaret: Antigen Presenterende Celler (APC)

(bl.a makrofager) 



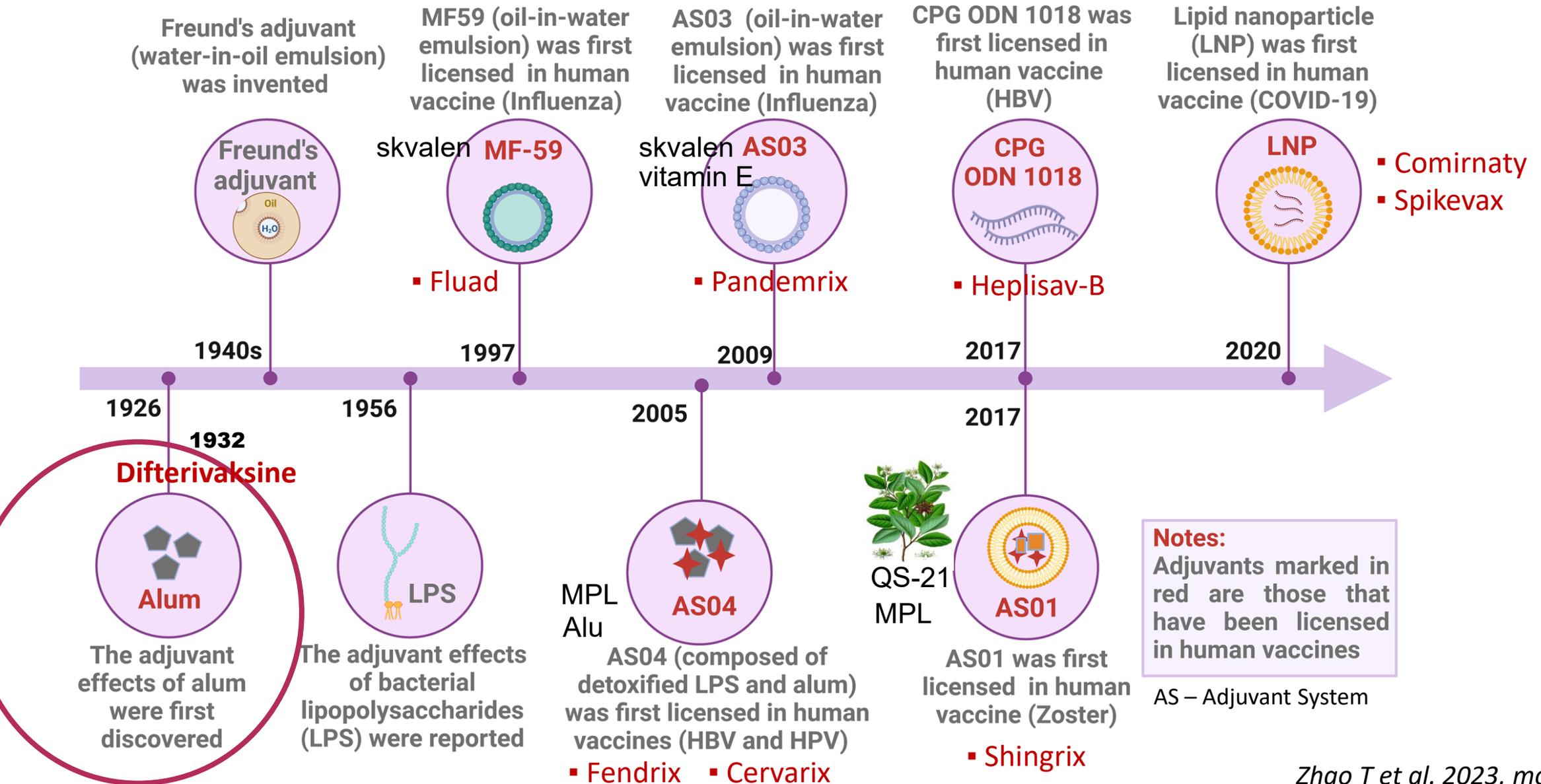
- kraftigere spesifikk immunrespons

- styre immunresponsen



Celle-medierte immunresponser (CMI)

Adjuvans i vaksiner har vært brukt i 100 år



Mange vaksiner inneholder aluminium som adjuvans

Aluminium – mest brukte adjuvansen i vaksiner

Brukt i humane vaksiner > 90 år med gode sikkerhetsdata, i Norge i bruk i vaksiner siden 1950-tallet



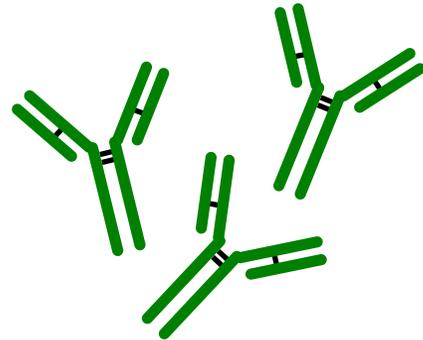
Aluminiumsalter

- Aluminiumhydroksid Al(OH)_3
- Aluminiumfosfat AlPO_4

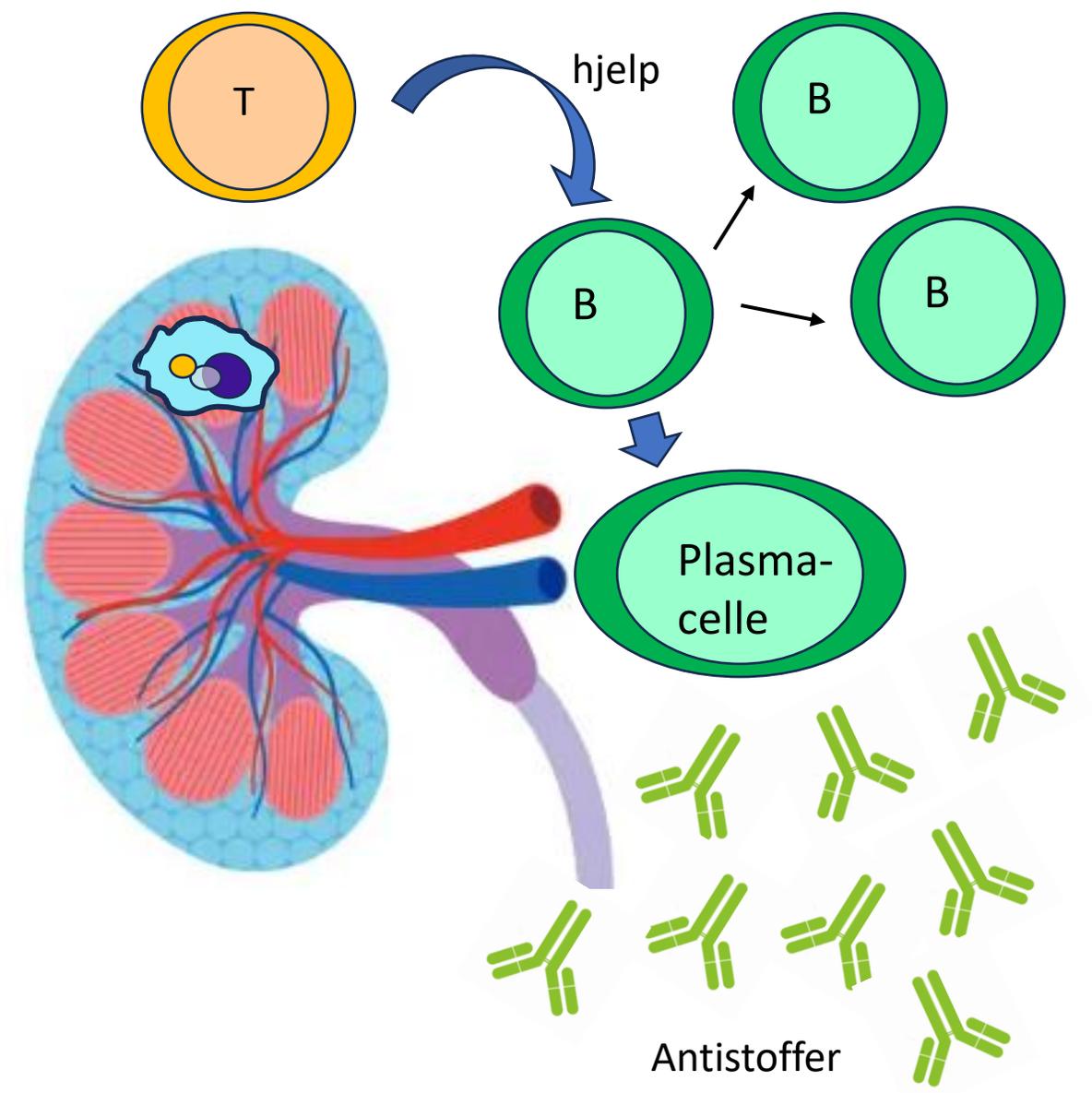
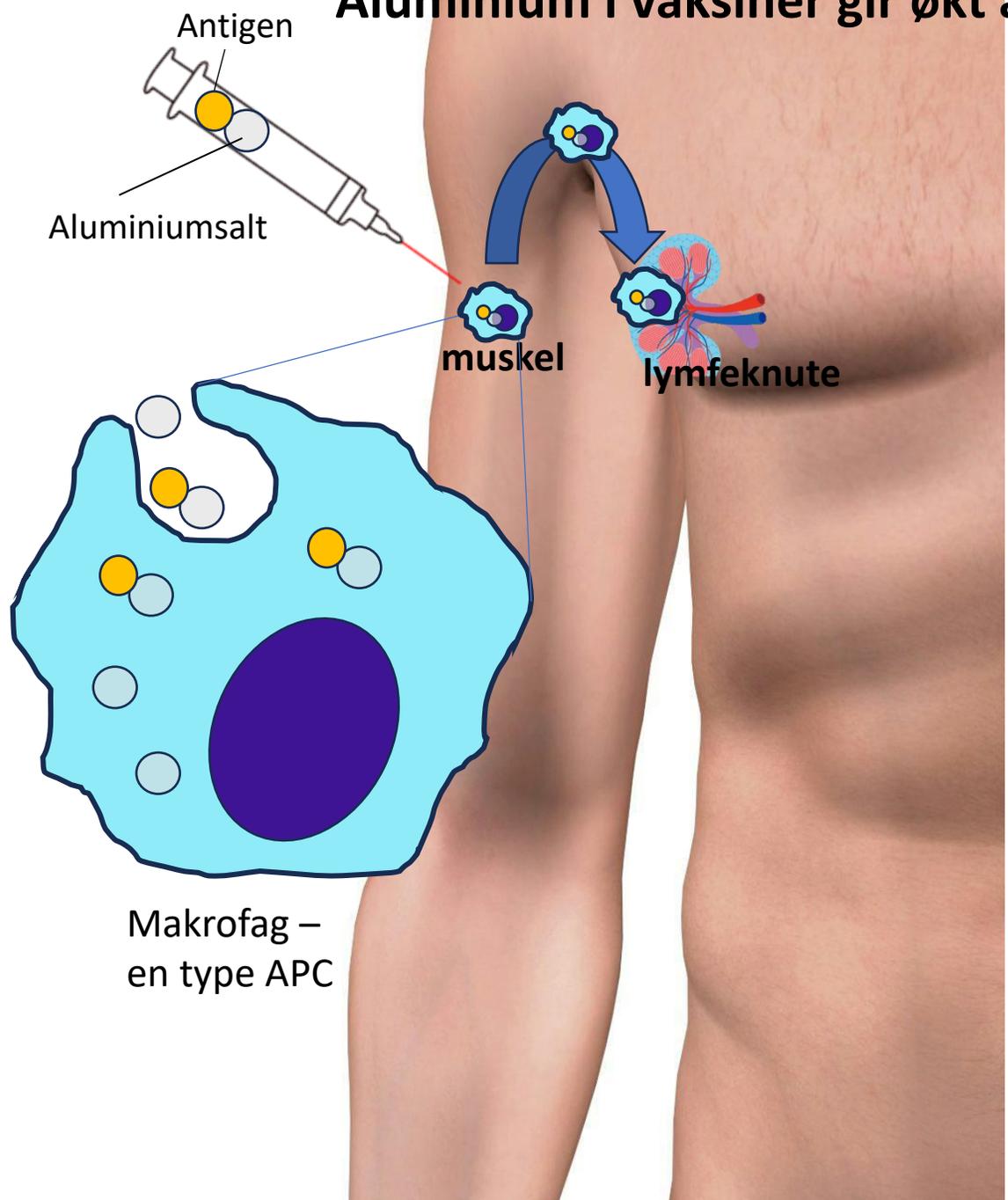
- DTP-IPV-Hib-HepB
- Hepatitt A
- Hepatitt B
- HPV
- Pneumokokk
- Meningokokk
- Japansk encefalitt
- TBE

Hvordan virker aluminium som adjuvans?

- Stimulerer det medfødte forsvaret
Aktiverer makrofager
- Depoteffekt - frigjør vaksineantigen langsomt fra stikkstedet
- Stimulerer dannelse av antistoffer

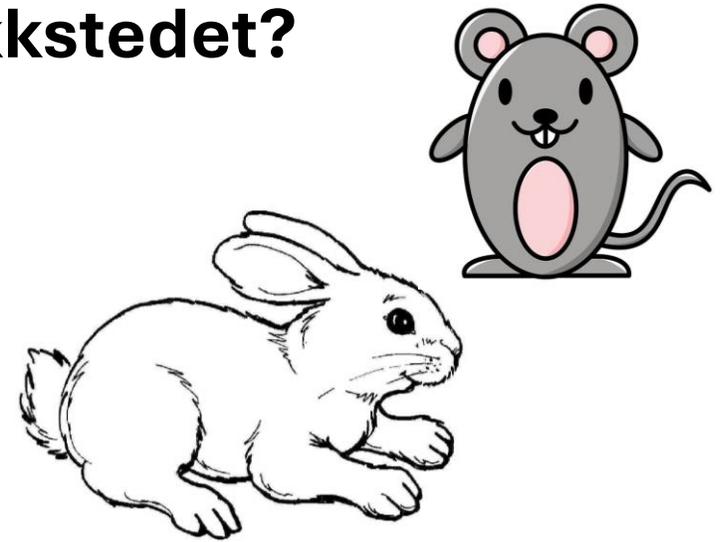


Aluminium i vaksiner gir økt aktivering av makrofager → økt antistoffrespons



Hva skjer med aluminium adjuvansen på stikkstedet?

