National Medical Oxygen Grid (NMOG)
Dr. Varun Manhas, Associate Director - Public Health Programs
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Need for National Medical Oxygen Grid (NMOG)

Medical oxygen demand in India (MT/day)

- At the height of India’s COVID-19 medical oxygen shortage, multiple IT platforms were developed by various stakeholders with the goals of aggregating, monitoring, and allocating India’s medical oxygen supply.
- Oxygen Digital Tracking System (ODTS), the Oxygen Demand Aggregation System (ODAS), and the OxyCare Management Information System (OC-MIS).
- Proved to be invaluable assets that allowed the authorities at district, state and national level to make meaningful decisions based on the aggregated data to optimize faster delivery of oxygen.

Limitations

- Not integrated with each other
- Not capturing all assets
- No dashboards, no decision analytics
- Mostly web portals and no offline mode
- Not user friendly
National Medical Oxygen Grid’s (NMOG’s) working & operations

One time activity:
- Facility registration with HFR ID under ABDM
- Facility to declare their oxygen assets

Daily data entry:
- Bed occupancy
- Disease specific patient load
- Oxygen stock, supply raised & received, consumed

Data entry personnel: Oxygen asset operator/staff nurse/pharmacist

Data entry: Under the supervision of oxygen nodal person such as a specialist, anesthetist, etc.

One time activity:
- Registration
- Declare their oxygen assets

Daily data entry:
- Orders received, accepted and dispatched
- Oxygen stock

Data entry personnel: Oxygen asset operator

Data entry: Under the supervision of facility manager

Dashboard indicators:

A. Facility Infra
   - Manufacturing capacity, storage capacity
   - Bed capacity

B. Last 30-day trends
   - Oxygen supply received, manufactured, consumed
   - Rational Use of Oxygen
   - Bed occupancy

C. 7-day predictive trend
   - Oxygen required
   - Different types of bed required
   - Case load of different patient types

Dashboard indicators:

A. District/State/National Infra
   - Manufacturing capacity, storage capacity, transportation
   - Different bed type capacity
   - No. of PSA plants, concentrators, LMO tanks & tankers, cylinders

B. Last 30-day trends
   - Oxygen supply received, manufactured, consumed
   - Rational Use of Oxygen
   - Bed occupancy

C. 7-day predictive trend
   - Oxygen required
   - Different types of bed required
   - Case load of different patient types

D. Supplier details
   - Oxygen manufacturing capacity
   - Oxygen supplied to hospitals

Open to all tools

Knowledge products tool:
- Guidelines, training videos, posters

Oxygen therapy consumables based on facility type tool

Cost analysis of Oxygen sources tool

Oxygen Unit Conversion tool
Specific efforts to improve data entry

Phone app as well as web portal

Technology enabled facility level data entry network

1. Bed occupancy data entry operator 1, 2 and so on...
2. Disease load data entry operator 1, 2 and so on...
3. Oxygen data entry operator 1, 2 and so on...

Aggregation of data

Master data entry operator

Features & functions:
- 7-day demand prediction tool
- Cost comparison tool
- Oxygen metric unit conversion tool
- Differences in estimated vs actual consumption tool
- Global capacity building repository

Customizable, dynamic data entry and analytics dashboard

Ability to give access rights to type of data to be entered (beds, disease load and/or oxygen)

Validation & Verification

Submission

- Real time status on the submission from each satellite data entry personnel
- Embedded checks for data submitted, to not exceed the capacity
Web portal (https://oxygengrid.in/login)

**Oxygen infrastructure**

- **PSC plant infrastructure**
  - Generation capacity: 1000 L/min
  - Cylinder refills available: Yes
  - Refilling capacity (in L): 100
  - Int. device available: Yes
  - PSA-CARES funded: Yes
  - In service with BMIS: Yes
  - PSA manufacturer: Tricub Press
  - Maintenance contract available: Yes
  - Maintenance vendor: AMC
  - Is functional: Yes

- **PSC plant 2**
  - Generation capacity: 2000 L/min
  - Cylinder refills available: Yes
  - Refilling capacity (in L): 100
  - Int. device available: Yes
  - PSA-CARES funded: Yes
  - In service with BMIS: Yes
  - PSA manufacturer: Tricub Press
  - Maintenance contract available: Yes
  - Maintenance vendor: AMC
  - Is functional: Yes

