This webinar is presented in partnership by:

the American Society of Nephrology and
the American Society of Transplantation
Welcome

VINEETA KUMAR, MD
Disclosures

**Employer:** University of Alabama at Birmingham

**Research Funding:** NIH CTOT studies – sub investigator

**Honoraria:** ASN – American Society of Nephrology for the early course for ASN Kidney Week invited lecture; ASN/AST – American Society of Nephrology/American Society of Transplantation for combined TNCC invited video lecture

**Scientific Advisor or Membership:** American Society of Transplantation – Elected Councilor at Large to the AST BOARD; June 2021; CareDX – one time honorarium <$500 in 2020

**Other Interests/Relationships:** American Society of Transplantation: Board Liaison to the Living Donor Community of Practice; Transplant Community and Community Education Committee; Incoming Chair of Planning Committee, Cutting Edge in Transplantation Planning Committee 2022; Member, AST Community Education Committee; UNOS Region 3 Representative to OPTN Living Donor Community
Agenda

Introductory Remarks
Vineeta Kumar, MD

Testimonials – Transplant Physicians Who Are Also Recipients
Ken Sutha, MD, PhD and Silke Niederhaus, MD, FACS

COVID-19 Vaccine Response in Transplant Recipients: What are the Data?
Deepali Kumar, MD, MSc, FRCPC, FAST

COVID-19 Vaccines: Enhancing Immunity
Emily Blumberg, MD

Q&A Roundtable Panel

Closing Remarks
Vineeta Kumar, MD
Housekeeping

This webinar is being recorded.

Following today's webinar, the recording, slides, and speaker bio handout will be posted on the ASN COVID-19 website at: https://www.asn-online.org/covid-19.
This webinar, ASN/AST COVID-19 Kidney Transplant Roundtable: Life After Vaccination is provided as information and education and should not be construed as medical advice or recommendations for patient care. The information expressed is that of the speaker(s) and contributor(s) only. Clinicians are to use their own training, clinical observations, and judgment to make all diagnostic and treatment decisions. The ASN Alliance (including ASN) does not offer medical advice.
Testimonial

KEN SUTHA, MD, PhD
Disclosures

Employer: Lucile Packard Children’s Hospital; Stanford University School of Medicine
Consultancy Agreements: Lung Biotechnology/United Therapeutics
Research Funding: American Society of Nephrology, KidneyCure
Scientific Advisor or Membership: American Living Organ Donor Fund (Board Member)
Other Interests/Relationships: Volunteer for National Kidney Foundation, American Kidney Fund, Donor Network West
Testimonial

SILKE NIEDERHAUS, MD, FACS
Disclosures

**Employer:** University of Maryland School of Medicine

**Honoraria:** ADA (American Diabetes Association) invited me to speak in 2019 on pancreas transplantation. Honorarium donated to ADA.

**Scientific Advisor or Membership:** National Kidney Foundation of Maryland/Delaware Board of Directors Member; UNOS Pancreas Committee Chair through 7/1/2020

**Other Interests/Relationships:** NKF-MD/DE as above; AST; ASTS; other academic societies, IPITA etc.
COVID-19 Vaccine Response in Transplant Recipients: What are the Data?

DEEPALI KUMAR, MD, MSc, FRCPC, FAST
Disclosures

Employer: University Health Network
Consultancy Agreements: Roche, Merck, GSK, Takeda
Research Funding: Roche, Merck, GSK, Atara, Takeda
Honoraria: Astellas
OpenSafely UK: Organ transplant recipients have greater risk of death from COVID-19

Population study of 17 million adults
10,000 deaths

>50% hospitalization rate
Overall mortality 10-30%
Risks: Older age, >=2 comorbidity