- Aluminiumet i adjuvansen er i form av partikler
- Tas raskt opp av APC (antigenpresenterende immunceller) i muskel og fraktes til nærmeste lymfeknute
- Noen av disse APC blir igjen på stikkstedet
- Aluminiumspartiklene vil frigjøres langsomt ut i blodet (dager, uker, mnd?) og noe kan til slutt ende opp i andre organer
- Skilles ut i urin



Uønskede bivirkninger etter vaksiner med Al-holdige vaksiner

- Lokalreaksjoner: Rødme, smerte, hevelse på stikkstedet (*Jefferson T et al. Lancet Infect Dis, 2004 – syst review DTP vaksiner*)
- Allergiske reaksjoner
- Hypersensitivitet (DTH - Delayed Type Hypersensitivity)

Aluminiumsgranulomer på stikkstedet (dager, uker, mnd) – ufarlige, men plagsom kløe/smerter



Prevalens: ca 1% (*Bergfors E et al, Eur J Pediatr, 2014*)



Spedbarn, 7 mnd

Lauren CT et al. Case Report of Subcutaneous Nodules and Sterile Abscesses Due to Delayed Type Hypersensitivity to Aluminum-Containing Vaccines, Pediatrics 138, 2016

Hvorfor er aluminium et aktuelt tema på årets Vaksinedag?

- Økende skepsis til aluminiumsalter i vaksiner de seneste årene - i hovedsak i vaksineskeptiske miljøer



Kan aluminium bidra til autisme? Astma og allergi?
Nevrologiske sykdommer? Autoimmune sykdommer?

- Aktualisert ved Trump administrasjonen i USA og Robert Kennedy Jr som helseminister..



Autism and Vaccines

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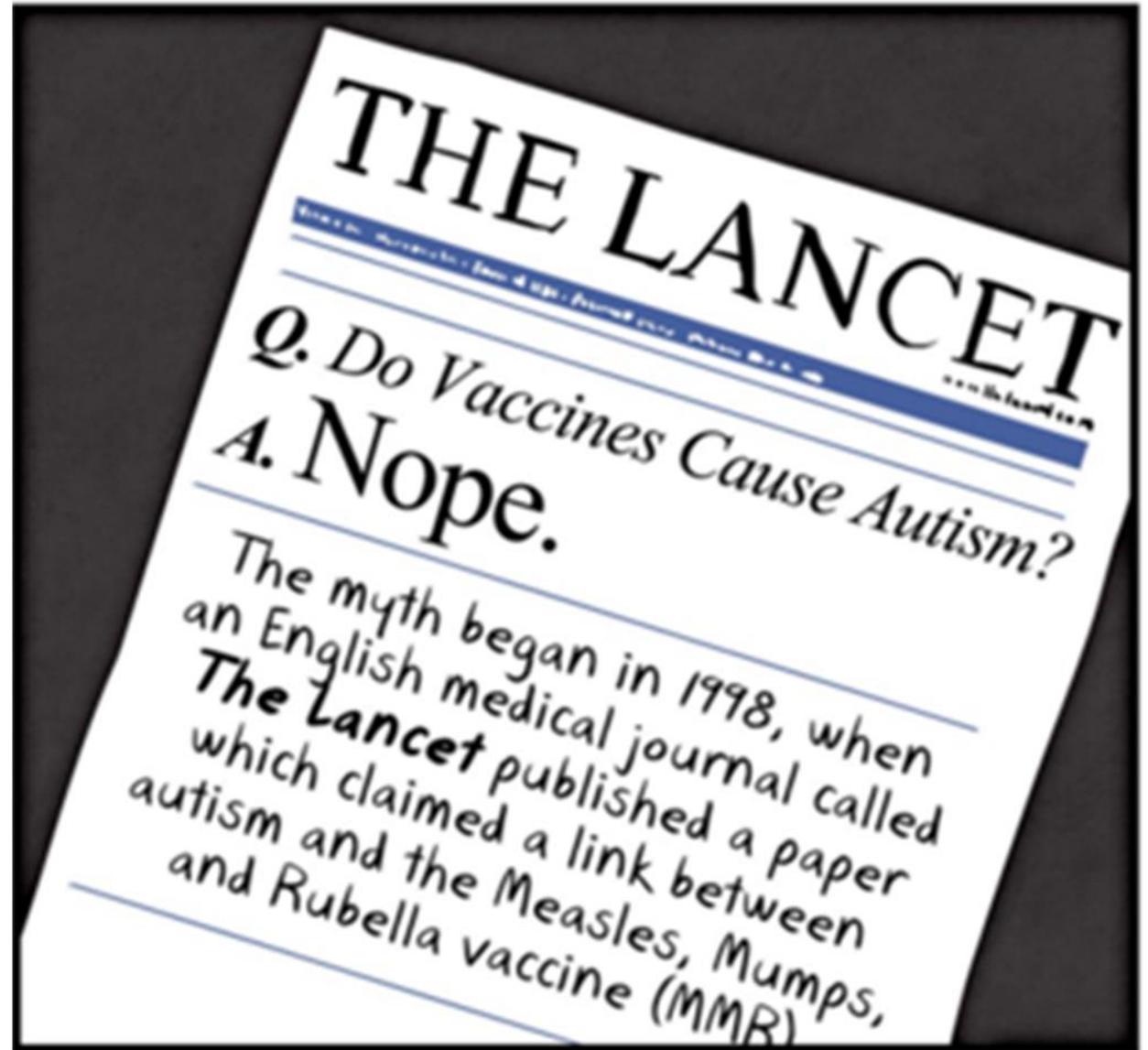
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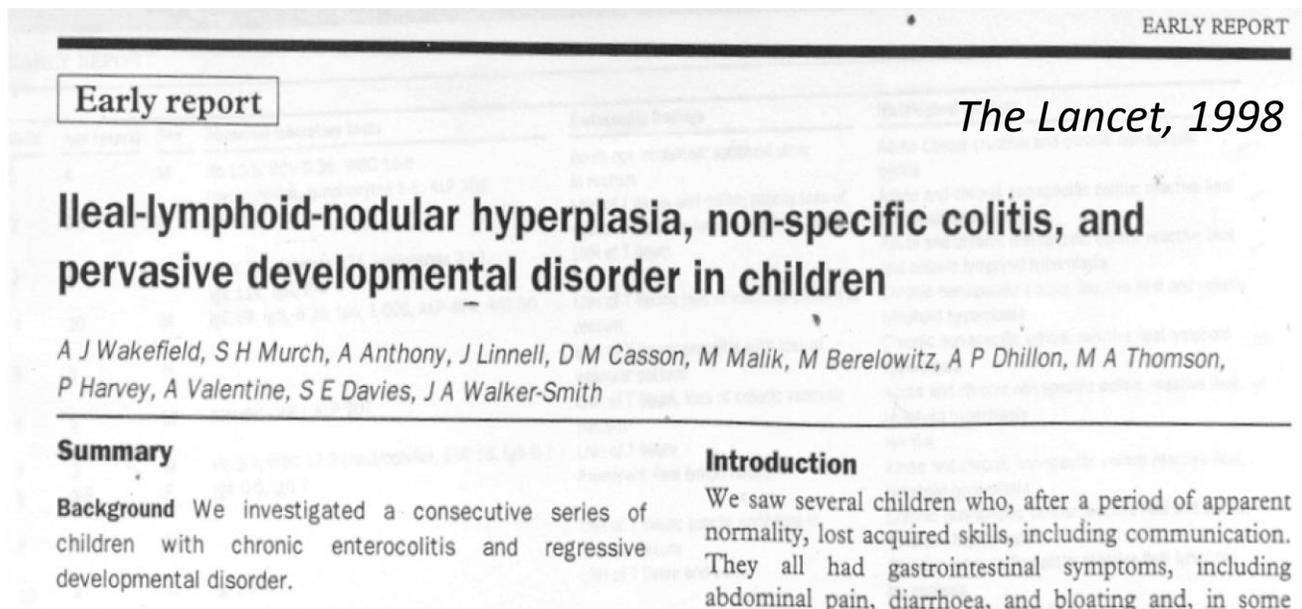
KEY POINTS

- The claim "vaccines do not cause autism" is not an evidence-based claim because studies have not ruled out the possibility that infant vaccines cause autism.
- Studies supporting a link have been ignored by health authorities.
- HHS has launched a comprehensive assessment of the causes of autism, including investigations on plausible biologic mechanisms and potential causal links.

MMR vaksinen



Wakefield affæren



Andrew Wakefield

- Inflammatorisk tarmsykdom & autisme?
- 12 kasuistikker – barn fra 15 mnd alder utviklet autistiske trekk og tarmproblemer
Foreldrene til 8 av barna oppga MMR vaksinerings rett før symptomdebut – hypotese: Sammenheng
- Ingen kontrollgruppe



Enorm oppmerksomhet i media

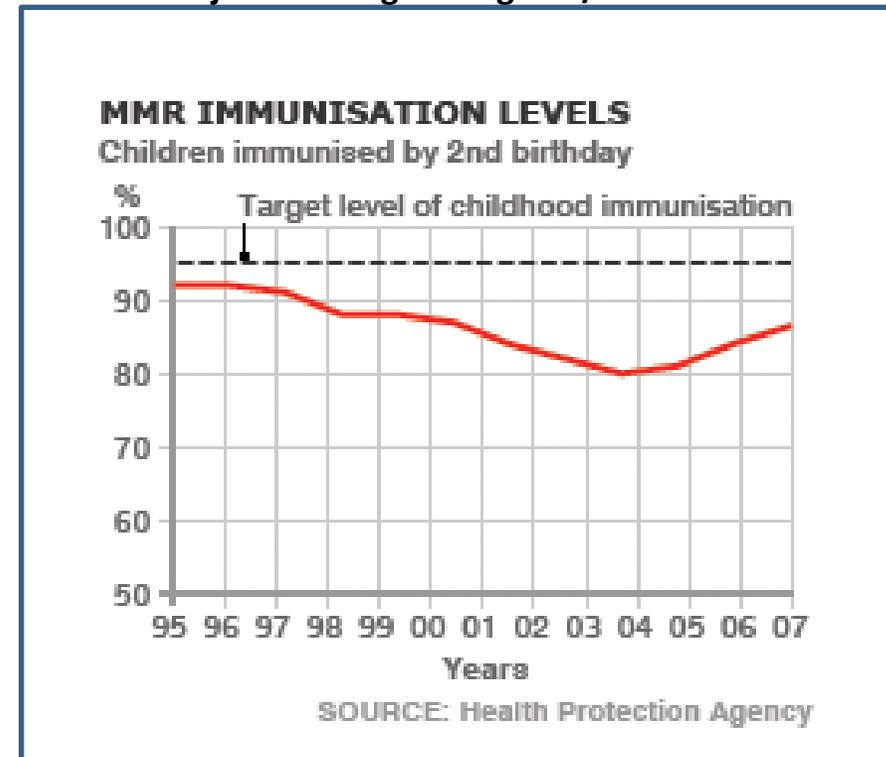


Vaksinasjonsdekningen for MMR vaksine gikk ned i mange land



Utbrudd av meslinger

Vaksinasjonsdekning for England/Wales for MMR



Det viste seg senere at ..

- Wakefield påtok seg betalt oppdrag fra advokatfirma som jobbet for en gruppe som arbeidet for å påvise sammenheng mellom MMR og autisme (søksmål mot vaksineprodusenter)
- Patent på alternativ meslingevaksine



Interessekonflikter – ikke oppgitt til Lancet

- Uetisk virksomhet– unødvendige undersøkelser av barn



Fratatt legelicens i UK



EARLY REPORT

2012

Early report

Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Summary
Background We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.
Methods 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.
Findings Onset of behavioural symptoms was associated with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and otitis media in another. All 12 children had intestinal abnormalities ranging from lymphoid nodular hyperplasia to crypt abscessation. Histology showed patchy chronic inflammation with hyperplasia in 11 children and reactive ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible postviral or vaccinal encephalitis (two). There were no focal neurological abnormalities and EEG tests were normal. Abnormal laboratory results were significantly raised urinary methylmalonic acid compared with age-matched controls (p=0.03), low haemoglobin in four children, and low serum IgA in four children.
Interpretation We identified associated gastrointestinal disease and developmental regression in a group of previously normal children, which was generally associated in time to possible environmental triggers.

Introduction
We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and vomiting and, in some cases, food intolerance. We describe clinical findings, and gastrointestinal features of these children.

Patients and methods
12 children, consecutively referred to a department of paediatric gastroenterology with a history of a pervasive developmental disorder with loss of acquired skills and intestinal symptoms (abdominal pain, bloating and food intolerance), were investigated. All children were admitted to the ward for a week, accompanied by their parents.

Clinical investigations
We took histories, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases the history was obtained by the senior clinician (JW-S). Neurological and psychiatric assessments were done by consultant staff (PH, MB) with HMS-4 criteria. Developmental records included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, ileocolonoscopy was performed by SHM or MAT under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal appearances in the terminal ileum. Barium follow-through radiography was possible in some cases.

Also under sedation, cerebral magnetic-resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

Laboratory investigations
Thyroid function, serum long-chain fatty acids, and

Lancet 1998; 351: 637–41

National Academy of Medicine i USA (tidligere IOM), 2002 & 2004

> 200 epidemiologiske og biologiske studier



Ingen sammenheng mellom MMR vaksine og autisme





Autism and Vaccines

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KEY POINTS

- The claim "vaccines do not cause autism" is not an evidence-based claim because studies have not ruled out the possibility that infant vaccines cause autism.
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- HHS has launched a comprehensive assessment of the causes of autism, including investigations on plausible biologic mechanisms and potential causal links.

Aluminium i vaksiner

Vi er omgitt av aluminium



Negative helseeffekter?