- **PSC plant 3**
  - Generation capacity: 5000 L/min
  - Cylinder refills available: Yes
  - Refilling capacity (in L): 100
  - Int. device available: Yes
  - PSA-CARES funded: Yes
  - In service with BMIS: Yes
  - PSA manufacturer: Tricub Press
  - Maintenance contract available: Yes
  - Maintenance vendor: AMC
  - Is functional: Yes

**Disease-wise patient occupancy**

- **Acute myocardial infarction**
  - Number of patients admitted: 67
  - Average oxygen flow rate used: 66
  - Average hours of therapy in a day: 24

- **Anaphylaxis**
  - Number of patients admitted: 76
  - Average oxygen flow rate used: 36
  - Average hours of therapy in a day: 24

- **Birth asphyxia**
  - Number of patients admitted: 76
  - Average oxygen flow rate used: 46
  - Average hours of therapy in a day: 15

- **Cerebral heart disorders**
  - Number of patients admitted: 45
  - Average oxygen flow rate used: 75
  - Average hours of therapy in a day: 14

- **COVID-19**
  - Number of patients admitted: 76
  - Average oxygen flow rate used: 46
  - Average hours of therapy in a day: 22

- **Cystic fibrosis**
  - Number of patients admitted: 45
  - Average oxygen flow rate used: 95
  - Average hours of therapy in a day: 14
## ODAS vs OCMIS vs NMOG

<table>
<thead>
<tr>
<th><strong>Metrics</strong></th>
<th><strong>ODAS</strong></th>
<th><strong>OCMIS</strong></th>
<th><strong>NMOG</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
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<tr>
<td>Intuitive user interface</td>
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<td>Master-satellite users</td>
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<tr>
<td>Personalised GUI</td>
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<td>Web portal</td>
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<tr>
<td>Phone app</td>
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<tr>
<td><strong>Features &amp; Functions</strong></td>
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<tr>
<td>Facility profile creation</td>
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<tr>
<td>Oxygen infrastructure management</td>
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<tr>
<td>Bed infrastructure management</td>
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<tr>
<td><strong>Disease-wise patient management</strong></td>
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<td>Mock drill management</td>
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<tr>
<td>Supplier management</td>
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<tr>
<td>Order placing &amp; management (demand side)</td>
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<tr>
<td><strong>Order placing &amp; management (supply side)</strong></td>
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<tr>
<td>Predictive analysis of oxygen demand, bed demand and disease-specific patient caseload</td>
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<tr>
<td>Decision analytics on asset allocation and patient management</td>
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<tr>
<td>Oxygen source operational cost analysis tool</td>
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<tr>
<td>Rational use of oxygen tool</td>
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<td>Oxygen unit conversion tool</td>
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<td>Oxygen knowledge products repository</td>
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<tr>
<td>Map based data visualisation</td>
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<td><strong>Help &amp; support</strong></td>
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<td>User manual</td>
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<td>Video tutorial</td>
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<td>Accessible technical support/ grievance redressal mechanism</td>
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Implementation across UP and Karnataka
Recommendations from the data analysis & observations made

- **PSA plants with cylinder refilling stations** can improve their utilisation and supply cost-effective oxygen to other facilities in a hub-spoke model, would require PESO approval.
- **Equipment need to be registered on EMMS** and relevant stake holders should be aware of equipment maintenance practices as well as AMC/CMC contracts.
- In future, for enhancing any on-site oxygen manufacturing capacity, **VSA plants could be preferred over PSA plants to tackle issues related to noise, electricity costs, and for improved performance** in conditions with higher altitude and humidity.
- **Dura cylinders can ensure quick enhancement of mobile bulk liquid storage** capacity and do not require PESO approval.
- **Concentrators could be allocated to old age homes or for home care use** through concentrator banks.
- Gaseous **cylinders should be kept full at all times** as they have expiry date of 3 years from the date of filling.
- **Oxygen audit** on rational use of oxygen may be required to ensure no wastage of medical oxygen.