Williamson et al. Nature, 2020
## COVID Vaccines

<table>
<thead>
<tr>
<th>Vaccine Type</th>
<th>Dosing Schedule</th>
<th>Efficacy Phase 3</th>
<th>Participants</th>
<th>Approval Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA-1273 Moderna</td>
<td>2 doses i.m. 28 days apart</td>
<td>94.1% efficacy</td>
<td>30,000</td>
<td>FDA EUA approved, Canada approved</td>
</tr>
<tr>
<td>mRNA BNT162b2 Pfizer/BioNTech</td>
<td>2 doses i.m. 21 days apart</td>
<td>95% efficacy</td>
<td>44,000</td>
<td>FDA EUA approved, Canada approved</td>
</tr>
<tr>
<td>Replication deficient viral vector (chimp adeno) Oxford/Astra-Zeneca ChAdOx1</td>
<td>2 doses i.m. 4 wks apart</td>
<td>62% - 90% efficacy</td>
<td>62% - 90% efficacy in phase 3 Immunogenicity in age&gt;70 is similar to younger age groups Approved in U.K., Canada approved</td>
<td></td>
</tr>
<tr>
<td>Nonreplicating adenoviral vector J&amp;J</td>
<td>1 dose 2-dose</td>
<td>72% efficacy</td>
<td></td>
<td>FDA EUA approved, Canada approved</td>
</tr>
<tr>
<td>Recombinant Spike Protein with Matrix-M Novavax</td>
<td>1 dose</td>
<td>96% efficacy</td>
<td></td>
<td>96% efficacy in phase 3 86% efficacy against alpha</td>
</tr>
</tbody>
</table>
COVID vaccines and New Technologies

mRNA vaccines

Adenovirus vector vaccines
**Variants and Vaccine Escape**

- **Spike Protein**
  - Viral attachment, fusion, entry, transmission

<table>
<thead>
<tr>
<th>Variant</th>
<th>Changes in Spike</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.1.1.7</td>
<td>N501Y 69/70 deletion</td>
<td>More transmissible, more severe disease; vaccine effective</td>
</tr>
<tr>
<td>Alpha Variant</td>
<td>P681H</td>
<td></td>
</tr>
<tr>
<td>B.1.351</td>
<td>N501Y, K417N, E484K</td>
<td>More transmissible, vaccine less effective</td>
</tr>
<tr>
<td>Beta Variant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P.1</td>
<td>N501Y, K417T, E484K</td>
<td>Likely more transmissible and vaccine less effective</td>
</tr>
<tr>
<td>Gamma Variant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.1.617</td>
<td>E484Q, L452R</td>
<td>More transmissible and vaccine less effective</td>
</tr>
<tr>
<td>Delta Variant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.37</td>
<td>Deletion in spike gene</td>
<td>Unclear significance</td>
</tr>
<tr>
<td>Lambda Variant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Transplant Recipients Recommended to get Vaccinated

- Phase 3 studies have excluded immunocompromised populations
- After consideration of benefits vs. risks, Vaccine recommended by transplant societies
  - AST
  - CST
  - BTS
  - ISHLT
  - TTS

www.myast.org/covid-19-information
Practical considerations for COVID vaccination

• When possible, administer vaccine in the pre-transplant setting

• In post-transplant patients, wait at least 1-3 months after transplant to provide vaccine

• If transplant occurs between the first and second doses, provide the second dose at >1 month after transplant. Additional doses are not recommended.

• If a patient has had COVID before, wait until symptom recovery before giving COVID vaccine.

• Since efficacy is lower than the general population, it is strongly recommended that patients continue to practice infection control measures. In addition, household contacts of the transplant recipient should also be vaccinated when possible.
How to measure success of a vaccine in Transplant

- **Vaccine Dosing**
- **Timing post-transplant**
- **Immunosuppression (induction and maintenance, rejection)**
- **Other immunologic factors (IgG levels, lymphocyte counts etc)**

Vaccine Evaluation in SOT

- **Efficacy**
- **Effectiveness**
- **Immunogenicity**
- **Safety**

  - Humoral
  - Cell-mediated
  - Local/Systemic Effects
  - DSA/Rejection
How do we measure immune response to COVID vaccine

- Antibodies – protective against infection
  - can be binding antibodies or neutralizing

- Neutralizing Antibodies – those that prevent the virus from interacting with ACE2 receptor

- T-cells – may not prevent infection but protect against severe disease/pneumonitis

- Antibody
  - Various commercial tests available
  - Different cut-offs for positivity
  - Varying sensitivity and specificity
  - Not all validated for vaccine immunity