Aluminium i menneskekroppen

- Ingen biologisk funksjon
- Aluminium i blod, vev (30-50 mg totalt)



mat, drikkevann (finnes i jordskorpa)



- Kun liten del tas opp i kroppen < 1% (0.01-5%), resten forsvinner ut via avføring



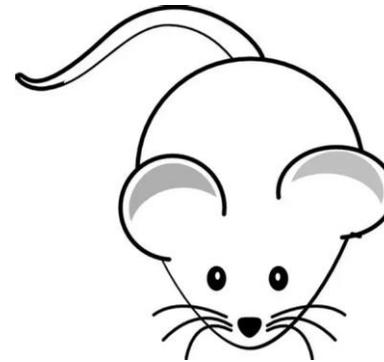
- bindes til transferrin i blodet og skilles raskt ut i urin
- noe vil lagres i skjelett, lunge, lever, nyre

2012: Tolerabelt inntak: 2 mg aluminium per kg kroppsvekt/uke (FAO/WHO)

- Alvorlig nyresvikt kan føre til aluminiumsmengder over anbefalt nivå

Toksisitet av aluminium

- Lav akutt toksisitet (ved oral eksponering)
- Ikke klassifisert som kreftfremkallende
- Nevrotoksisk i forsøksdyr
Psykomotorisk kontroll, hukommelse, kognitive funksjoner
- Toksisk i mennesker ved gjentatt eksponering for svært høye doser (tidligere sett hos dialysepasienter)
→ hjerneskade



Hvor mye aluminium er det i vaksiner?

EU & USA: Maksimal dose 1,25 mg aluminium per dose

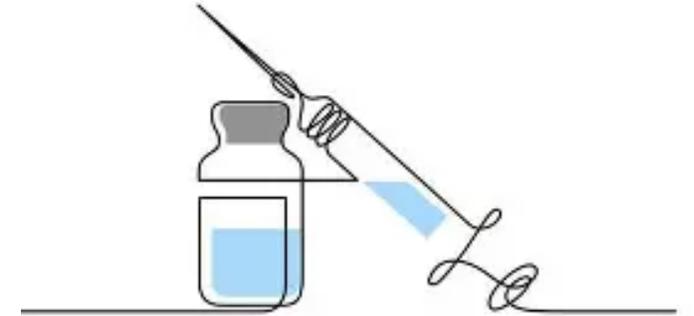
- Optimal mengde adjuvans - avhengig av vaksineantigen, må bestemmes empirisk

Sikkerhet – uspesifikke effekter



Effektiv
immunrespons

- Testes ut i dyreforsøk og kliniske forsøk før en vaksine godkjennes



Aluminiummengde i barnevaksiner i Norge

Vaksiner i barnevaksinasjonsprogrammet de to første leveår (2017)



Mot sykdom	Antall doser	Preparat navn	Aluminium per dose
DTP-IPV-HepB-Hib	3	Hexyon	Aluminiumhydroksid 0,6 mg Al ³⁺
Invasiv pneumokokksykdom	3	Prevenar 13	Aluminiumfosfat 0,125 mg
MMR	1	Priorix	ingen
Rotavirus	2	Rotarix	ingen
Tilbys risikogrupper			
Tuberkulose (BCG)	1	BCG-SSI	ingen

Totalt alle doser: Mindre enn 3 mg aluminium

Øistein Riise

Aluminiumeksponering hos spedbarn

- Mat/drikke



Aluminium finnes i morsmelk, morsmelktillegg og barnegrøt



Kun liten del tas opp i kroppen < 1% (0.01-5%), resten forsvinner ut via avføring



skilles ut via urin

- Vaksiner

Aluminiumnivåer i vaksiner mye lavere enn i mat og drikke, men regner med at 100% av det som injiseres tas opp i kroppen



Vi kan derfor ikke sammenlikne nivåene direkte med det vi spiser/drikker!

USA: Dobbelt så mye aluminium fra vaksiner som fra mat og drikke

Det meste av aluminiumet som finnes i kroppen hos spedbarnet første leveår er fra vaksiner, men overstiger ikke grenseverdier satt for helseskadelige effekter *Mitkus RJ et al. Vaccine, 2011*

Hva vet vi om alumiumadjuvans i vaksiner og autisme?

**AUTISM
SPECTRUM
DISORDER
(ASD)**



Studier av aluminium adjuvans i vaksiner til mennesker

- Stort antall kliniske studier av vaksiner med aluminiumadjuvans som har evaluert sikkerhet
- Brukt i mer enn 90 år i hundrevis av millioner av mennesker verden over
- Få kinetikkstudier i mennesker

Movsas et al. JAMA Pediatr, 2013 :

Målte aluminiummengden etter vaksinasjon ved 2 mnd alder i 12 premature barn

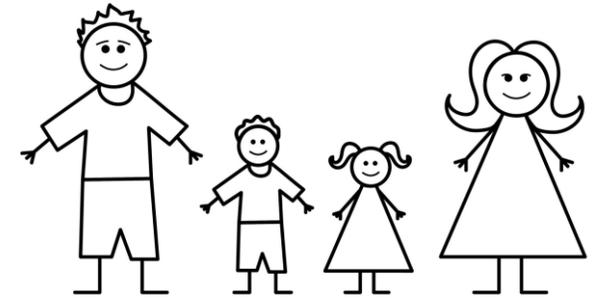
Fant ingen endring i aluminiumsnivåene i blod og urin før og 24 timer etter vaksinasjon

- Flere store, epidemiologiske undersøkelser (registerstudier) som har sett på sammenheng mellom aluminiumholdige vaksiner og kroniske tilstander som astma, autisme og ADHD



Finner ingen klar sammenheng

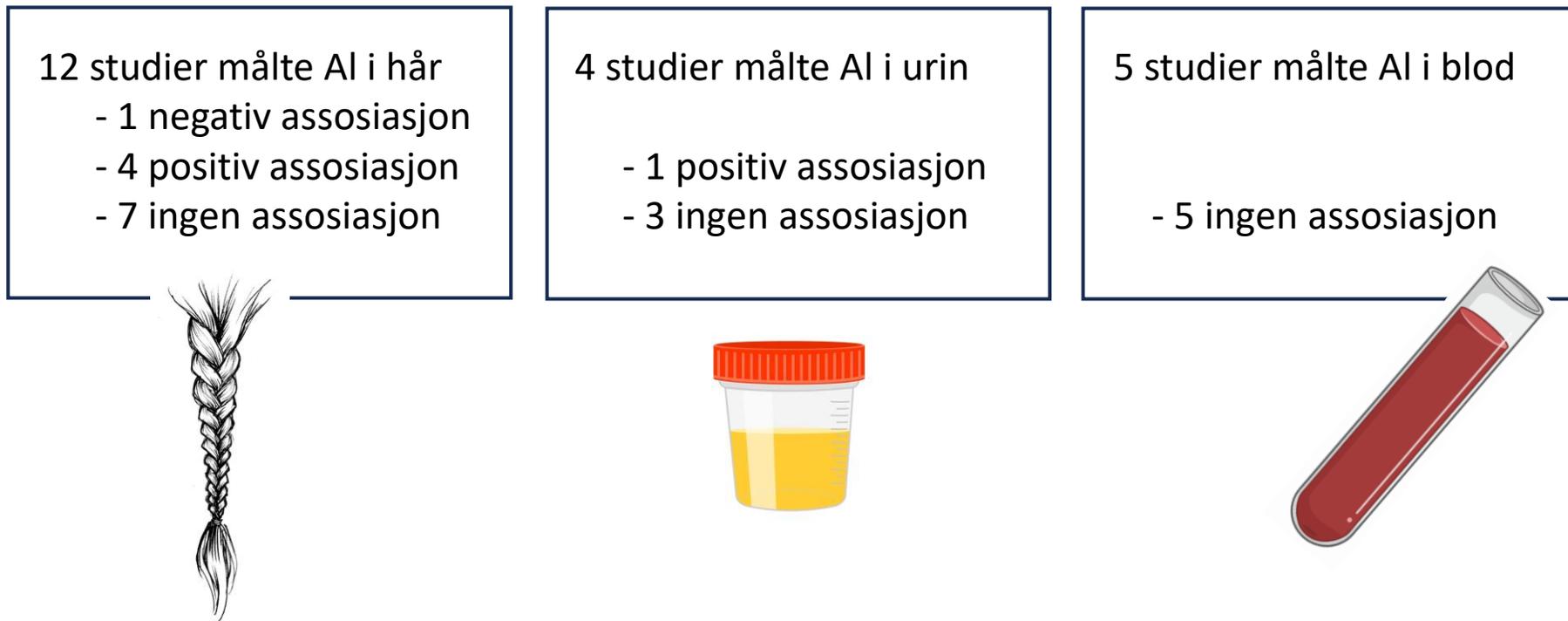
én studie fant en mulig sammenheng med astma,
men metodiske svakheter



Har individer med ASD høyere nivåer av aluminium i kroppen?

Systematisk review og meta analyse, *Sulaiman R et al. Chem Res Toxicol, 2020*

18 studier fra 10 land – sammenliknet nivået av Al hos barn (N=17-116) med ASD og en kontrollgruppe



Det ser ikke ut til at individer med ASD har forhøyede nivåer av aluminium
(men kan ikke utelukke høyere nivåer i f.eks skjelett og hjerne)

«Ingen assosiasjon mellom vaksiner med aluminium adjuvans og alvorlige, uønskede hendelser»

Global Advisory Committee on Vaccine Safety (GACVS) , WHO 2012

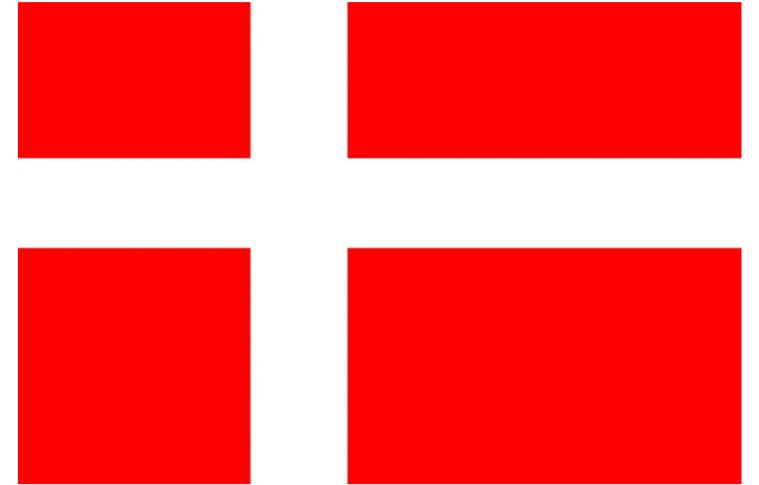
Kelso et al. 2012 Systematic review, J Allergy Clin Immunol, 2012

Willhite CC, Systematic review, Critical reviews in toxicology, 2014



Stor, dansk epidemiologiske studie av aluminiumholdige vaksiner og kroniske sykdommer

Statens Serum Institut (SSI)



Andersson NW; Anders Hviid et al. Aluminum-Adsorbed Vaccines and Chronic Diseases in Childhood: A Nationwide Cohort Study, Ann. Intern. Med. 2025

- Over 1.2 millioner danske barn.
 - Så på antall doser hver av de hadde fått og dermed aluminiummengde.
- Fant ingen økning i risiko med økende mengde aluminium i vaksiner for kroniske tilstander (bla autism, ADHD og astma)

Merk! Sammenliknet ikke uvaksinerte (N= 50 000) med vaksinerte.





Autism and Vaccines

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En rekke organisasjoner og enkeltforskere har gått hardt ut mot CDCs nye hjemmesider

- American Academy of Pediatrics (AAP) :

«This is madness. Vaccines do not cause autism, and unfortunately, we can no longer trust health-related information coming from our government.» Dr. Sean O’Leary, Leder AAP



- American College of Obstetricians and Gynecologists
- Autism Society of America
- Autism Speaks
- Autism Science Foundation

Autism Science Foundation: 'Vaccines do not cause autism'

'There is no correlation between autism and vaccines. This has been confirmed through dozens of scientific studies examining different types of vaccines and different vaccine timing schedules.'

Strong Voice for Science

- Led the media response to misinformation around the causes of autism, and advocated for a separate diagnosis for "profound autism".



Dr. Alycia Halladay



Solid dokumentasjon



Aluminium adjuvans gjør vaksiner mer effektive med minimal risiko for alvorlige bivirkninger



Takk for oppmerksomheten!

Autisme – økning i alle aldersgrupper siden 1980-tallet



økning i antall diagnostiserte (prevalens)
ikke nødvendigvis i antall tilfeller (insidens)

Prevalens

Europa: 0,6-1% av befolkningen (2018)

USA: 0,6-1,7% (2014)

- Diagnosekriterier er endret

Definisjonen av autisme for snever



Autismebegrepet ble utvidet - inkluderte mer milde symptomer (f.eks lære og språkvansker, Asperger)

Autism spectrum disorder (ASD)

- Økt fokus og kapasitet til å stille diagnose



The Denmark Study

- On July 15, 2025, Niklas Andersson and others published a nationwide cohort [study](#) on the association between aluminum adjuvants and chronic diseases in childhood. The study was published in a respected and peer-reviewed journal, *Annals of Internal Medicine*, and examined the medical records of over 1.2 million children born in Denmark between 1997 and 2018. The study looked at incident events of 50 chronic disorders versus the cumulative aluminum received through vaccination during the first 2 years of life. Records were analyzed from age 2 through 5 years, with some analyzed through age 8 years if additional analysis was needed.
- The study looked at aluminum exposure by milligram, comparing children who received vaccines and had low aluminum exposure to those who received vaccines and had high aluminum exposure (range 0-4.5 mg). No difference in outcomes was found, regardless of the cumulative aluminum exposure.
- The study concluded there was no increase in incidence of any of the 50 chronic conditions (neurodevelopmental, autoimmune, allergic disorder, etc.) because of increased aluminum exposure from vaccines.