However, more and regular data on bed occupancy and disease specific patient load required to draw insights.
Testimonials from Uttar Pradesh and Karnataka

<table>
<thead>
<tr>
<th>CHCs</th>
<th>SDHs</th>
<th>DHs</th>
<th>GMCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>“App is useful to document oxygen usage and <strong>data entry made easy</strong>.”</td>
<td>“Very easy to use and carefully designed tool.”</td>
<td>“Incredibly <strong>practical tool</strong> that facilitates the understanding on medical oxygen consumption”</td>
<td>“<strong>Novel and excellent app</strong>, user-friendly interface <strong>encourages consistent data entry, easy to use</strong>, particularly effective for inventory monitoring.”</td>
</tr>
<tr>
<td>“Easy to use the app and data entry is simple.”</td>
<td>“The NMOG app is valuable as it allows us to monitor our oxygen consumption and manage the distribution of oxygen effectively. It enables us to track our daily oxygen usage and proves to be a beneficial tool for our hospital.”</td>
<td>“Tool allows us to access comprehensive information regarding oxygen &amp; bed availability and equipment specifications.”</td>
<td>“<strong>Highly beneficial</strong> for our daily data entry needs, provides insights into bed occupancy, performs automatic calculations.”</td>
</tr>
<tr>
<td>“Tool allows us to monitor our consumption and supply especially refilling of cylinders.”</td>
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</tr>
</tbody>
</table>

- Nursing Officers
- PSA plant Operator
- Chief Pharmacist
- Data Entry Operator
- Biomedical Engineer
- Data Entry Operator
- Chief Pharmacist
- Data Entry Operator
End user feedback (n=16)

1. Did you find the new portal useful?  
   - 62.5% Extremely useful
   - 31.3% Useful
   - 5.6% Neutral
   - 0% Unusual
   - 0% Extremely unusual

2. How easy was it to use or navigate through the new portal?  
   - 56.3% Extremely easy
   - 25% Easy
   - 18.8% Neutral
   - 0% Difficult
   - 0% Extremely difficult

3. How easy was it to understand information on the new portal?  
   - 62.5% Extremely easy
   - 12.5% Easy
   - 25% Neutral
   - 0% Difficult
   - 0% Extremely difficult

4. How easy was it to enter data on the new portal?  
   - 56.3% Extremely easy
   - 25% Easy
   - 18.8% Neutral
   - 0% Difficult
   - 0% Extremely difficult

5. How was your experience in comparison to ODAS and OCMIS?  
   - 56.3% Much better
   - 31.3% Better
   - 12.5% Neutral
   - 0% Worse
   - 0% Much worse

6. Does the new portal meet your expectations?  
   - 43.8% Very much meets
   - 37.5% Meets
   - 18.8% Neutral
   - 0% Does not meet
   - 0% Does not meet at all
National Medical Oxygen Grid (NMOG) development timelines

- **System Requirement Specifications, Wireframes and Screens Including data input portals, output indicators & dashboards**
- **NHSRC meeting for knowledge sharing on NMOG**
- **NMOG tool testing**
- **Monthly updates to BMGF**
- **NHSRC meeting for NMOG demo & review**
- **NMOG tool piloting in UP & Karnataka**
- **Pilot implementation across hospitals in MP and Tamil Nadu, followed by scale-up**
- **Scale up across UP & Karnataka**
- **Outreach activities to 15 other Indian states**
- **End of BMGF support**

Highlighting the development of BMGF supported NMOG in the Oxygen National TAC meeting being held in Udaipur

Going forward, focus would be on collaborations with other development partners such as PATH, CHAI, etc.

Legend - Stakeholders

- BMGF
- NHSRC/ State govts.
- OHT team
## Current status of NMOG implementation

<table>
<thead>
<tr>
<th>Ongoing</th>
<th>Uttar Pradesh</th>
<th>Karnataka</th>
<th>Madhya Pradesh</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of facility</strong></td>
<td><strong>Government Medical Colleges (GMCs)</strong></td>
<td><strong>District Hospitals (DHs)</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>Government Medical Colleges (GMCs)</td>
<td>35</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>District Hospitals (DHs)</td>
<td>108</td>
<td>20</td>
<td>51</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>143</strong></td>
<td><strong>44</strong></td>
<td><strong>64</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected in Feb 2024</th>
<th>Tamil Nadu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Medical Colleges (GMCs)</td>
<td>37</td>
</tr>
<tr>
<td>District Hospitals (DHs)</td>
<td>29</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>66</strong></td>
</tr>
</tbody>
</table>

**Current reach out activities:**
- Reached out to the medical oxygen nodal officers in 15 other Indian states
- Presented NMOG to WHO Geneva, WHO SEARO and WHO Middle-East offices
NMOG implementation strategy – 1. Value Proposition