- Neutralizing antibody
  - Live or Pseudovirus Neutralization Tests
  - Surrogate Virus Neutralization Tests

- Cell-mediated immunity
  - T-cells
  - B-cells
  - Other eg NK
Percent of subjects with antibody response after **two** mRNA vaccine doses by immunocompromising condition and study (n=63)

- Studies that compared response after 1st and 2nd dose demonstrated poor response to dose 1
- Antibody measurement and threshold levels vary by study protocol

Compiled by ACIP
# COVID-19 Vaccine Studies in Kidney Transplant Recipients

<table>
<thead>
<tr>
<th>Study/Location</th>
<th>N</th>
<th>2-dose Vaccine</th>
<th>Ab Test</th>
<th>2-dose response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boyarsky, JAMA U.S.</td>
<td>322</td>
<td>BNT162b2 (Pfizer) mRNA-1273</td>
<td>Roche Euroimmun</td>
<td>47.8%</td>
</tr>
<tr>
<td>Stumpf, Lancet Regional Health, Germany</td>
<td>368</td>
<td>BNT162b2 mRNA-1273</td>
<td>Euroimmun</td>
<td>33.6% (vs. 94.5% in dialysis)</td>
</tr>
<tr>
<td>Rosen-Zvi, Clin Micro Infect, Israel</td>
<td>308</td>
<td>BNT162b2</td>
<td>Abbott</td>
<td>36.4% - Poor response with older age, worse kidney function, mycophenolate, higher CNI level</td>
</tr>
<tr>
<td>Grupper, AJT, Israel</td>
<td>136</td>
<td>BNT162b2</td>
<td>Diasorin anti-S1/S2</td>
<td>37.5% - Poor response with Mycophenolate, high dose steroids, older age</td>
</tr>
<tr>
<td>Marion, Ann Int Med France</td>
<td>271</td>
<td>BNT162b2 mRNA-1273</td>
<td>Wantai ELISA</td>
<td>33%</td>
</tr>
<tr>
<td>Chavarot, Transplantation, France</td>
<td>101</td>
<td>BNT162b2</td>
<td>Abbott Wantai</td>
<td>5.7% 5% T-cell response</td>
</tr>
</tbody>
</table>
Data from Toronto
- 127 patients given mRNA-1273, 2-dose vaccine
- Overall good safety profile
- Response rate to 1st dose 6/121 (5%)
- Response rate to 2nd dose 38/110 (34.5%)
- Antibody level somewhat lower than natural infection

Neutralizing Ab:
- 7/119 (5.9%)
- 29/108 (26.9%)
- r:0.77, p<0.001)
Polyfunctional CD4-Tcell response (n=30)
- After 1 dose: 4/40 (10%) had a positive T-cell response
- After 2 doses 23/48 (47.9%) had a positive response
- Only modest correlation with Ab response: many (almost half) patients with negative Ab still had positive CD4 T-cell response

T-cells can form in the absence of antibody

Hall, Ferreira et al. AJT in press
## Vaccine Breakthroughs

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Hospitalized</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caillard et al, Kidney Int</td>
<td>55 KTx with prev mRNA vaccine 24/25 neg serology post-vaccination</td>
<td>15 (27%)</td>
<td>3 (5%)</td>
</tr>
<tr>
<td>Tsapepas et al, Am J Kid Dis</td>
<td>13 KTx with prev mRNA (12) and Janssen (1)</td>
<td>3 (23%)</td>
<td>1 (8%)</td>
</tr>
<tr>
<td>Wadei et al, AJT</td>
<td>7 (3 KTx)</td>
<td>5 (71%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Song et al, TID</td>
<td>7 KTx</td>
<td>4 (57%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Tau et al, AJT</td>
<td>18 KTx</td>
<td>10 (56%)</td>
<td>4 (22%)</td>
</tr>
<tr>
<td>Ali et al, Transplantation</td>
<td>14</td>
<td>7 (50%)</td>
<td>1 (7%)</td>
</tr>
</tbody>
</table>

- Rate of breakthrough greater in organ transplant compared to the general population
- Rate depends on community prevalence
- Breakthrough in vaccinated vs. unvaccinated transplant population

Qin et al., Transplantation, 2021
Key points about COVID vaccine / transplant

- Transplant recipients are at greater risk of severe disease from COVID
- Current COVID-19 vaccines are poorly immunogenic – antibody response, neutralization, T-cells (vaccine timing is important)
- T-cells that recognize SARS-CoV-2 can form in the absence of antibody
- Breakthrough infections occur and range in severity
- Better prevention strategies are needed!
Thank you!