The Critics

- The study excluded children who died before age 2 or who were diagnosed with chronic conditions prior to age 2: Correct. Children born with serious congenital conditions or who have heart disease, liver failure, etc., that was diagnosed before age 2 were unlikely to have completed the vaccination series or to have their conditions because of aluminum in vaccines.
- The study excluded children with records indicating abnormally high aluminum exposures: Correct. These were thought to be spurious and due to coding anomalies or duplicated records.
- The analysis adjusted for the number of medical visits in the first 2 years of life: Correct. If this was not done, some conditions would be diagnosed based on more frequent interactions with the medical system rather than because of their exposure to aluminum.
- The study did not look at vaccinated versus unvaccinated: Correct. This study is more important as it looked at the dose-response relationship between aluminum exposure and the development of chronic disease. It showed that there was no increase in incidence of those diseases between those who had low exposures versus children who had high exposures.
- A figure in the supplemental materials found a hazard ratio for Asperger syndrome per milligram of aluminum of 1.67, indicating those with aluminum exposure had a higher risk of developing Asperger syndrome (now classified as part of Autism Spectrum Disorder): Correct. But the confidence interval was 1.01 to 2.77 and the case number was very small—51 cases out of more than 1.2M children. This mild increase in risk was only seen in the group of children born between 2007 and 2018 and was not seen when researchers extended the follow up from age 5 years to age 8 years, nor was it seen in the analysis of the full cohort.
- Denmark's childhood immunization schedule is different from that of the U.S. and has fewer vaccinations: Correct. But the range of aluminum exposure in this analysis was 0-4.5 mg, which would include similar exposures as in the U.S.
- Three authors work at an institute that produces vaccines used in Denmark. Correct. But conflicts were disclosed in the publication and reviewed by the journal. Those criticizing the research have conflicts as well, as they are involved in lawsuits against vaccine manufacturers.
- [The reference for the information above can be found here.](#)

Aluminium og autisme (ASD, autismespekterforstyrrelser)

- Kombinasjon av genetikk og miljøfaktorer
- Har autister høyere nivåer av aluminium i hjernen enn andre?



Få studier, sprikende funn

Konsensus per i dag

Ikke funnet noen årsakssammenheng eller klar sammenheng mellom aluminium mengde i hjernen/kroppen og autisme

Toksisitet av aluminium

- Ikke akutt toksisk (oral eksponering)
- Ikke kreftfremkallende
- Kan gi dårligere sædkvalitet (hunder)
- Nevrotoksisk (mus, rotter) *Hukommelse, kognitive funksjoner, psykomotorisk kontroll*

Al krysser blod-hjerne barrieren

Risikofaktor for Alzheimer?

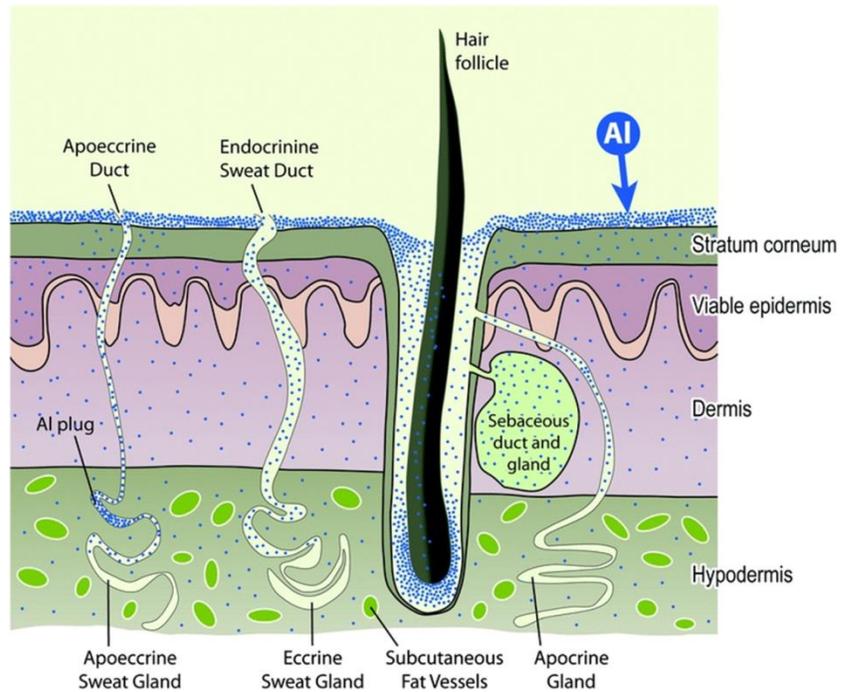
WHO: mange epidemiologiske studier, ingen holdepunkter for årsakssmh

- Kan påvirke foster (ikke teratogent)

Aluminium i kosmetikk

- deodoranter

Aktivt virkestoff: aluminiumforbindelser
aluminium klorhydrat



Risikovurdering VKM, 2013:

Mat og drikke – ingen helserisiko

Daglig bruk av deodorant kan gi eksponeringer 30-50x høyere enn det som er helsemessig forsvarlig

CNN

“Medical researchers across the globe have spent more than 25 years thoroughly studying this claim.

All have come to the same conclusion: Vaccines are not linked to autism,” according to [a statement](#) from more than 60 organizations, including the American Academy of Pediatrics, the American Medical Association and the Autism Science Foundation.

Here’s what to know about what’s changed and what hasn’t.

What does research into autism and vaccines show?

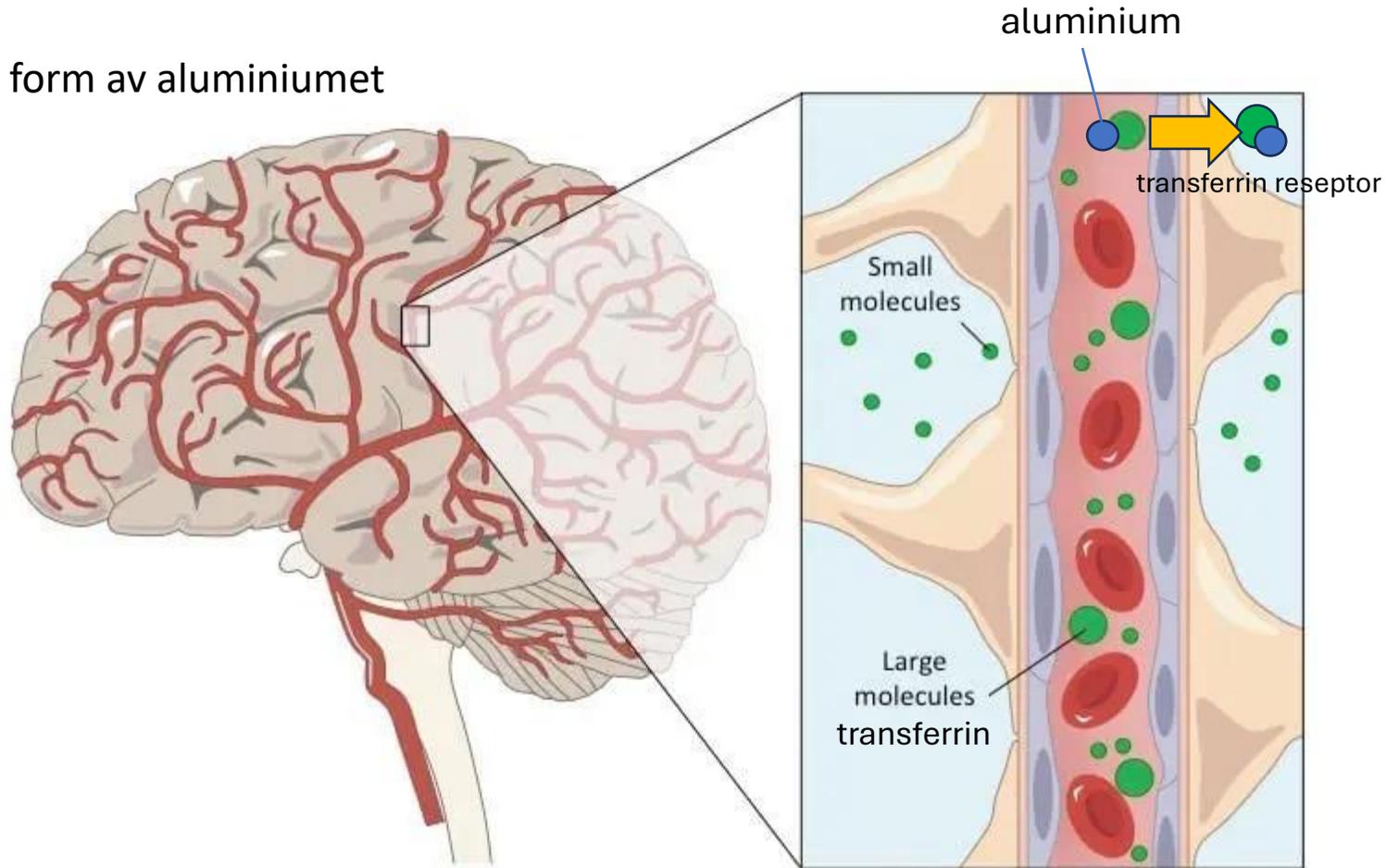
Independent researchers across seven countries have conducted more than 40 studies involving over 5.6 million people to conclude that there is no link between vaccines and autism, said Dr. Sean O’Leary, a professor of pediatrics and infectious diseases at the University of Colorado Denver Anschutz Medical Campus and Children’s Hospital Colorado.

Links between vaccines and autism have “been debunked many times,” O’Leary, who chairs the Committee on Infectious Diseases for the American Academy of Pediatrics, said at a news briefing last week. “It is considered settled science.”

Dr. Alycia Halladay, the chief science officer for the Autism Science Foundation, noted that [experiments](#) in countries including Denmark, Sweden, Finland, Israel and Japan collected data from large groups of people and tracked their vaccination patterns and whether they had an autism diagnosis.

Aluminium kan krysse blod-hjerne barrieren

Avhenger av kjemisk form av aluminiumet



Er aluminium involvert i nevrologiske sykdommer?

Alzheimer, **Autisme** ADHD, Parkinson ?

Exclusive: US CDC plans study into vaccines and autism, sources say

By Dan Levine and Leah Douglas

March 10, 2025 3:48 AM GMT+1 · Updated March 10, 2025



By Céline Gounder

OCTOBER 6, 2025

 [REPUBLIC THIS STORY](#)

Department of Health and Human Services Secretary [Robert F. Kennedy Jr.](#) has floated a seismic idea: adding autism to the list of conditions covered by the Vaccine Injury Compensation Program. The program, known as VICP, provides a system for families to file claims against vaccine providers in cases in which they experience severe side effects. Kennedy has also suggested broadening the definitions of two serious brain conditions — encephalopathy and encephalitis — so that autism cases could qualify.

Aluminium i legemidler

- Syrenøytraliserende middel mot sur mage, sure oppstøt, halsbrann, magesår



Nøytraliserer saltsyre

- Beskytter slimhinner i magesekken

Aktivt virkestoff: **aluminiumhydroksid**



Aluminium i kosmetikk/ kroppspeieprodukter

- Deodoranter

Aktivt virkestoff: **aluminium klorhydrat**

- Leppestift, solkrem, tannkrem, make-up



Kan det være helseskadelig?

Risikovurderinger – ulik vurdering

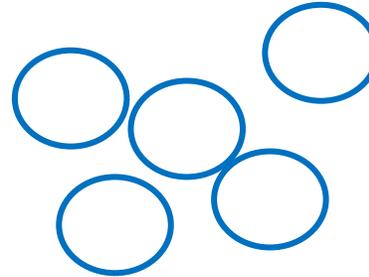
- VKM, Norge, 2013: Ved daglig bruk av deodorant kan man overstige verdier som anses som trygt, men trenger nye studier
- RIVM, Nederland, 2021: Deodoranter ikke noe problem, forsvinnende lite som tas opp gjennom hud

Studier av aluminium adjuvans i forsøksdyr

Aluminiumsalter: aluminium hydroksid, aluminiumfosfat

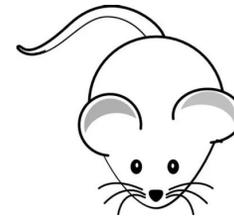


ikke-løselig form (nanopartikler)



- Få studier på aluminiumadjuvans som injiseres i forsøksdyr

- Noen få studier av aluminiumadjuvans (uten vaksineantigen) i mus viser nevrotoksiske effekter, men ikke konsistente resultater



- Studie i rotter som fikk injisert aluminium adjuvans intramuskulært fant minimal økning av aluminium i hjerne, men økning i skjelett.
Wisser K et al. Arch. Toxicology, 2019



Makrofagisk myofasciitt (MMF) – mulig bivirkning etter vaksinasjon med aluminiumholdige vaksiner

- Svært sjelden muskelsykdom
- Kun rapportert i Frankrike (noen svært få tilfeller i andre land)
- Vedvarende makrofager med aluminium i muskelen ved stikkstedet



Kronisk betennelse



muskelsmerter, tretthet, neurologiske symptomer (?)

Flere studier er nødvendig

Aluminium i vaksiner

Lisbeth Meyer Næss, PhD
Seniorforsker i vaksineimmunologi, FHI

Vaksine- og Smitteverndag 11. februar 2026



Vaksiner inneholder

- Antigen (vaksineantigen)
Virkestoff (aktiv komponent)
- **Adjuvans** *Tilsetningstoff
(hjelpstoff)*



Adjuvans *adjuvare (latin) = å hjelpe*

=

Stoff som tilsettes vaksiner for å gjøre de mer effektive

Adjuvans øker den spesifikke immunresponsen til vaksineantigener

Hva oppnår vi ved å tilsette adjuvans til vaksiner?

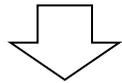
- Økt mengde/kvalitet på antistoffer
- Økning i cellulære immunresponser (CMI)
- Lenger varighet av immunresponsen
- Bedre immunrespons i populasjoner med dårlig immunsvare (eldre, spedbarn, immunsupprimerte)
- Klare oss med lavere dose av antigen
- Klare oss med færre vaksinedoser



Hvordan virker adjuvans?