- Pandemic preparedness, demand management & supply strengthening of oxygen and hospital beds (predictive analysis, decision analysis, supplier mapping, order placements & tracking)
- Asset management (asset (re)allocation, procurement, maintenance through map-based visualisations)
- Capacity Building (clinical and technical personnel)
- Policy Building (procurement, operations & maintenance of equipment, use & pricing of medical oxygen, COVID-19 vs non-COVID-19 oxygen demand)
- Cost analysis of Oxygen sources (Procurement of LMO vs refilling of cylinders vs running of PSA plants)
- Rational use of Oxygen (Comparison of estimated vs actual consumption)
- Personalised GUI & User Interactive Interface (Web, phone app - android & iOS)
- Ease of Data Entry (Multiple data entry users per facility, offline data entry using phone app)
NMOG implementation strategy – 2. Ideal implementation timelines for a state (also applicable to a country)

- OHT team engages with state’s Directorate of Medical and Health Services with a request to implement NMOG.
- Request states that NMOG tool would be provided for zero-costs and based on the funds available OHT would support the implementation and uptake.

**Step 1** (2-4 weeks)
- OHT team engages with state’s oxygen nodal officers to modify NMOG as per local needs.

**Step 2** (1 month)
- 3-6 different facility types are finalized for a one-month pilot (online & in-person capacity building activities on NMOG).
  b. This creates multiple master trainers who could be utilized for state-wide implementation.

**Step 3** (1 month)
- Pilot report submitted to the government on implementation & uptake including end-user feedback on NMOG.

**Step 4** (1 week)
- Expansion and scaling it to all tertiary care hospitals in the state, which is mostly through online, and in-person support wherever required.

**Step 5** (3-6 months)
- Rebranding as per State’s requirements, followed by handover of the NMOG to the state which is to be hosted on servers owned and managed by state IT cell or data center.

**Step 6** (2 months)
- Implementation and uptake report submission

**Step 7** (1 month)
- Support the state in implementation of NMOG in secondary and primary care hospitals.

**Step 8** (6-12 months)
- Provide technical support whenever required.

Going forward, focus would be on collaborations with other development partners such as WHO, PATH, CHAI, Jhpiego, etc.
## 3. Estimated cost implications

<table>
<thead>
<tr>
<th>No.</th>
<th>Description of Cost</th>
<th>For an Indian state (USD)</th>
<th>For another country (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Procurement cost of NMOG IT platform</td>
<td>Free-of-charge</td>
<td>Free-of-charge</td>
</tr>
<tr>
<td>2.</td>
<td>Annual cost for hosting iOS app on the App store</td>
<td>$99</td>
<td>$99</td>
</tr>
<tr>
<td>3.</td>
<td>One-Time cost for hosting Android app on Google play store</td>
<td>$25</td>
<td>$25</td>
</tr>
<tr>
<td>4.</td>
<td>Annual estimated cost for a customised web domain name</td>
<td>$45</td>
<td>$45</td>
</tr>
<tr>
<td>5.</td>
<td>IT costs for translation of NMOG portal into a non-English language such as French, Spanish, Arabic, etc. (not including the translator costs)</td>
<td>Not applicable</td>
<td>Up to $5,000 per language</td>
</tr>
<tr>
<td>6.</td>
<td>Maintenance IT costs (only if required by the state)</td>
<td>Up to $10,000 per year</td>
<td>Up to $10,000 per year</td>
</tr>
<tr>
<td>7.</td>
<td>Hand holding and implementation support from OHT (remote)</td>
<td>Up to $2000 per month</td>
<td>Up to $2000 per month</td>
</tr>
<tr>
<td>8.</td>
<td>Hand holding and implementation support from OHT (in person)</td>
<td>Up to $6000 per month</td>
<td>Up to $8,000 per month</td>
</tr>
<tr>
<td>9.</td>
<td>One-Time security audit charges before the platform is hosted on state-owned data centre as mandated by IT laws and regulations</td>
<td>Up to $5,000</td>
<td>Charges as applicable by country (usually up to $5,000)</td>
</tr>
</tbody>
</table>

### Total Costs

<table>
<thead>
<tr>
<th>Description of Cost</th>
<th>For an Indian state (USD)</th>
<th>For another country (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One – Time Costs (including 6-month [in person] handholding by OHT team)</td>
<td>$41,025</td>
<td>$58,025</td>
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<tr>
<td>One – Time Costs (including 6-month [remote] handholding by OHT team)</td>
<td>$17,025</td>
<td>$22,025</td>
</tr>
<tr>
<td>Recurring Costs (primarily maintenance costs)</td>
<td>$10,144 per year</td>
<td>$10,144 per year</td>
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</tbody>
</table>
Thank You!

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