Deepali.kumar@uhn.ca
COVID-19 Vaccines: Enhancing Immunity

EMILY A. BLUMBERG, MD
Disclosures

**Employer:** Perelman School of Medicine at the University of Pennsylvania

**Consultancy Agreements:** Merck (unpaid)

**Research Funding:** Merck (letermovir), Takeda (Maribavir, CMV), Hologic (CMV testing platform)

**Scientific Advisor or Membership:** Deputy Editor Am J Transplant, member of the Editorial Board of Transplant Infect Dis, Section Editor UptoDate

**Other Interests/Relationships:** DSMB GSK – unpaid (immunosupp), Amplyx (BK monoclonal), Chair NIH Trialnet DSMB
What is the problem we are trying to solve?

WHERE DO WE GO FROM HERE?
Defining the landscape of testing

Focus on antibody testing but
- >50 FDA EUA approved tests (fewer RBD)
- Antibody tests vary
  - Platform
  - Specificity
  - Sensitivity
  - Predictive value
  - Immunoglobulin isotype
  - Targeted antigens
  - Binding vs neutralizing
- Timing of testing can affect results
- No direct correlation of Ab with CMI
- **Protective levels not defined**
- **Post vaccination antibody testing not recommended by FDA**
What can we do to enhance immunity? Very few modifiable factors

Timing of vaccination
- Pre transplant immunization
- Post transplant timing

Immunosuppression
- Post transplant immunosuppression modification
  - Belatacept
  - Rituximab
  - Mycophenolic acid

Vaccine delivery/dose
- “Booster” (3rd dose) vaccination
What can we do to enhance immunity? Pre-transplant immunization

Longlune, et al Nephrol Dial Transplant
doi: 10.1093/ndt/gfab193
Mohamadou, et al. Transplantation
doi: 10.1097/TP.00000000000003862
Would dose reduction of mycophenolic acid improve vaccine response?

- Dose appears to affect antibody development but
  - Potential inherent bias
  - Prospective study of dose adjustment not done
  - No guidance for duration and degree of immune modulation

Hod, et al. Transplantation DOI: 10.1097/TP.0000000000003889
History of "booster" (multi-dose) vaccines

• "Booster" vaccines commonly employed for multiple infections
  • Primary series
    • Common childhood vaccines – e.g. DTaP, MMR, Hepatitis B
    • Hepatitis A
  • Combination primary series and later boost
    • Pneumococcal
    • Tetanus
  • Annual "booster" vaccination to accommodate changes in pathogen
    • Influenza
Are “booster” (3rd dose) vaccines the answer? Caveat emptor

• Almost all studies are letters
  • Limited/preliminary data
  • Mostly measure antibody response
  • No effectiveness data
• No randomized controls thus far (1 completed/pending)
• In US not allowed under EUA
  • Fluid situation
Retrospective evaluation SARS-CoV-2 vaccine “booster” (3rd dose)

- Case series of 30 patients in US – all low (6) or no antibody (24) (22 K, 1 KP)
  - Random assortment of vaccines and boosters
    - Primary all mRNA (57% 162b2, 43% mRNA-1273)
    - 3rd dose Ad26. COVD2.S in 50%
    - Time from transplant varied (median 4.5 years, IQR 2.3-10.5)
  - Time to 3rd dose varied (67 days, IQR 54-81 days)
  - Time points of testing varied
    - Pre 3rd dose testing median 9 days (IQR 2-33)
    - Post dose median 14 days (IQR 14-17)

Retrospective evaluation SARS-CoV-2 vaccine “booster” (3rd dose)