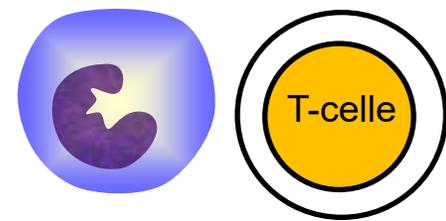
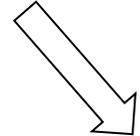
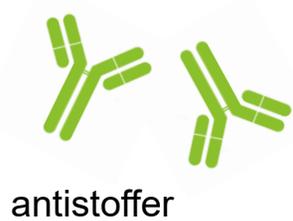
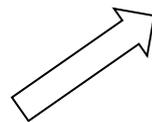
Adjuvans aktiverer det medfødte immunforsvaret: Antigen Presenterende Celler (APC)

(bl.a makrofager) 



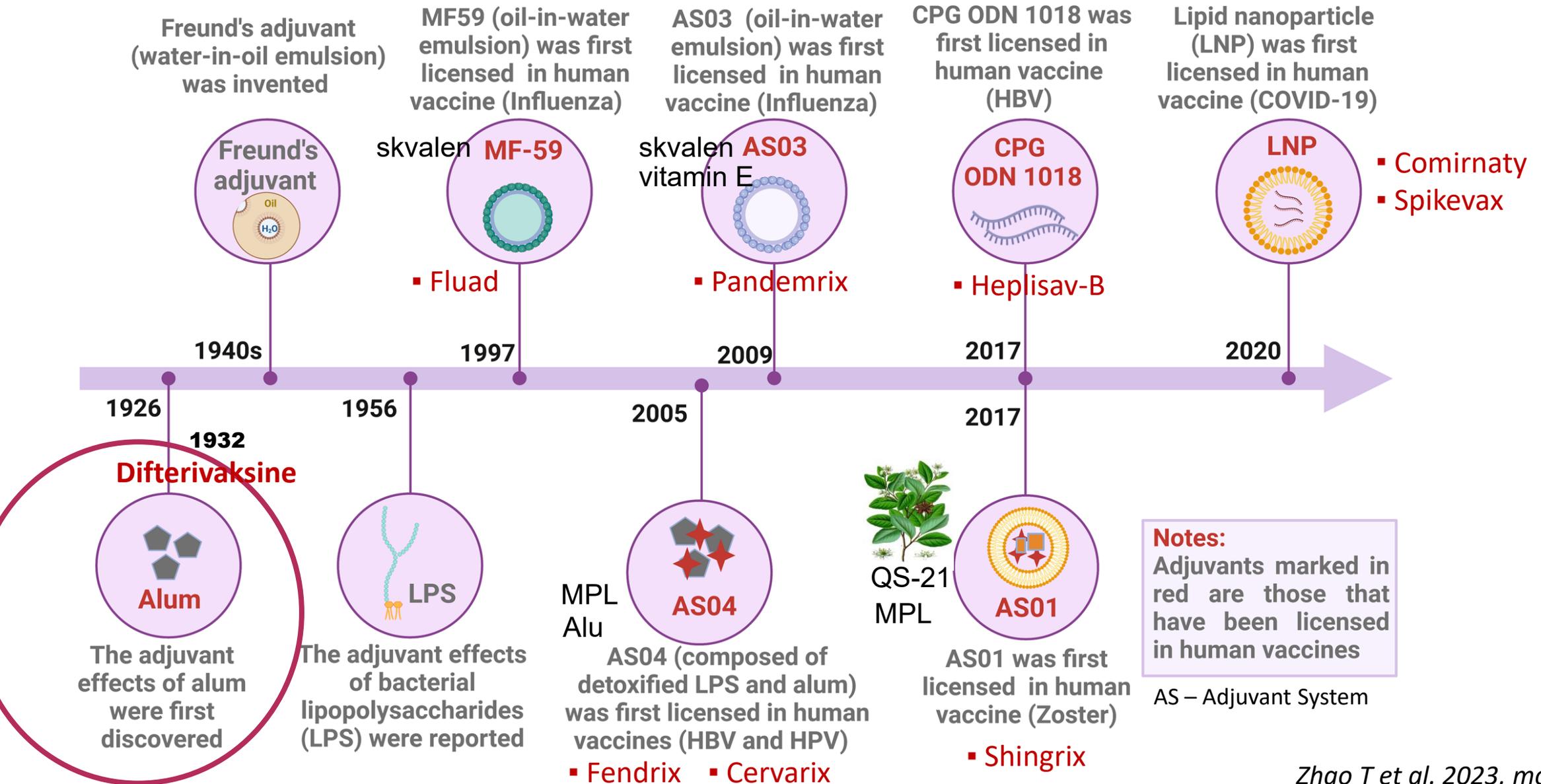
- kraftigere spesifikk immunrespons

- styre immunresponsen



Celle-medierte immunresponser (CMI)

Adjuvans i vaksiner har vært brukt i 100 år



Mange vaksiner inneholder aluminium som adjuvans

Aluminium – mest brukte adjuvansen i vaksiner

Brukt i humane vaksiner > 90 år med gode sikkerhetsdata, i Norge i bruk i vaksiner siden 1950-tallet



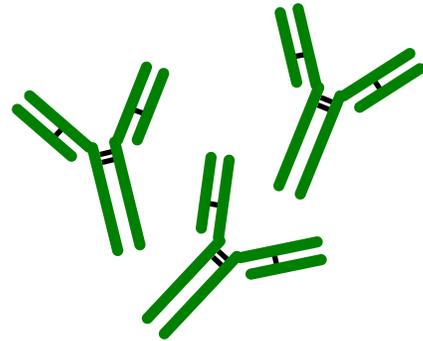
Aluminiumsalter

- Aluminiumhydroksid Al(OH)_3
- Aluminiumfosfat AlPO_4

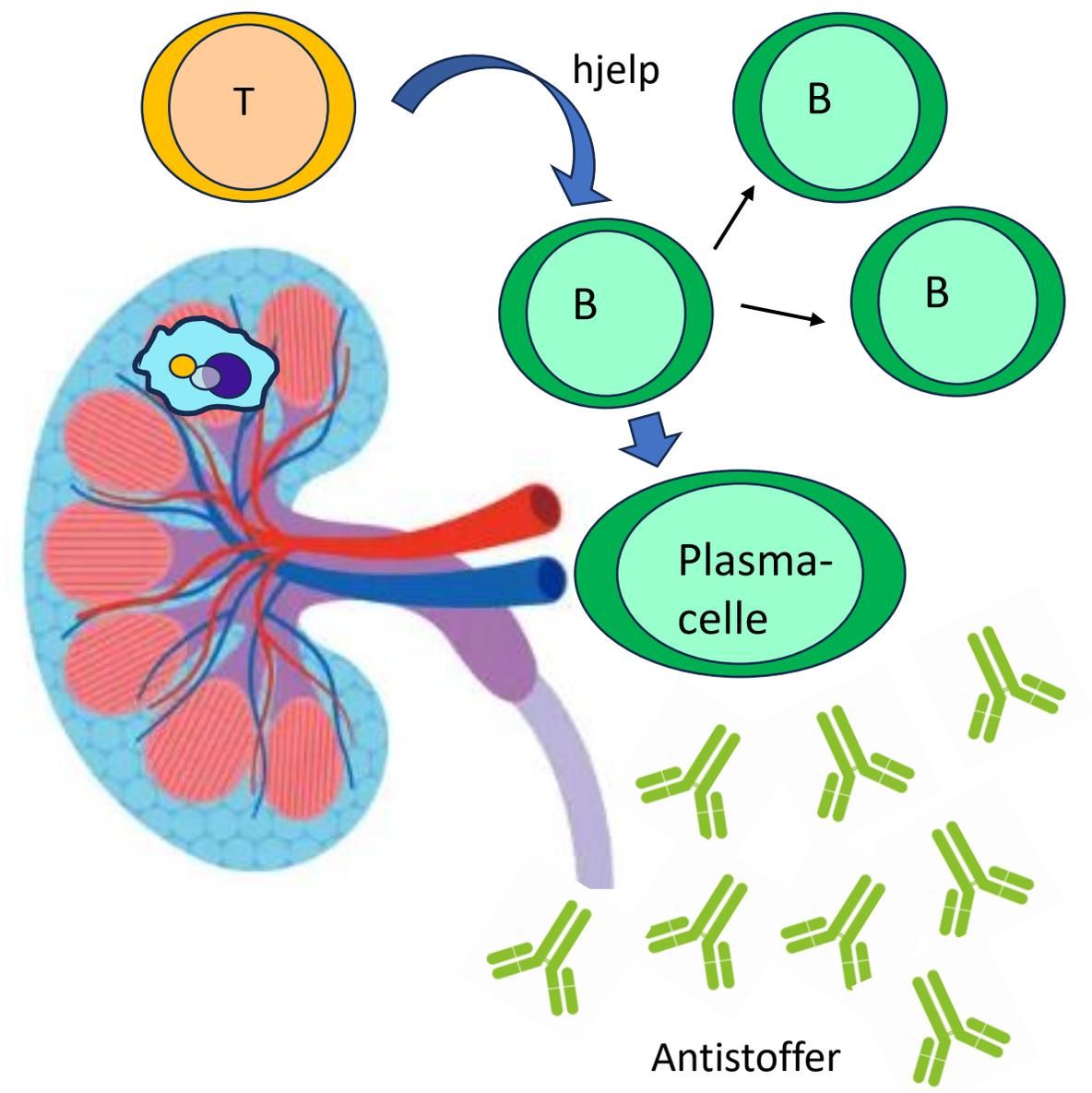
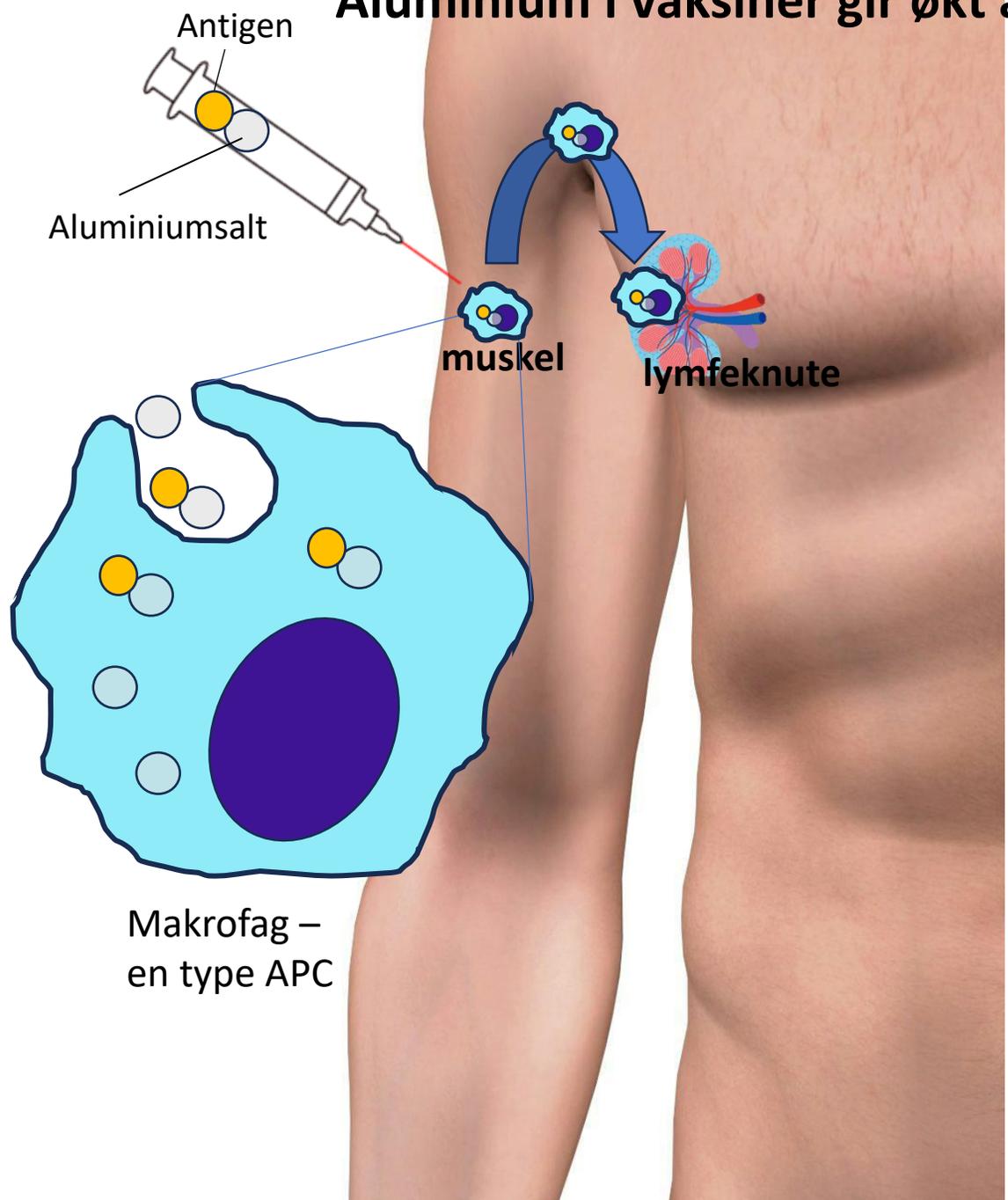
- DTP-IPV-Hib-HepB
- Hepatitt A
- Hepatitt B
- HPV
- Pneumokokk
- Meningokokk
- Japansk encefalitt
- TBE

Hvordan virker aluminium som adjuvans?