Response to Booster

Generally well tolerated but
• 1 rejection

What can we do to enhance immunity? “Booster” (3rd dose) vaccines

<table>
<thead>
<tr>
<th></th>
<th>Anti-SARS-CoV-2 + (n=67; 59*)</th>
<th>Anti-SARS-CoV-2 Neg (32; 30*)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney</td>
<td>51 (76)</td>
<td>25 (78)</td>
<td></td>
</tr>
<tr>
<td>Age (mean )</td>
<td>54 ± 2</td>
<td>65 ± 3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mos tx to vax</td>
<td>99 ±10</td>
<td>94 ± 16</td>
<td>0.793</td>
</tr>
<tr>
<td>Immsupp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMF</td>
<td>40 (98)</td>
<td>24</td>
<td>0.176</td>
</tr>
<tr>
<td>Belatacept</td>
<td>5 (7)</td>
<td>7 (22)</td>
<td>0.052</td>
</tr>
<tr>
<td>ALC</td>
<td>1561 (±123)</td>
<td>1173 ± 114</td>
<td>0.049</td>
</tr>
<tr>
<td>CD4+ Tcells*</td>
<td>529±37</td>
<td>339±38</td>
<td>0.002</td>
</tr>
<tr>
<td>CD19+ Tcells*</td>
<td>182±83</td>
<td>89±33</td>
<td>0.003</td>
</tr>
<tr>
<td>eGFR</td>
<td>60±3</td>
<td>45±4</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Kamar, et al. NEJM DOI: 10.1056/NEJMc2108861
Antibody response to 3rd dose in 159 KTx patients

- 49% of non responders responded to booster
- Absence of response associated with
  - Triple immunosuppression (MMF/MPA + Tac + Steroids)
  - Non response to primary series

Data from Germany – 71 kidney recipients

- Mean age 57 ± 14.4 years
- Median time post tx 7.5±6 years
- 73% MPA
- 48 with insufficient Ab post BNT162b2 (68±1 day post dose 2)
- Response variable
  - Initial responders did boost
  - After 3 doses 55% response rate

Stumpf, et al. Transplantation
DOI: 10.1097/TP.0000000000003903
Another look at 3 dose vaccine series

"Booster" (3rd dose) results


• Caveats
  • Magnitude of response still lower than healthy controls
  • Persistently low neutralizing antibody (including against variants of concern)
  • # of subjects limited to 61
Transplant patients are a heterogeneous group (even if we just look at kidney recipients). It is unlikely that one size will fit all.
Known vs Unknown

**UNKNOWN**
- Relationship of immune response to effectiveness
- Safest approach to management of IS
- Optimal approach to 3rd dose vaccine
  - Vaccine type
  - Dose
  - Administration site
  - Time between doses

**KNOWN**
- Pre-transplant vaccination responses are better
- Household/close contact vaccination creates safer environment
Current recommendations from AST and partner societies

- In the absence of effectiveness data, definition of protective antibody, guidance regarding optimal booster dosing, federal authorization
  - All SOT should be vaccinated with locally approved vaccines
  - Pre-transplant vaccination preferred
  - Antibody testing not routinely recommended
  - No recommendation for “booster” (3rd dose) vaccines yet
- VACCINATE
  - Household contacts
  - Health care workers
- **More research is needed**

ROUNDTABLE

Moderator: Vineeta Kumar, MD
Roundtable Panelist Disclosures

Emily Blumberg, MD
**Employer:** Perelman School of Medicine at the University of Pennsylvania  
**Consultancy Agreements:** Merck (unpaid)  
**Research Funding:** Merck (letermovir), Takeda (Maribavir, CMV), Hologic (CMV testing platform)  
**Scientific Advisor or Membership:** Deputy Editor Am J Transplant, member of the Editorial Board of Transplant Infect Dis, Section Editor UptoDate  
**Other Interests/Relationships:** DSMB GSK – unpaid (immunosupp), Amplyx (BK monoclonal), Chair NIH Trialnet DSMB

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**Employer:** Yale School of Medicine  
**Consultancy Agreements:** ASN; National Institutes of Diabetes, Digestive Diseases and the Kidney  
**Honoraria:** several universities and medical schools, professional organizations - honoraria for lectures, seminars, webinars  
**Scientific Advisor or Membership:** Qualidigm (Quality Improvement Organization)  
**Other Interests/Relationships:** Renal Physicians Association; American Society of Nephrology

Deepali Kumar, MD, MSc, FRCPC, FAST
**Employer:** University Health Network  
**Consultancy Agreements:** Roche, Merck, GSK, Takeda  
**Research Funding:** Roche, Merck, GSK, Atara, Takeda  
**Honoraria:** Astellas

Silke Niederhaus, MD, FACS
**Employer:** University of Maryland School of Medicine  
**Honoraria:** ADA (American Diabetes Association) invited me to speak in 2019 on pancreas transplantation. Honorarium donated to ADA.  
**Scientific Advisor or Membership:** National Kidney Foundation of Maryland/Delaware Board of Directors Member; UNOS Pancreas Committee Chair through 7/1/2020  
**Other Interests/Relationships:** NKF-MD/DE as above; AST; ASTS; other academic societies, IPITA etc.
Roundtable Panelist Disclosures

Shannon Novosad, MD, MPH
Employer: Centers for Disease Control and Prevention

Ken Sutha, MD, PhD
Employer: Lucile Packard Children’s Hospital; Stanford University School of Medicine
Consultancy Agreements: Lung Biotechnology/United Therapeutics
Research Funding: American Society of Nephrology, KidneyCure
Scientific Advisor or Membership: American Living Organ Donor Fund (Board Member)
Other Interests/Relationships: Volunteer for National Kidney Foundation, American Kidney Fund, Donor Network West

Glenda Roberts (see following page)
Glenda Roberts

Employer:
- Kidney Research Institute, Director – External Relations and Patient Engagement
- Center for Disease Innovation, Director – External Relations and Patient Engagement
- Engagement

Research Funding:
- Center for Disease Innovation, AKTIV Human Factors Project, funded by Veterans Administration

Honoraria:
- Kidney Research Institute (KRI) Patient Advisory Committee (PAC)
- Kidney Precision Medicine Project: Community Engagement Committee
- International Nephrology Society (ISN), Research Collaborative Meeting and 1st International Consensus Meeting on Defining Kidney Failure in Clinical Trials (Honorarium)
- APOLLO APOL1 Long-term Kidney Transplantation Outcomes Consortium Community Advisory Council (CAC), funded by NIDDK (Honorarium)

Scientific Advisor or Membership:
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- American Association of Kidney Patients (AAKP), Speakers Bureau
- Center for Dialysis Innovation (CDI) Patient Advisory Board (PAB)

Other Interests/Relationships:
- Kidney Health Initiative (KHI) Patient Family Partnership Council
- American Society of Nephrology (ASN) COVID-19 Response Team
- American Society of Nephrology (ASN) COVID-19 Response Team, Transplant Subcommittee
- APOLLO APOL1 Long-term Kidney Transplantation Outcomes Consortium, Recruitment Committee
- International Nephrology Society (ISN), Global Trials Focus – Accessible to Patients
- International Nephrology Society (ISN), Patient Group
- Can-SOLVE CKD International Research Advisory Committee
- Home Dialyzers United, Advisory Committee
- Kidney Precision Medicine Project, Member of Collaboration Committee
- Kidney Precision Medicine Project, Member of Return-of-Results Committee
- Kidney Precision Medicine Project, Director of Communications
- Founder & CEO, OUI Works

Financial Disclosure - Financial Support
- American Society of Nephrology (ASN), Kidney Week speaker (T&L Support)
- “The Role of the Kidney and SGLT2 in Glucose Homeostasis and Kidney Disease” Workshop, sponsored by the National Kidney Foundation (T&L Support)
- APOL1 Delphi Consensus Meeting, funded by AstraZeneca (T&L Support)
- Microsoft stock ownership

Intellectual Property:
- Water-Conserving Kidney Dialysis System Incorporating Urea Photo-Oxidation, Center for Disease Innovation
- “DaGuardian: The Internet of Things” software application, Options Unlimited International, LLC
Closing Remarks

VINEETA KUMAR, MD