- Stimulerer det medfødte forsvaret
Aktiverer makrofager
- Depoteffekt - frigjør vaksineantigen langsomt fra stikkstedet
- Stimulerer dannelse av antistoffer

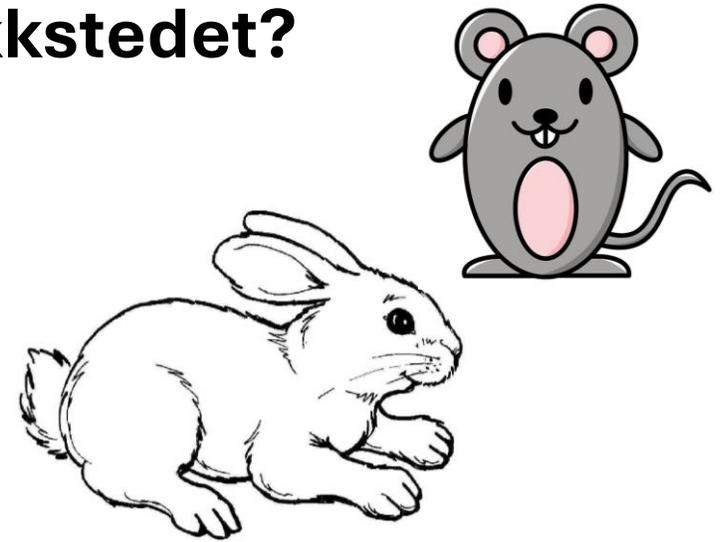


Aluminium i vaksiner gir økt aktivering av makrofager → økt antistoffrespons



Hva skjer med aluminium adjuvansen på stikkstedet?

- Aluminiumet i adjuvansen er i form av partikler
- Tas raskt opp av APC (antigenpresenterende immunceller) i muskel og fraktes til nærmeste lymfeknute
- Noen av disse APC blir igjen på stikkstedet
- Aluminiumspartiklene vil frigjøres langsomt ut i blodet (dager, uker, mnd?) og noe kan til slutt ende opp i andre organer
- Skilles ut i urin



Uønskede bivirkninger etter vaksiner med Al-holdige vaksiner

- Lokalreaksjoner: Rødme, smerte, hevelse på stikkstedet (*Jefferson T et al. Lancet Infect Dis, 2004 – syst review DTP vaksiner*)
- Allergiske reaksjoner
- Hypersensitivitet (DTH - Delayed Type Hypersensitivity)

Aluminiumsgranulomer på stikkstedet (dager, uker, mnd) – ufarlige, men plagsom kløe/smerter



Prevalens: ca 1% (*Bergfors E et al, Eur J Pediatr, 2014*)



Spedbarn, 7 mnd

Lauren CT et al. Case Report of Subcutaneous Nodules and Sterile Abscesses Due to Delayed Type Hypersensitivity to Aluminum-Containing Vaccines, Pediatrics 138, 2016

Hvorfor er aluminium et aktuelt tema på årets Vaksinedag?

- Økende skepsis til aluminiumsalter i vaksiner de seneste årene - i hovedsak i vaksineskeptiske miljøer



Kan aluminium bidra til autisme? Astma og allergi?
Nevrologiske sykdommer? Autoimmune sykdommer?

- Aktualisert ved Trump administrasjonen i USA og Robert Kennedy Jr som helseminister..



Autism and Vaccines

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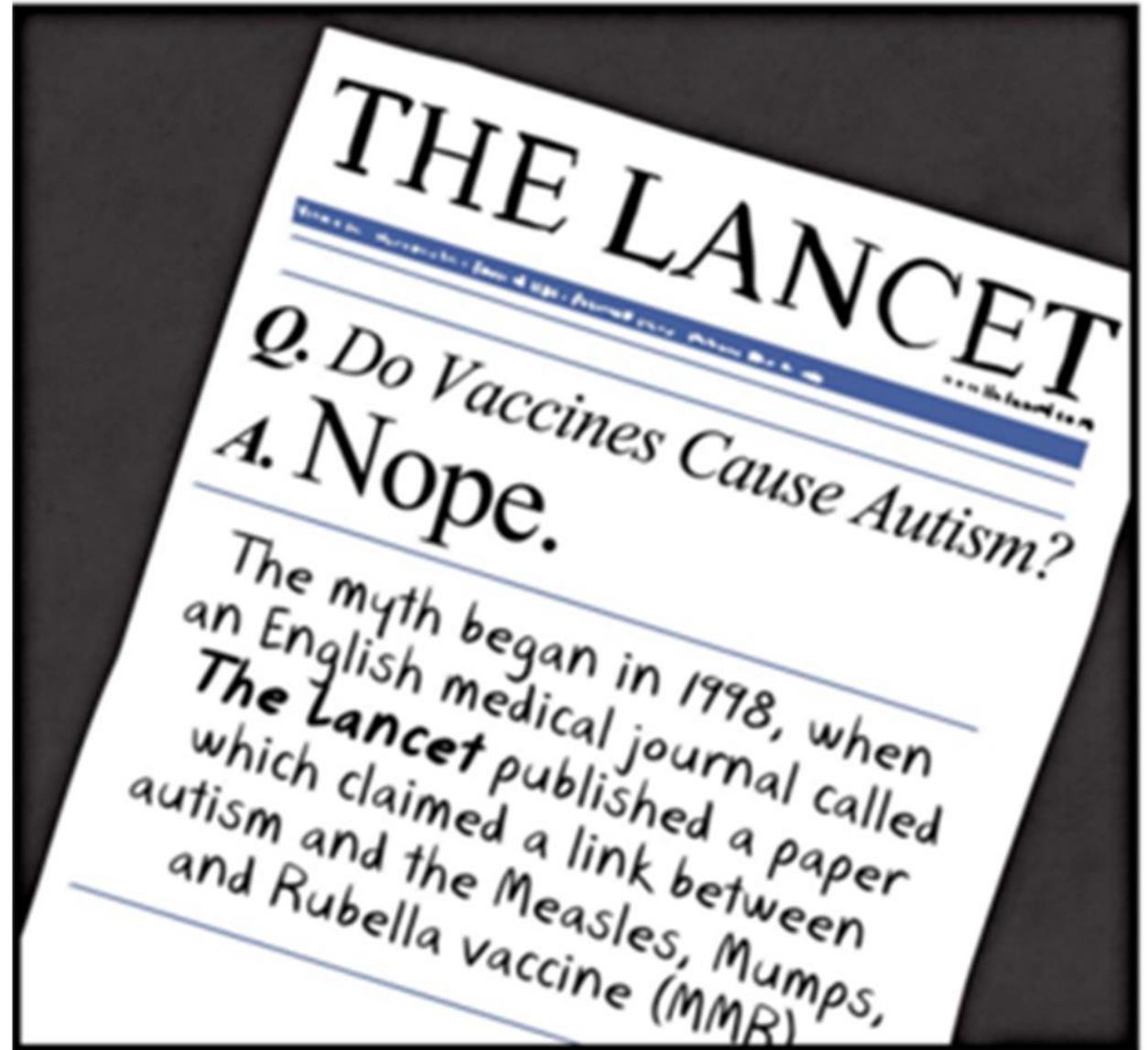
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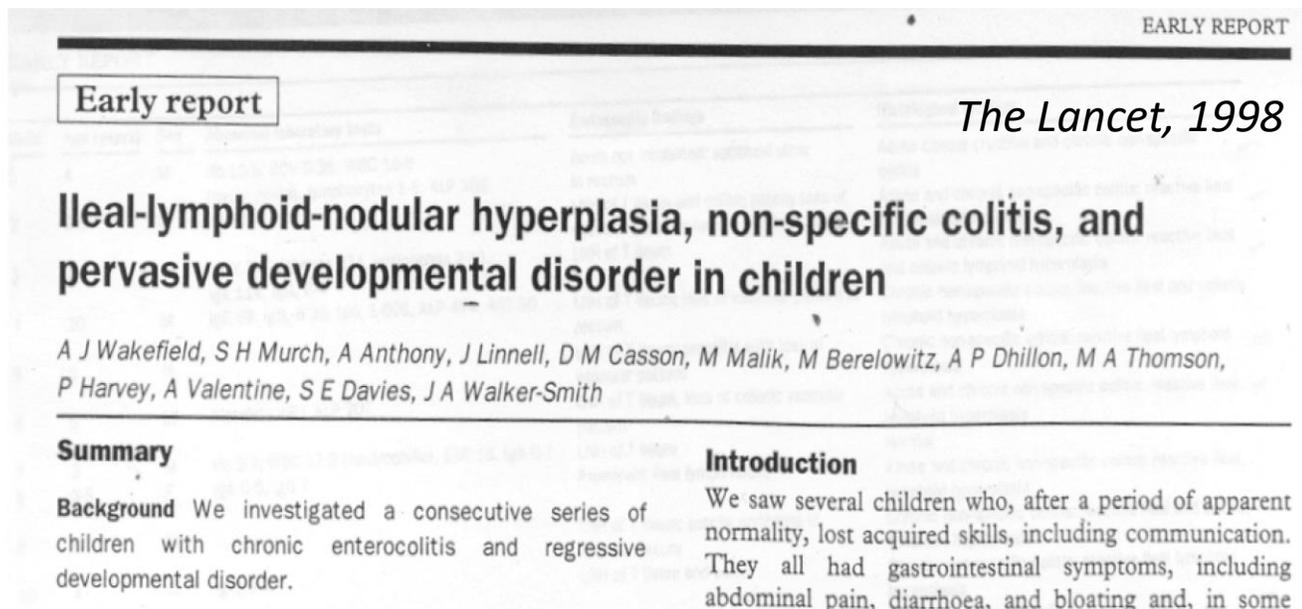
KEY POINTS

- The claim "vaccines do not cause autism" is not an evidence-based claim because studies have not ruled out the possibility that infant vaccines cause autism.
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MMR vaksinen



Wakefield affæren



Andrew Wakefield

- Inflammatorisk tarmsykdom & autisme?
- 12 kasuistikker – barn fra 15 mnd alder utviklet autistiske trekk og tarmproblemer
Foreldrene til 8 av barna oppga MMR vaksinerings rett før symptomdebut – hypotese: Sammenheng
- Ingen kontrollgruppe



Enorm oppmerksomhet i media

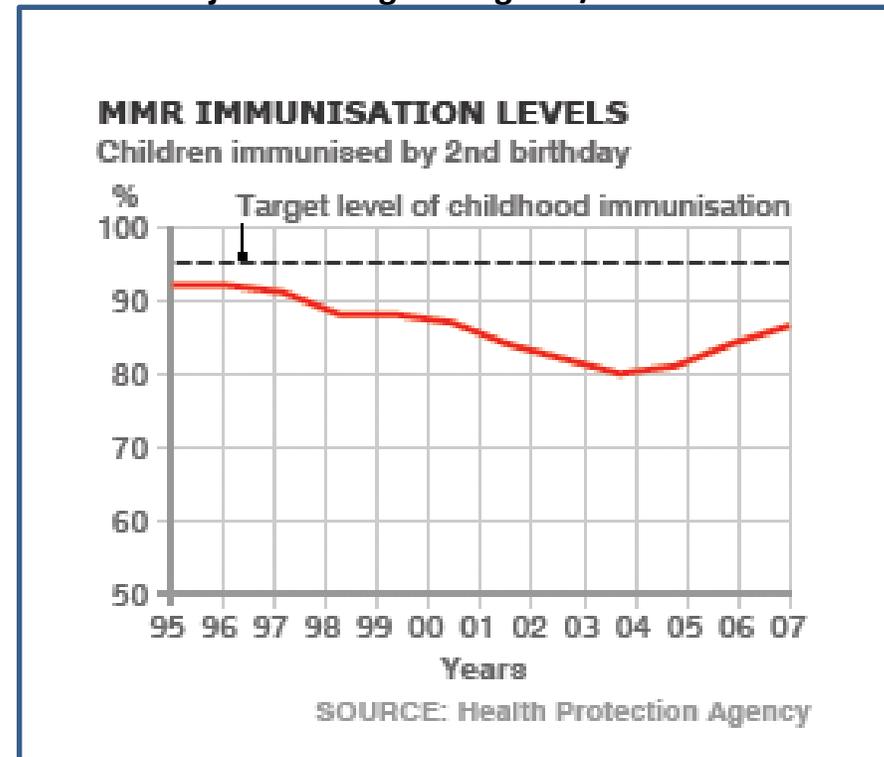


Vaksinasjonsdekningen for MMR vaksine gikk ned i mange land



Utbrudd av meslinger

Vaksinasjonsdekning for England/Wales for MMR



Det viste seg senere at ..

- Wakefield påtok seg betalt oppdrag fra advokatfirma som jobbet for en gruppe som arbeidet for å påvise sammenheng mellom MMR og autisme (søksmål mot vaksineprodusenter)
- Patent på alternativ meslingevaksine



Interessekonflikter – ikke oppgitt til Lancet

- Uetisk virksomhet– unødvendige undersøkelser av barn



Fratatt legelicens i UK



EARLY REPORT

2012

Early report

Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children

A J Wakefield, S H Murch, A Anthony, J Linnell, D M Casson, M Malik, M Berelowitz, A P Dhillon, M A Thomson, P Harvey, A Valentine, S E Davies, J A Walker-Smith

Summary
Background We investigated a consecutive series of children with chronic enterocolitis and regressive developmental disorder.
Methods 12 children (mean age 6 years [range 3–10], 11 boys) were referred to a paediatric gastroenterology unit with a history of normal development followed by loss of acquired skills, including language, together with diarrhoea and abdominal pain. Children underwent gastroenterological, neurological, and developmental assessment and review of developmental records. Ileocolonoscopy and biopsy sampling, magnetic-resonance imaging (MRI), electroencephalography (EEG), and lumbar puncture were done under sedation. Barium follow-through radiography was done where possible. Biochemical, haematological, and immunological profiles were examined.
Findings Onset of behavioural symptoms was associated with measles, mumps, and rubella vaccination in eight of the 12 children, with measles infection in one child, and otitis media in another. All 12 children had intestinal abnormalities ranging from lymphoid nodular hyperplasia to crypt abscessation. Histology showed patchy chronic inflammation with hyperplasia in 11 children and reactive ileal lymphoid hyperplasia in seven, but no granulomas. Behavioural disorders included autism (nine), disintegrative psychosis (one), and possible postviral or vaccinal encephalitis (two). There were no focal neurological abnormalities and EEG tests were normal. Abnormal laboratory results were significantly raised urinary methylmalonic acid compared with age-matched controls (p=0.03), low haemoglobin in four children, and low serum IgA in four children.
Interpretation We identified associated gastrointestinal disease and developmental regression in a group of previously normal children, which was generally associated in time to possible environmental triggers.

Introduction
We saw several children who, after a period of apparent normality, lost acquired skills, including communication. They all had gastrointestinal symptoms, including abdominal pain, diarrhoea, and vomiting and, in some cases, food intolerance. We describe clinical findings, and gastrointestinal features of these children.

Patients and methods
12 children, consecutively referred to a department of paediatric gastroenterology with a history of a pervasive developmental disorder with loss of acquired skills and intestinal symptoms (abdominal pain, bloating and food intolerance), were investigated. All children were admitted to the ward for a week, accompanied by their parents.

Clinical investigations
We took histories, including details of immunisations and exposure to infectious diseases, and assessed the children. In 11 cases the history was obtained by the senior clinician (JW-S). Neurological and psychiatric assessments were done by consultant staff (PH, MB) with HMS-4 criteria. Developmental records included a review of prospective developmental records from parents, health visitors, and general practitioners. Four children did not undergo psychiatric assessment in hospital; all had been assessed professionally elsewhere, so these assessments were used as the basis for their behavioural diagnosis.

After bowel preparation, ileocolonoscopy was performed by SHM or MAT under sedation with midazolam and pethidine. Paired frozen and formalin-fixed mucosal biopsy samples were taken from the terminal ileum; ascending, transverse, descending, and sigmoid colons, and from the rectum. The procedure was recorded by video or still images, and were compared with images of the previous seven consecutive paediatric colonoscopies (four normal colonoscopies and three on children with ulcerative colitis), in which the physician reported normal appearances in the terminal ileum. Barium follow-through radiography was possible in some cases.

Also under sedation, cerebral magnetic-resonance imaging (MRI), electroencephalography (EEG) including visual, brain stem auditory, and sensory evoked potentials (where compliance made these possible), and lumbar puncture were done.

Laboratory investigations
Thyroid function, serum long-chain fatty acids, and

Lancet 1998; 351: 637–41

National Academy of Medicine i USA (tidligere IOM), 2002 & 2004

> 200 epidemiologiske og biologiske studier



Ingen sammenheng mellom MMR vaksine og autisme





Autism and Vaccines

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NOV. 19, 2025



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Aluminium i vaksiner

Vi er omgitt av aluminium



Negative helseeffekter?



Aluminium i menneskekroppen

- Ingen biologisk funksjon
- Aluminium i blod, vev (30-50 mg totalt)



mat, drikkevann (finnes i jordskorpa)



- Kun liten del tas opp i kroppen < 1% (0.01-5%), resten forsvinner ut via avføring



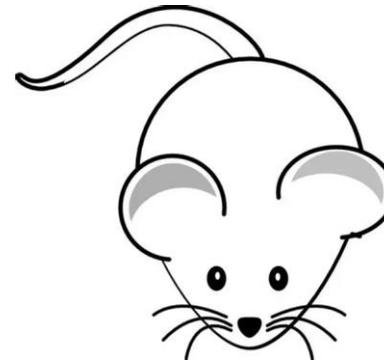
- bindes til transferrin i blodet og skilles raskt ut i urin
- noe vil lagres i skjelett, lunge, lever, nyre

2012: Tolerabelt inntak: 2 mg aluminium per kg kroppsvekt/uke (FAO/WHO)

- Alvorlig nyresvikt kan føre til aluminiumsmengder over anbefalt nivå

Toksisitet av aluminium

- Lav akutt toksisitet (ved oral eksponering)
- Ikke klassifisert som kreftfremkallende
- Nevrotoksisk i forsøksdyr
Psykomotorisk kontroll, hukommelse, kognitive funksjoner
- Toksisk i mennesker ved gjentatt eksponering for svært høye doser (tidligere sett hos dialysepasienter)
→ hjerneskade



Hvor mye aluminium er det i vaksiner?

EU & USA: Maksimal dose 1,25 mg aluminium per dose

- Optimal mengde adjuvans - avhengig av vaksineantigen, må bestemmes empirisk

Sikkerhet – uspesifikke effekter



Effektiv
immunrespons

- Testes ut i dyreforsøk og kliniske forsøk før en vaksine godkjennes



Aluminiummengde i barnevaksiner i Norge

Vaksiner i barnevaksinasjonsprogrammet de to første leveår (2017)



Mot sykdom	Antall doser	Preparat navn	Aluminium per dose
DTP-IPV-HepB-Hib	3	Hexyon	Aluminiumhydroksid 0,6 mg Al ³⁺
Invasiv pneumokokksykdom	3	Prevenar 13	Aluminiumfosfat 0,125 mg
MMR	1	Priorix	ingen
Rotavirus	2	Rotarix	ingen
Tilbys risikogrupper			
Tuberkulose (BCG)	1	BCG-SSI	ingen

Totalt alle doser: Mindre enn 3 mg aluminium

Øistein Riise

Aluminiumeksponering hos spedbarn

- Mat/drikke



Aluminium finnes i morsmelk, morsmelktillegg og barnegrøt



Kun liten del tas opp i kroppen < 1% (0.01-5%), resten forsvinner ut via avføring



skilles ut via urin

- Vaksiner

Aluminiumnivåer i vaksiner mye lavere enn i mat og drikke, men regner med at 100% av det som injiseres tas opp i kroppen



Vi kan derfor ikke sammenlikne nivåene direkte med det vi spiser/drikker!

USA: Dobbelt så mye aluminium fra vaksiner som fra mat og drikke

Det meste av aluminiumet som finnes i kroppen hos spedbarnet første leveår er fra vaksiner, men overstiger ikke grenseverdier satt for helseskadelige effekter *Mitkus RJ et al. Vaccine, 2011*

Hva vet vi om alumiumadjuvans i vaksiner og autisme?

**AUTISM
SPECTRUM
DISORDER
(ASD)**



Studier av aluminium adjuvans i vaksiner til mennesker

- Stort antall kliniske studier av vaksiner med aluminiumadjuvans som har evaluert sikkerhet
- Brukt i mer enn 90 år i hundrevis av millioner av mennesker verden over
- Få kinetikkstudier i mennesker

Movsas et al. JAMA Pediatr, 2013 :

Målte aluminiummengden etter vaksinasjon ved 2 mnd alder i 12 premature barn

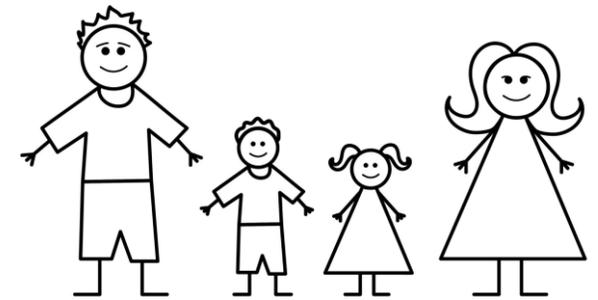
Fant ingen endring i aluminiumsnivåene i blod og urin før og 24 timer etter vaksinasjon

- Flere store, epidemiologiske undersøkelser (registerstudier) som har sett på sammenheng mellom aluminiumholdige vaksiner og kroniske tilstander som astma, autisme og ADHD



Finner ingen klar sammenheng

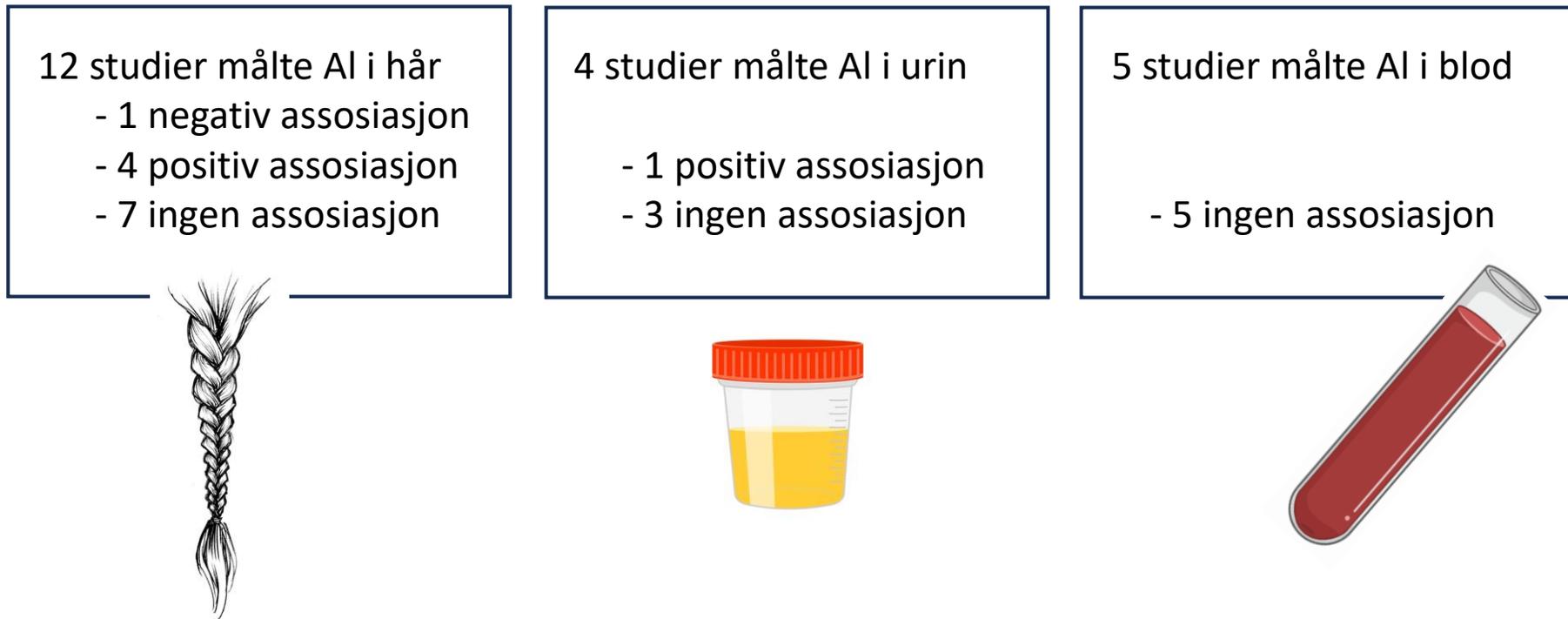
én studie fant en mulig sammenheng med astma,
men metodiske svakheter



Har individer med ASD høyere nivåer av aluminium i kroppen?

Systematisk review og meta analyse, *Sulaiman R et al. Chem Res Toxicol, 2020*

18 studier fra 10 land – sammenliknet nivået av Al hos barn (N=17-116) med ASD og en kontrollgruppe



Det ser ikke ut til at individer med ASD har forhøyede nivåer av aluminium
(men kan ikke utelukke høyere nivåer i f.eks skjelett og hjerne)

«Ingen assosiasjon mellom vaksiner med aluminium adjuvans og alvorlige, uønskede hendelser»

Global Advisory Committee on Vaccine Safety (GACVS) , WHO 2012

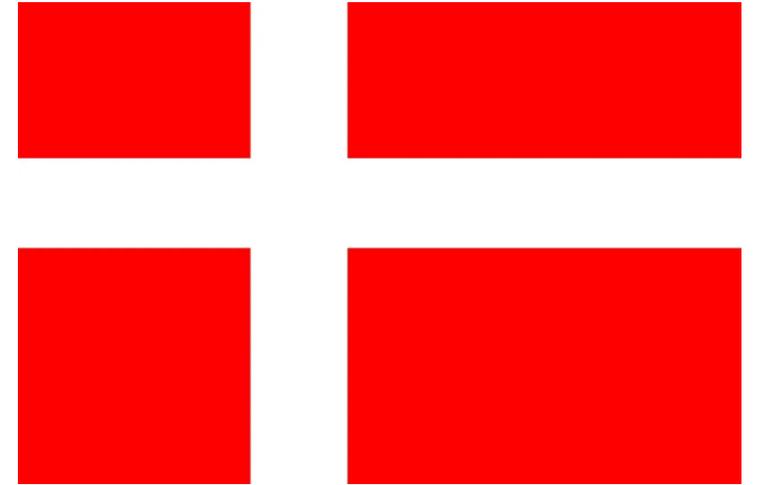
Kelso et al. 2012 Systematic review, J Allergy Clin Immunol, 2012

Willhite CC, Systematic review, Critical reviews in toxicology, 2014



Stor, dansk epidemiologiske studie av aluminiumholdige vaksiner og kroniske sykdommer

Statens Serum Institut (SSI)



Andersson NW; Anders Hviid et al. Aluminum-Adsorbed Vaccines and Chronic Diseases in Childhood: A Nationwide Cohort Study, Ann. Intern. Med. 2025

- Over 1.2 millioner danske barn.
 - Så på antall doser hver av de hadde fått og dermed aluminiummengde.
- Fant ingen økning i risiko med økende mengde aluminium i vaksiner for kroniske tilstander (bla autism, ADHD og astma)

Merk! Sammenliknet ikke uvaksinerte (N= 50 000) med vaksinerte.





Autism and Vaccines

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En rekke organisasjoner og enkeltforskere har gått hardt ut mot CDCs nye hjemmesider

- American Academy of Pediatrics (AAP) :

«This is madness. Vaccines do not cause autism, and unfortunately, we can no longer trust health-related information coming from our government.» Dr. Sean O’Leary, Leder AAP



- American College of Obstetricians and Gynecologists
- Autism Society of America
- Autism Speaks
- Autism Science Foundation

Autism Science Foundation: 'Vaccines do not cause autism'

'There is no correlation between autism and vaccines. This has been confirmed through dozens of scientific studies examining different types of vaccines and different vaccine timing schedules.'

Strong Voice for Science

- Led the media response to misinformation around the causes of autism, and advocated for a separate diagnosis for "profound autism".



Dr. Alycia Halladay



Solid dokumentasjon



Aluminium adjuvans gjør vaksiner mer effektive med minimal risiko for alvorlige bivirkninger



Takk for oppmerksomheten!

Autisme – økning i alle aldersgrupper siden 1980-tallet



økning i antall diagnostiserte (prevalens)
ikke nødvendigvis i antall tilfeller (insidens)

Prevalens

Europa: 0,6-1% av befolkningen (2018)

USA: 0,6-1,7% (2014)

- Diagnosekriterier er endret

Definisjonen av autisme for snever



Autismebegrepet ble utvidet - inkluderte mer milde symptomer (f.eks lære og språkvansker, Asperger)

Autism spectrum disorder (ASD)

- Økt fokus og kapasitet til å stille diagnose



The Denmark Study

- On July 15, 2025, Niklas Andersson and others published a nationwide cohort [study](#) on the association between aluminum adjuvants and chronic diseases in childhood. The study was published in a respected and peer-reviewed journal, *Annals of Internal Medicine*, and examined the medical records of over 1.2 million children born in Denmark between 1997 and 2018. The study looked at incident events of 50 chronic disorders versus the cumulative aluminum received through vaccination during the first 2 years of life. Records were analyzed from age 2 through 5 years, with some analyzed through age 8 years if additional analysis was needed.
- The study looked at aluminum exposure by milligram, comparing children who received vaccines and had low aluminum exposure to those who received vaccines and had high aluminum exposure (range 0-4.5 mg). No difference in outcomes was found, regardless of the cumulative aluminum exposure.
- The study concluded there was no increase in incidence of any of the 50 chronic conditions (neurodevelopmental, autoimmune, allergic disorder, etc.) because of increased aluminum exposure from vaccines.

The Critics

- The study excluded children who died before age 2 or who were diagnosed with chronic conditions prior to age 2: Correct. Children born with serious congenital conditions or who have heart disease, liver failure, etc., that was diagnosed before age 2 were unlikely to have completed the vaccination series or to have their conditions because of aluminum in vaccines.
- The study excluded children with records indicating abnormally high aluminum exposures: Correct. These were thought to be spurious and due to coding anomalies or duplicated records.
- The analysis adjusted for the number of medical visits in the first 2 years of life: Correct. If this was not done, some conditions would be diagnosed based on more frequent interactions with the medical system rather than because of their exposure to aluminum.
- The study did not look at vaccinated versus unvaccinated: Correct. This study is more important as it looked at the dose-response relationship between aluminum exposure and the development of chronic disease. It showed that there was no increase in incidence of those diseases between those who had low exposures versus children who had high exposures.
- A figure in the supplemental materials found a hazard ratio for Asperger syndrome per milligram of aluminum of 1.67, indicating those with aluminum exposure had a higher risk of developing Asperger syndrome (now classified as part of Autism Spectrum Disorder): Correct. But the confidence interval was 1.01 to 2.77 and the case number was very small—51 cases out of more than 1.2M children. This mild increase in risk was only seen in the group of children born between 2007 and 2018 and was not seen when researchers extended the follow up from age 5 years to age 8 years, nor was it seen in the analysis of the full cohort.
- Denmark's childhood immunization schedule is different from that of the U.S. and has fewer vaccinations: Correct. But the range of aluminum exposure in this analysis was 0-4.5 mg, which would include similar exposures as in the U.S.
- Three authors work at an institute that produces vaccines used in Denmark. Correct. But conflicts were disclosed in the publication and reviewed by the journal. Those criticizing the research have conflicts as well, as they are involved in lawsuits against vaccine manufacturers.
- [The reference for the information above can be found here.](#)

Aluminium og autisme (ASD, autismespekterforstyrrelser)

- Kombinasjon av genetikk og miljøfaktorer
- Har autister høyere nivåer av aluminium i hjernen enn andre?



Få studier, sprikende funn

Konsensus per i dag

Ikke funnet noen årsakssammenheng eller klar sammenheng mellom aluminium mengde i hjernen/kroppen og autisme

Toksisitet av aluminium

- Ikke akutt toksisk (oral eksponering)
- Ikke kreftfremkallende
- Kan gi dårligere sædkvalitet (hunder)
- Nevrotoksisk (mus, rotter) *Hukommelse, kognitive funksjoner, psykomotorisk kontroll*

Al krysser blod-hjerne barrieren

Risikofaktor for Alzheimer?

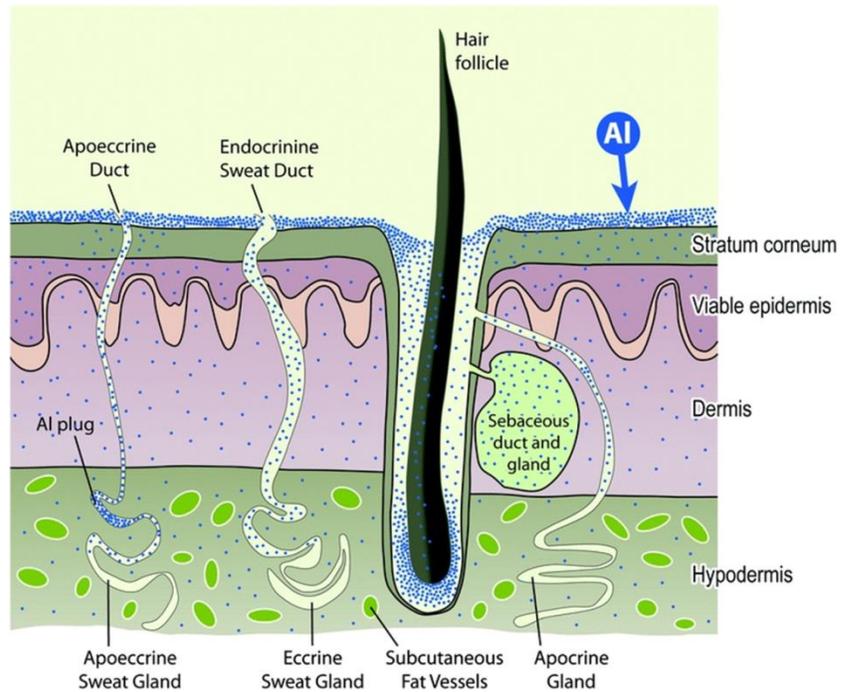
WHO: mange epidemiologiske studier, ingen holdepunkter for årsakssmh

- Kan påvirke foster (ikke teratogent)

Aluminium i kosmetikk

- deodoranter

Aktivt virkestoff: aluminiumforbindelser
aluminium klorhydrat



Risikovurdering VKM, 2013:

Mat og drikke – ingen helserisiko

Daglig bruk av deodorant kan gi eksponeringer 30-50x høyere enn det som er helsemessig forsvarlig

CNN

“Medical researchers across the globe have spent more than 25 years thoroughly studying this claim.

All have come to the same conclusion: Vaccines are not linked to autism,” according to [a statement](#) from more than 60 organizations, including the American Academy of Pediatrics, the American Medical Association and the Autism Science Foundation.

Here’s what to know about what’s changed and what hasn’t.

What does research into autism and vaccines show?

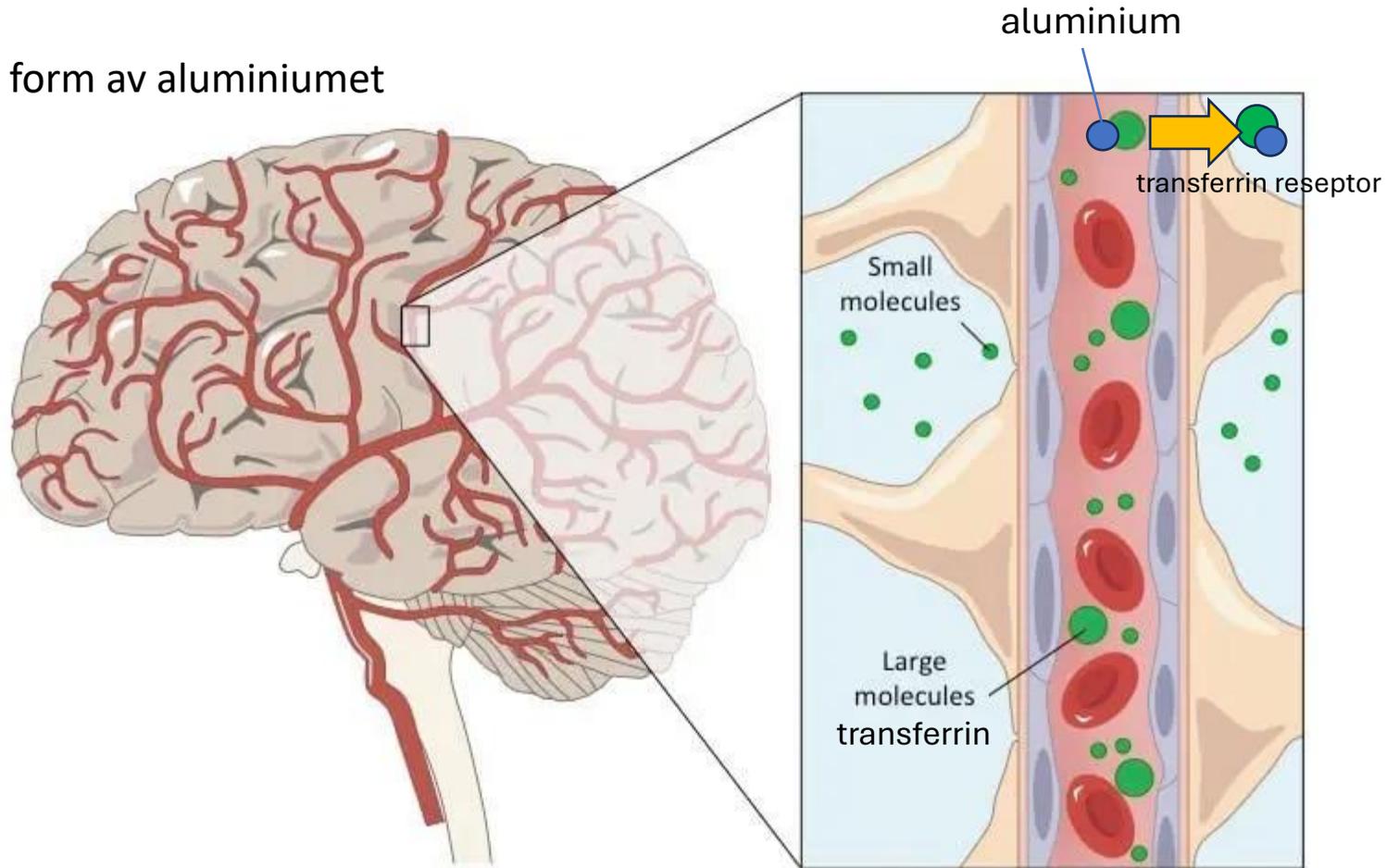
Independent researchers across seven countries have conducted more than 40 studies involving over 5.6 million people to conclude that there is no link between vaccines and autism, said Dr. Sean O’Leary, a professor of pediatrics and infectious diseases at the University of Colorado Denver Anschutz Medical Campus and Children’s Hospital Colorado.

Links between vaccines and autism have “been debunked many times,” O’Leary, who chairs the Committee on Infectious Diseases for the American Academy of Pediatrics, said at a news briefing last week. “It is considered settled science.”

Dr. Alycia Halladay, the chief science officer for the Autism Science Foundation, noted that [experiments](#) in countries including Denmark, Sweden, Finland, Israel and Japan collected data from large groups of people and tracked their vaccination patterns and whether they had an autism diagnosis.

Aluminium kan krysse blod-hjerne barrieren

Avhenger av kjemisk form av aluminiumet



Er aluminium involvert i nevrologiske sykdommer?

Alzheimer, **Autisme** ADHD, Parkinson ?

Exclusive: US CDC plans study into vaccines and autism, sources say

By Dan Levine and Leah Douglas

March 10, 2025 3:48 AM GMT+1 · Updated March 10, 2025



By Céline Gounder

OCTOBER 6, 2025

 REPUBLISH THIS STORY

Department of Health and Human Services Secretary [Robert F. Kennedy Jr.](#) has floated a seismic idea: adding autism to the list of conditions covered by the Vaccine Injury Compensation Program. The program, known as VICP, provides a system for families to file claims against vaccine providers in cases in which they experience severe side effects. Kennedy has also suggested broadening the definitions of two serious brain conditions — encephalopathy and encephalitis — so that autism cases could qualify.

Aluminium i legemidler

- Syrenøytraliserende middel mot sur mage, sure oppstøt, halsbrann, magesår



Nøytraliserer saltsyre

- Beskytter slimhinner i magesekken

Aktivt virkestoff: **aluminiumhydroksid**



Aluminium i kosmetikk/ kroppspeieprodukter

- Deodoranter

Aktivt virkestoff: **aluminium klorhydrat**

- Leppestift, solkrem, tannkrem, make-up



Kan det være helseskadelig?

Risikovurderinger – ulik vurdering

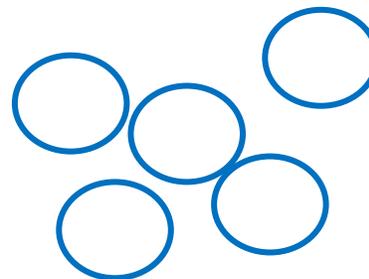
- VKM, Norge, 2013: Ved daglig bruk av deodorant kan man overstige verdier som anses som trygt, men trenger nye studier
- RIVM, Nederland, 2021: Deodoranter ikke noe problem, forsvinnende lite som tas opp gjennom hud

Studier av aluminium adjuvans i forsøksdyr

Aluminiumsalter: aluminium hydroksid, aluminiumfosfat

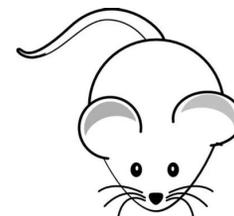


ikke-løselig form (nanopartikler)



- Få studier på aluminiumadjuvans som injiseres i forsøksdyr

- Noen få studier av aluminiumadjuvans (uten vaksineantigen) i mus viser nevrotoksiske effekter, men ikke konsistente resultater



- Studie i rotter som fikk injisert aluminium adjuvans intramuskulært fant minimal økning av aluminium i hjerne, men økning i skjelett.

Wisser K et al. Arch. Toxicology, 2019



Makrofagisk myofasciitt (MMF) – mulig bivirkning etter vaksinasjon med aluminiumholdige vaksiner

- Svært sjelden muskelsykdom
- Kun rapportert i Frankrike (noen svært få tilfeller i andre land)
- Vedvarende makrofager med aluminium i muskelen ved stikkstedet



Kronisk betennelse



muskelsmerter, tretthet, neurologiske symptomer (?)

Flere studier er nødvendig